2. Typical Model of Rice Harvesting Machinery and its Working Principle

Cloud School

Sharing for Learning

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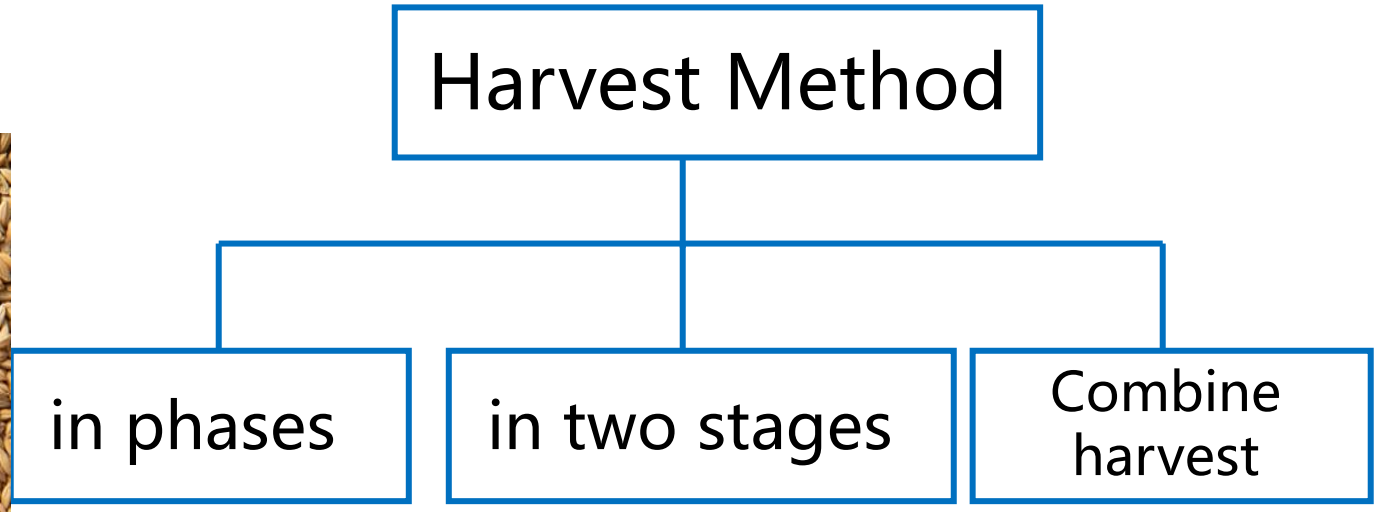
2.1 Structure of rice harvesting machinery and its working principle



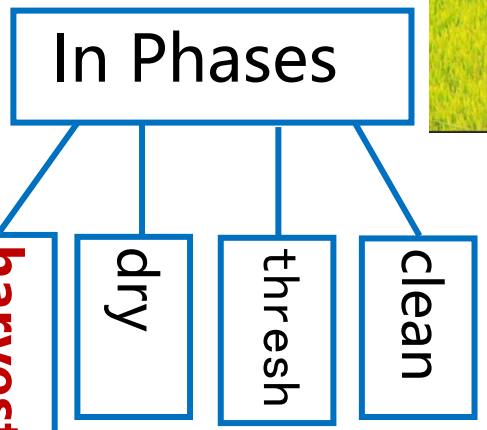
2.1 Structure of rice harvesting machinery and its working principle

- In Phases




In stripes

In bundles



sickle

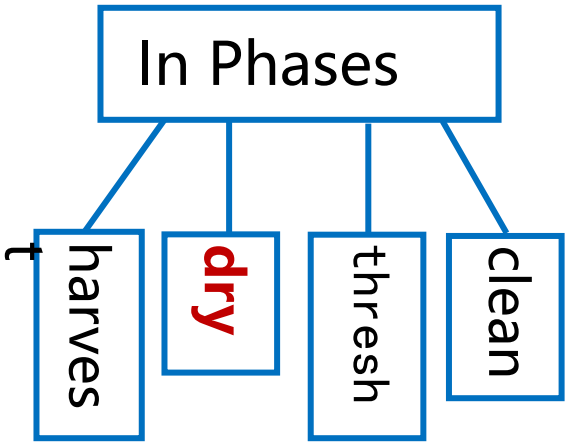
Back cutter

cutter-windrower

As per rice harvest requirement, conduct harvest at the end of ripening period, make sure cutting height meet the requirement.

2.1 Structure of rice harvesting machinery and its working principle

- In Phases



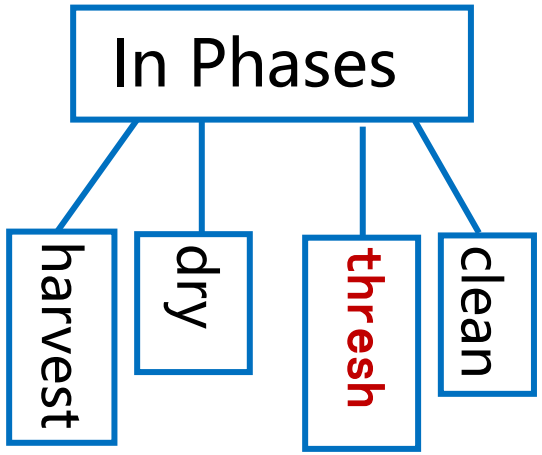
Dry in the rice field

Dry in the drying field

Dry from sunlight for 5-7 days, rice would ripe in full with water content of 15%-28%, and become ready for threshing.

1.1 Harvest Method

- In Phases



Manual threshing

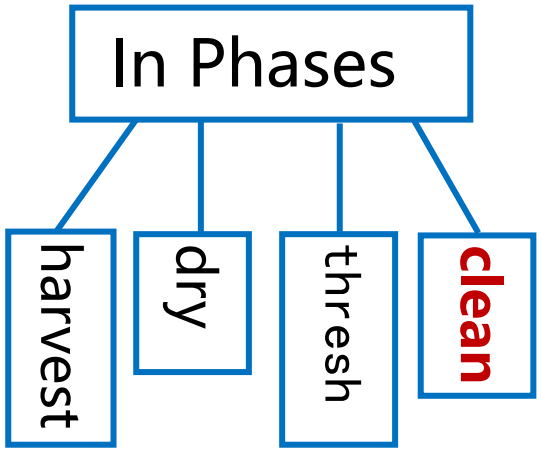
thresher

Harvester with pickup device

It mainly utilizes the impacting and combing principles, to separate the grains from the rice panicles. It has certain separation ability, but is restricted by the requirement of crushing rate and impurity rate.

2.1 Structure of rice harvesting machinery and its working principle

- In Phases



Natural wind cleaning

Axial flow wind cleaning

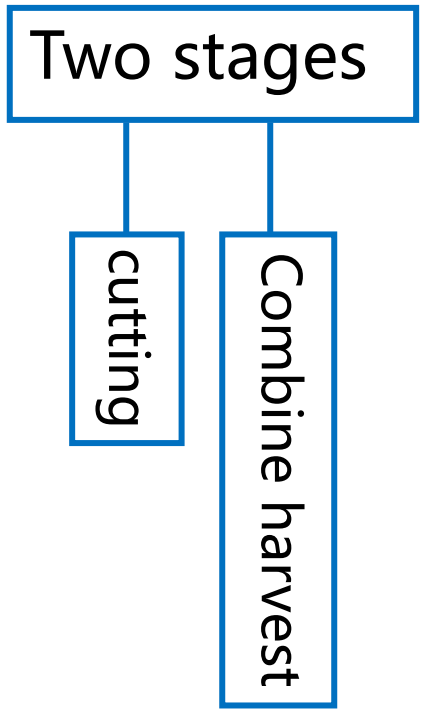
Separate and sieve the grains from crust, panicles, long and short stems and etc., through wind and sieves.

Axial flow fan

Sieve Bed

2.1 Structure of rice harvesting machinery and its working principle

- In two stages



Cutting + drying

Pick up, threshing + cleaning

2.1 Structure of rice harvesting machinery and its working principle

◆Advantages of rice harvesting in phases and stages:

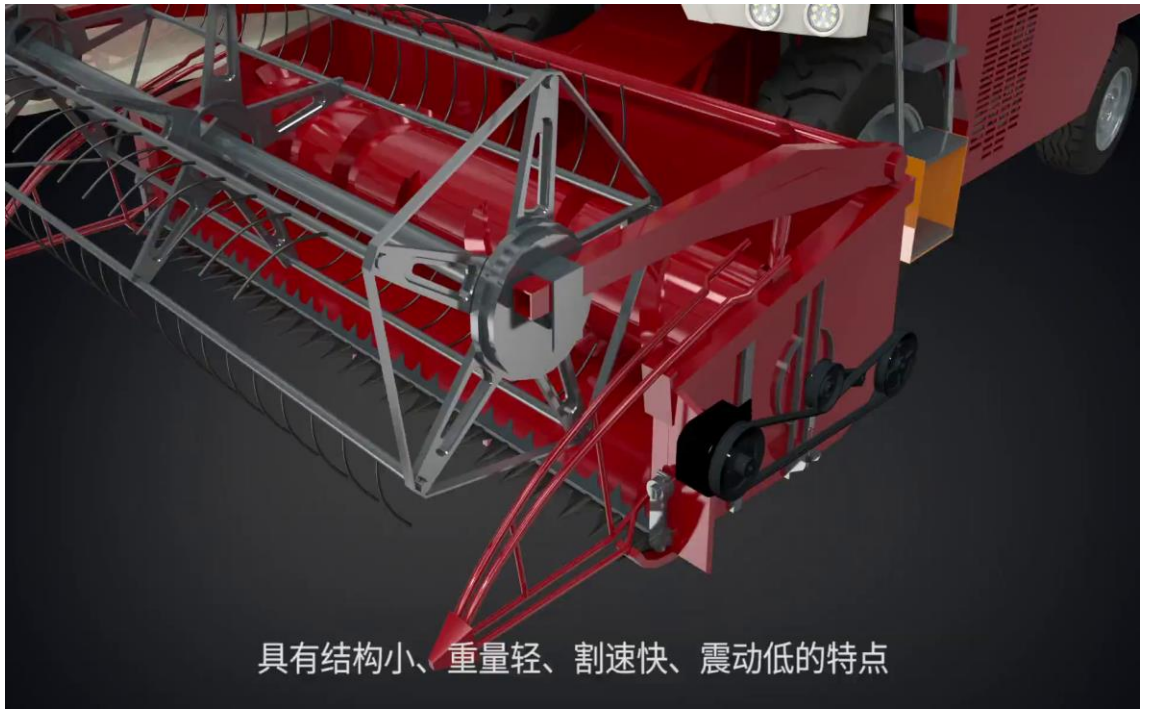
- ➢Help solve the imbalanced machinery utilization, and alleviate the pressure from harvest rush;
- ➢Suitable for crop varieties with inconsistent maturity state;
- ➢Beneficial to the post-ripening of the crops.

◆ Disadvantages of rice harvesting in phases and stages:

- ➢Long harvest period, more working procedures, and high working intensity;
- ➢Occupy field for drying, not favorable for field plowing and planting for coming crops;
- ➢High requirements on climate during drying, only suits for areas with little rain.

2.1 Structure of rice harvesting machinery and its working principle

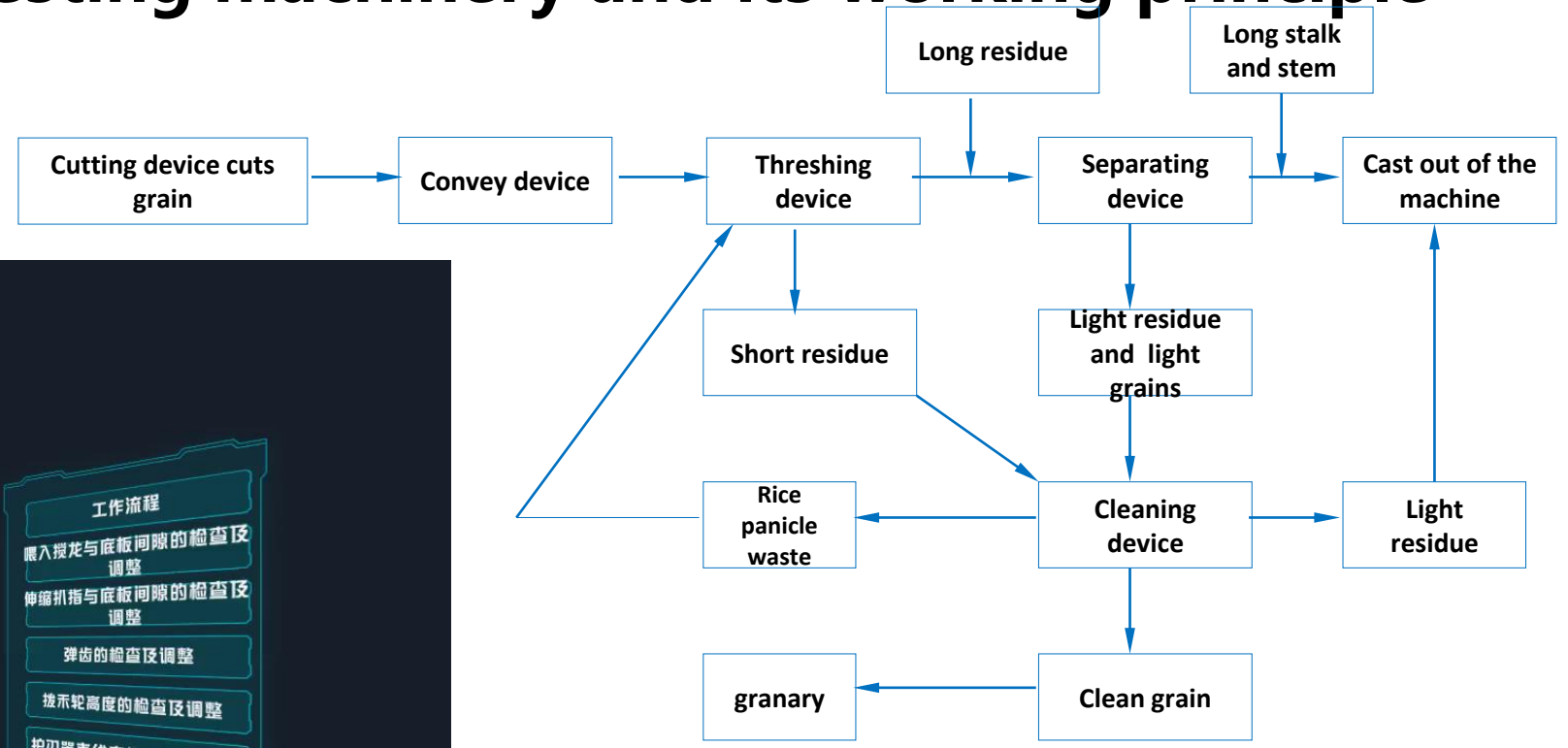
- Combine harvest



Conduct and complete cutting, conveying, threshing, cleaning and collecting in sequence, and to finally obtain clean grains.

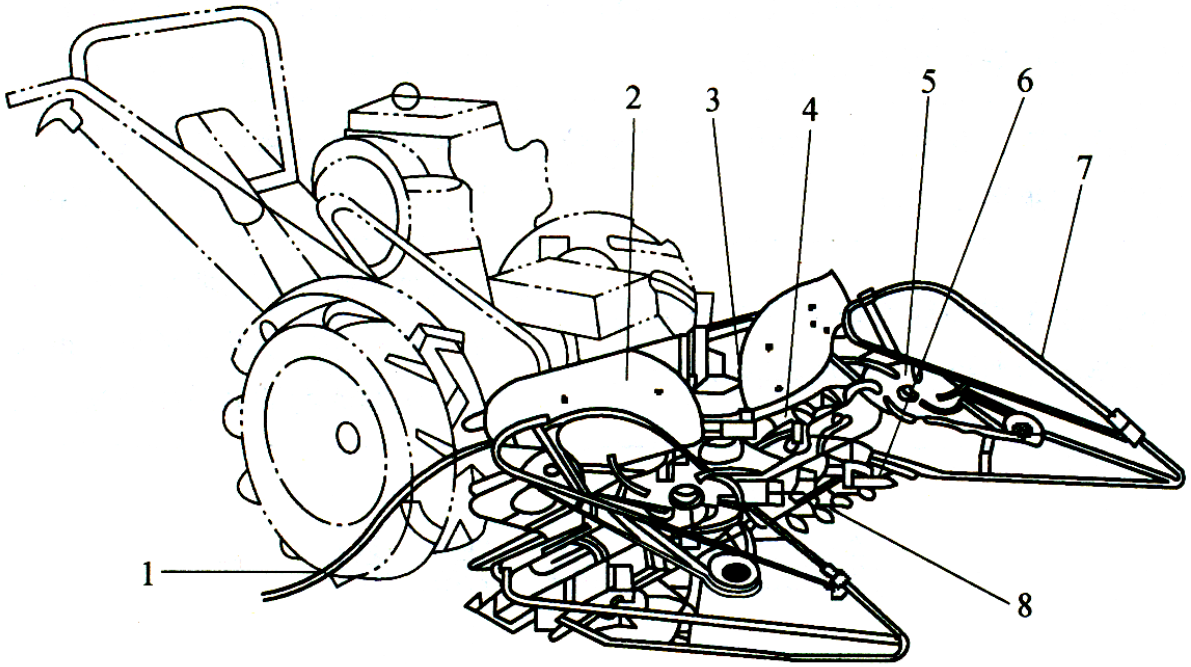
2.1 Structure of rice harvesting machinery and its working principle

- Working procedure of combine harvester



2.1 Structure of rice harvesting machinery and its working principle

- Structure and working principle of vertical cutter (cutting, drying, bundling machine)



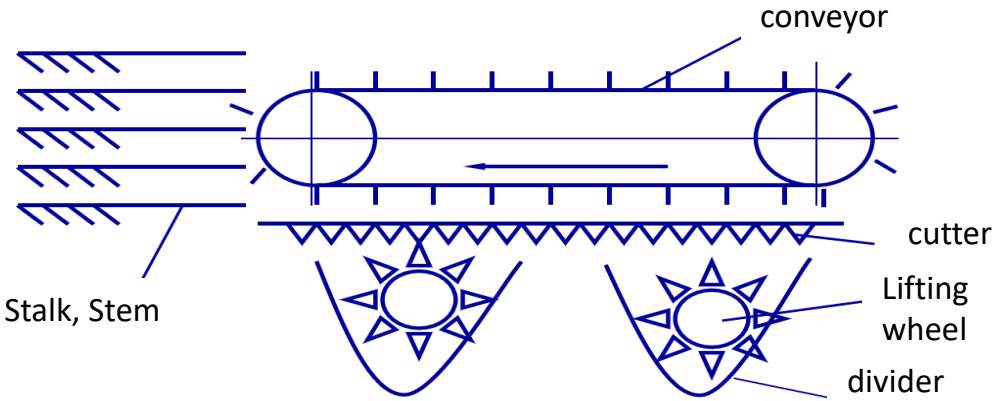
1.Laying Rod 2.Rear fender 3.Steering Valve 4.Upper Conveyor 5.Cutter Wheel 6.Cutter 7.Divider 8.Lower Conveyor

2.1 Structure of rice harvesting machinery and its working principle

Working principle (vertical model): When a harvester works, the conveyor and cutter are driven by power output of the tractor. The grains in a line are bundled by the divider, and be led to the cutting area, the lifting wheel supports the grains until the grains are cut, the vertical conveyor then take the grains to the other side for laying or bundling.

Cutting and Drying Machine

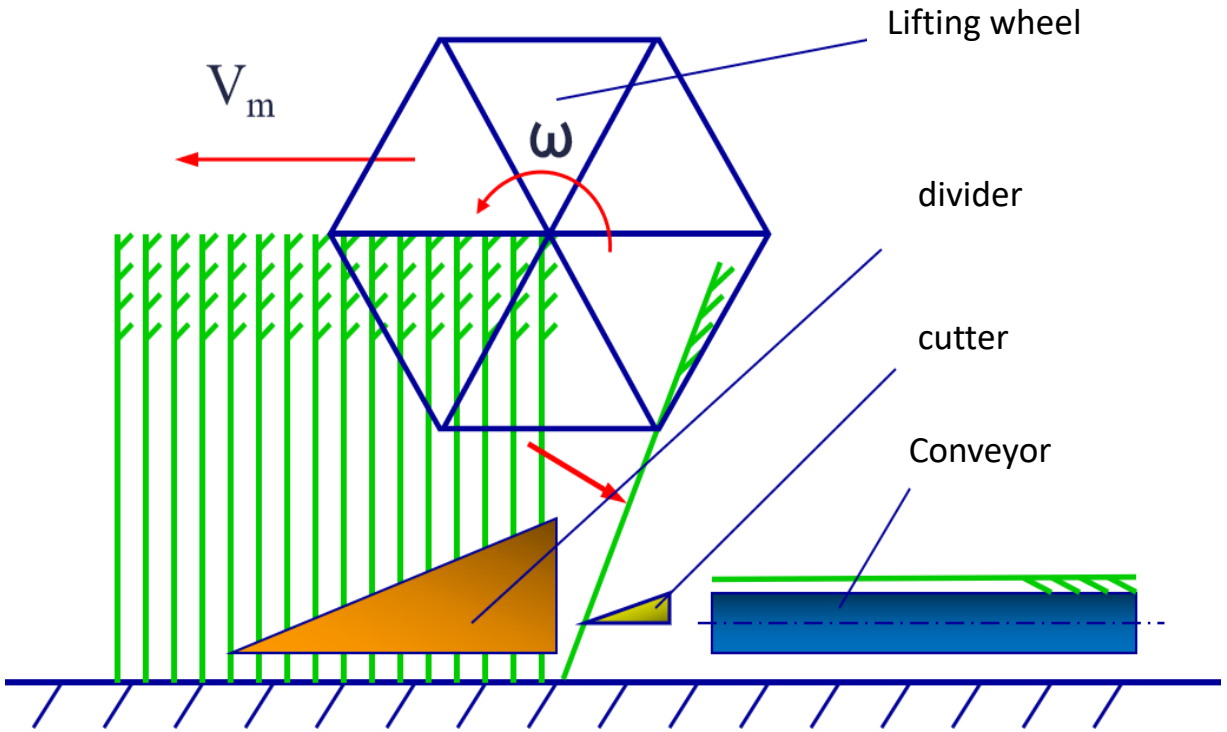
Cutting and Bundling Machine



Components: Divider, lifting wheel, cutter, vertical conveyor belt, driving device.

2.1 Structure of rice harvesting machinery and its working principle

Working principle: **When the harvester works, lifting wheel, convey belt and cutter are driven by the power output of the tractor. The divider leads the grains to the cutting area, and grains are cut by the cutter in the support of the lifting wheel, and then fall on the convey belt (or spiral stirrer).**

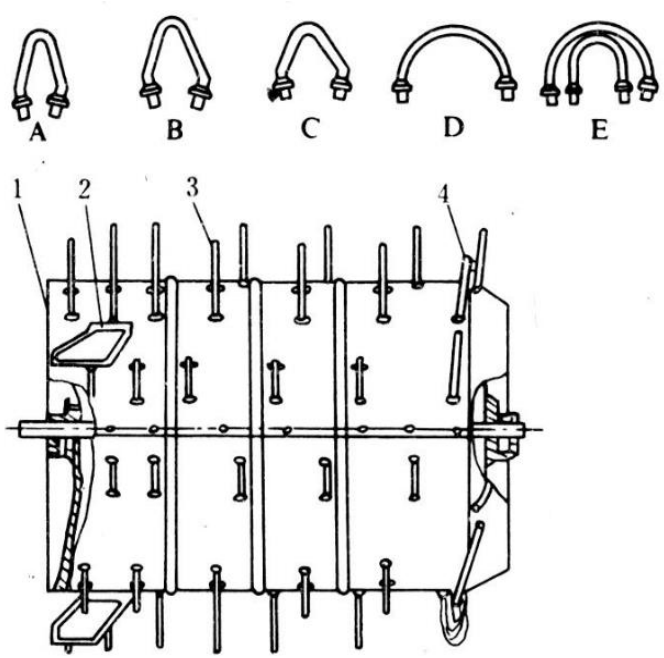


Components: Divider, lifting wheel, cutter, conveyor, driving device

2.2 Structure of rice threshing machinery and its working principle

Impact Threshing

Rubbing Threshing



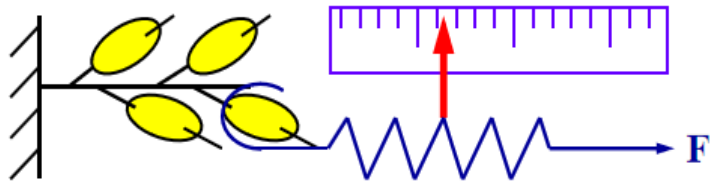
Grinding Threshing

- ✓ Impact threshing: to thresh by the impact between threshing tool and grain panicle, the stronger the impact speed, comes greater breaking rate, and brings better threshing result.
- ✓ Rubbing threshing: to thresh by the friction between threshing tool and grain. The threshing gap of the tool is very important.
- ✓ Combing threshing: to thresh by applying a pulling force to the grain with combing threshing device.
- ✓ Grinding threshing: to thresh by applying an extrusion force to the grain with a grinding device, and generate a lateral relative displacement between the grain and its shell.

2.2 Structure of rice threshing machinery and its working principle

- Threshing characteristic of grain

Threshing: to separate the grain from the panicle



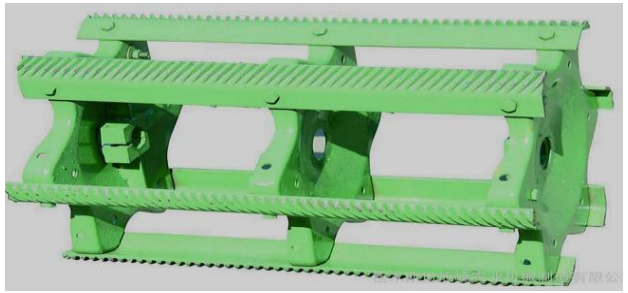
Factors affecting threshing:

- Variety of the crop
- Maturity of the crop
- Humidity of the crop

2.2 Structure of rice threshing machinery and its working principle

- According to the structure of the roller/shape of the threshing parts

Open/Teeth



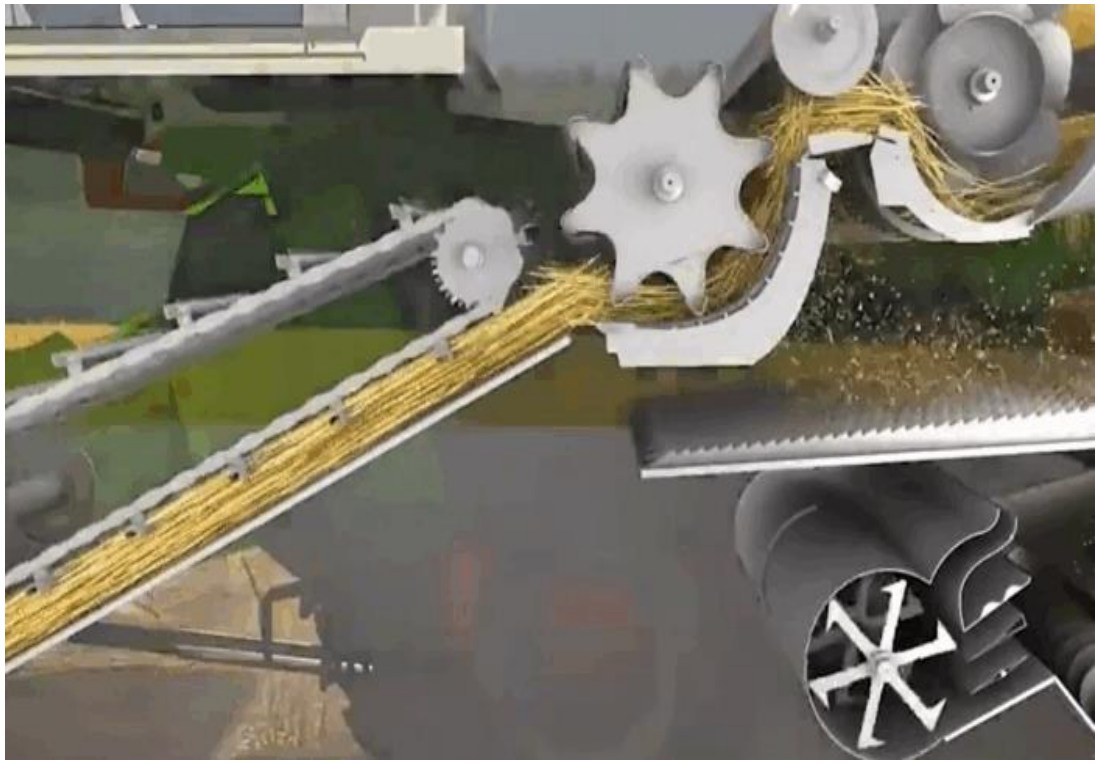
Open/Bar

Cylinder/Hammer claw

Cylinder/Arch teeth

2.2 Structure of rice threshing machinery and its working principle

- According to the direction of the material entering the roller

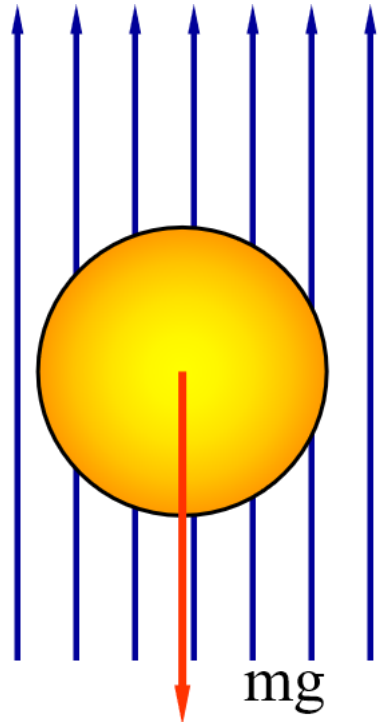


Tangential threshing cylinder

Axial threshing cylinder

2.3 Structure of rice cleaning machinery and its working principle

➢ Cleaning by airflow



Object floating velocity Vp

Floating velocity Vp of object – place object upward on a vertical airflow, the force of the airflow “P” to the object equals to the gravity of the object “mg”, and the object stays at a relatively stationary suspended state, this speed of the airflow is object floating velocity.

2.3 Structure of rice cleaning machinery and its working principle

➢ Cleaning by airflow






T6.1 Floating Velocity of different materials V_p

Item	Floating Velocity Vp (m/s)	Item	Floating Velocity Vp (m/s)
rice	10.1-12.2	Stripped panicle	3.5-5.0
wheat	8.9-11.5	Long stem (<100mm)	5.0-6.0
barley	8.4-10.8	Long stem (100-150mm)	6.0-8.0
millet	9.8-11.8	Long stem (150-200mm)	8.0-10.0
corn	12.5-14.0	Long stem (200-300mm)	10.0-13.5
soybean	17.5-17.5	Long stem (300-400mm)	13.5-16.0
Husk of rice/wheat	0.6-5.0	sand	100

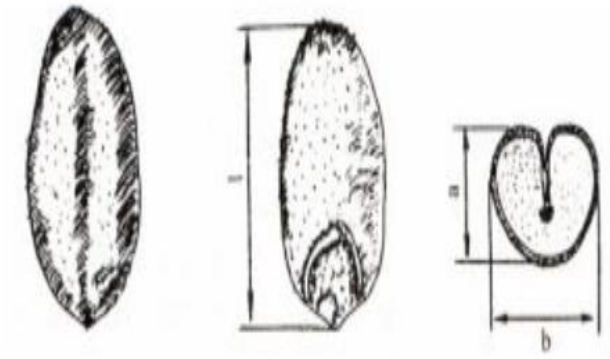
Condition for airflow cleaning:

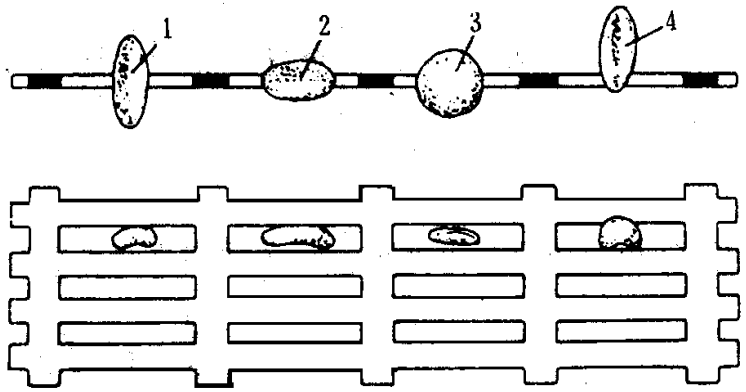
$$V_{residue} < V < V_{grain}$$

2.3 Structure of rice cleaning machinery and its working principle

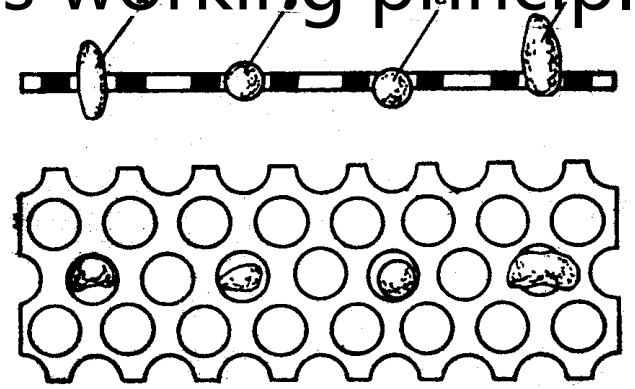
➢ Sieving

Sieve according to the size of the seed:
length (l) X width (b) X thickness (a)

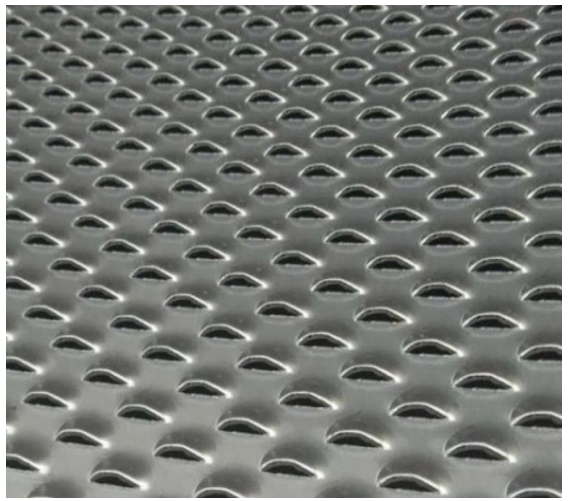




Slotted hole sieve（seed thickness）



Round hole sieve（seed width）



Raised hole sieve（seed length）

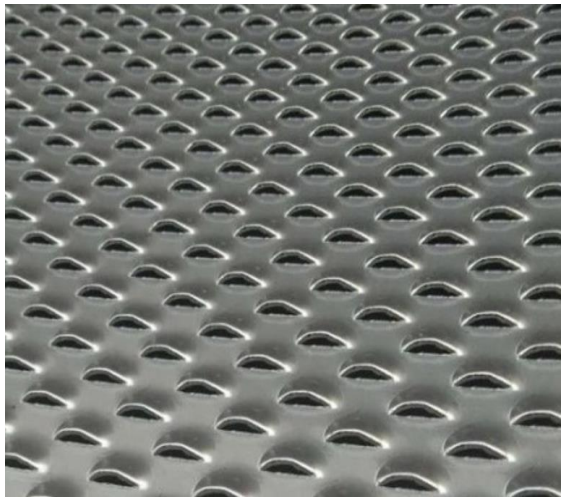
- **l > b > a , flat long seed, such as rice, wheat, barley**
- **l > b = a , cylindrical seed, such as adzuki beans**
- **l = b > a , flat round seed, such as vetch**
- **l = b = a , spherical seed, such as pea**

2.3 Structure of rice cleaning machinery and its working principle

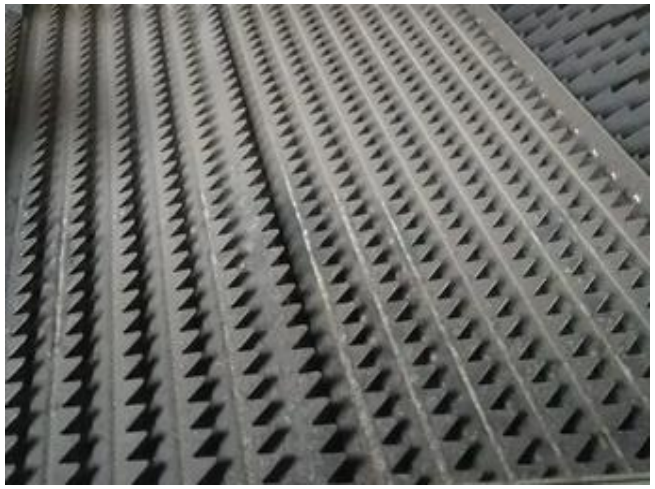
➢ Sieving

Perforated sieve

Grating sieve



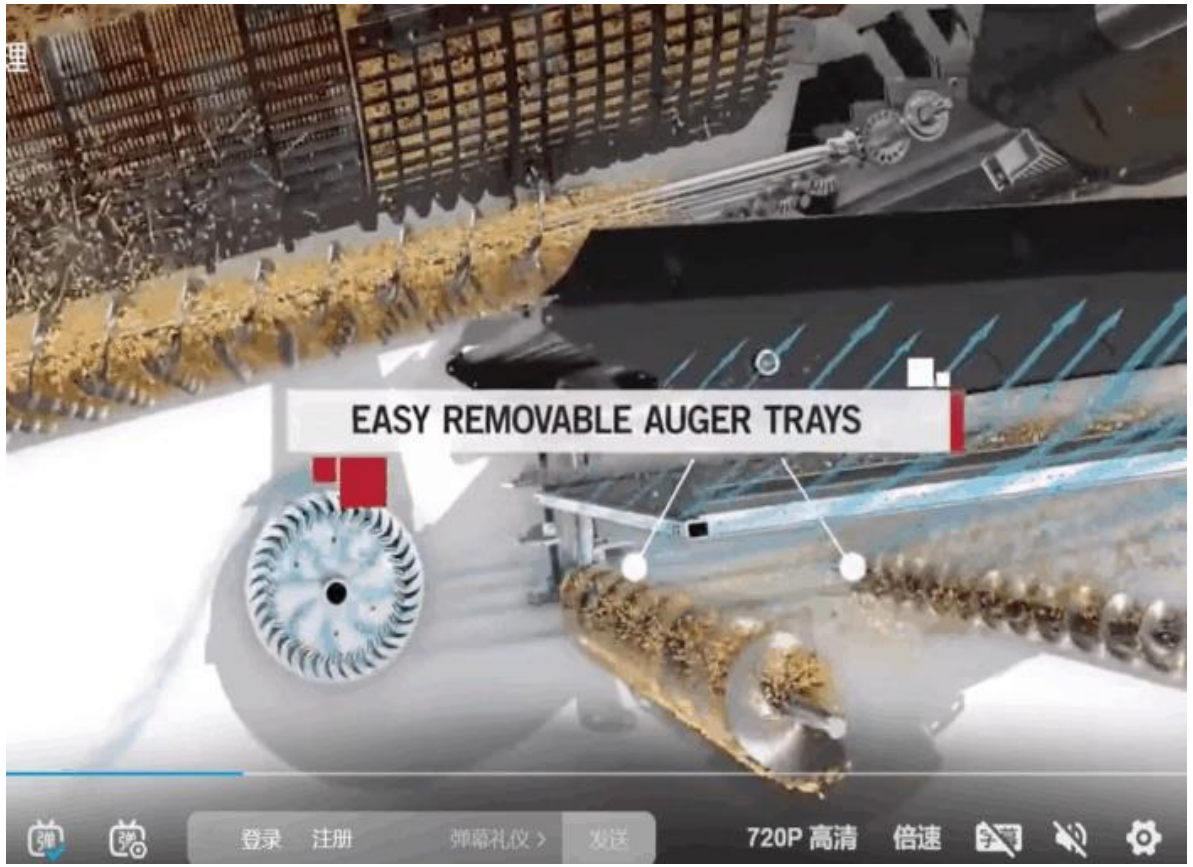
Raised hole sieve



Louver sieve

2.3 Structure of rice cleaning machinery and its working principle

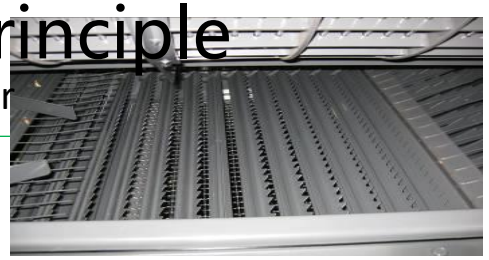
➢ Sieving

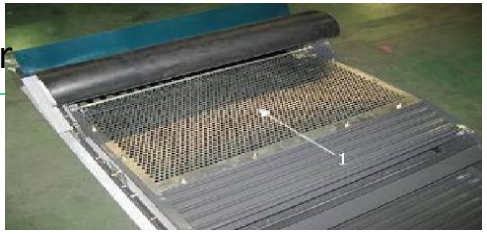


Upper layer

Middle layer

Lower layer





Commonly used sieve beds normally have three layers, upper layer, middle layer and lower layer:
Upper layer： Louver sieve removes oversized impurities, so as to facilitate the grains flow and even grains distribution;
Middle layer: Grating sieve removes large impurities, and allows grains and small residues to pass through;
Lower layer: Perforated sieve gets rid of small residues, and leaves grains on the sieve surface.

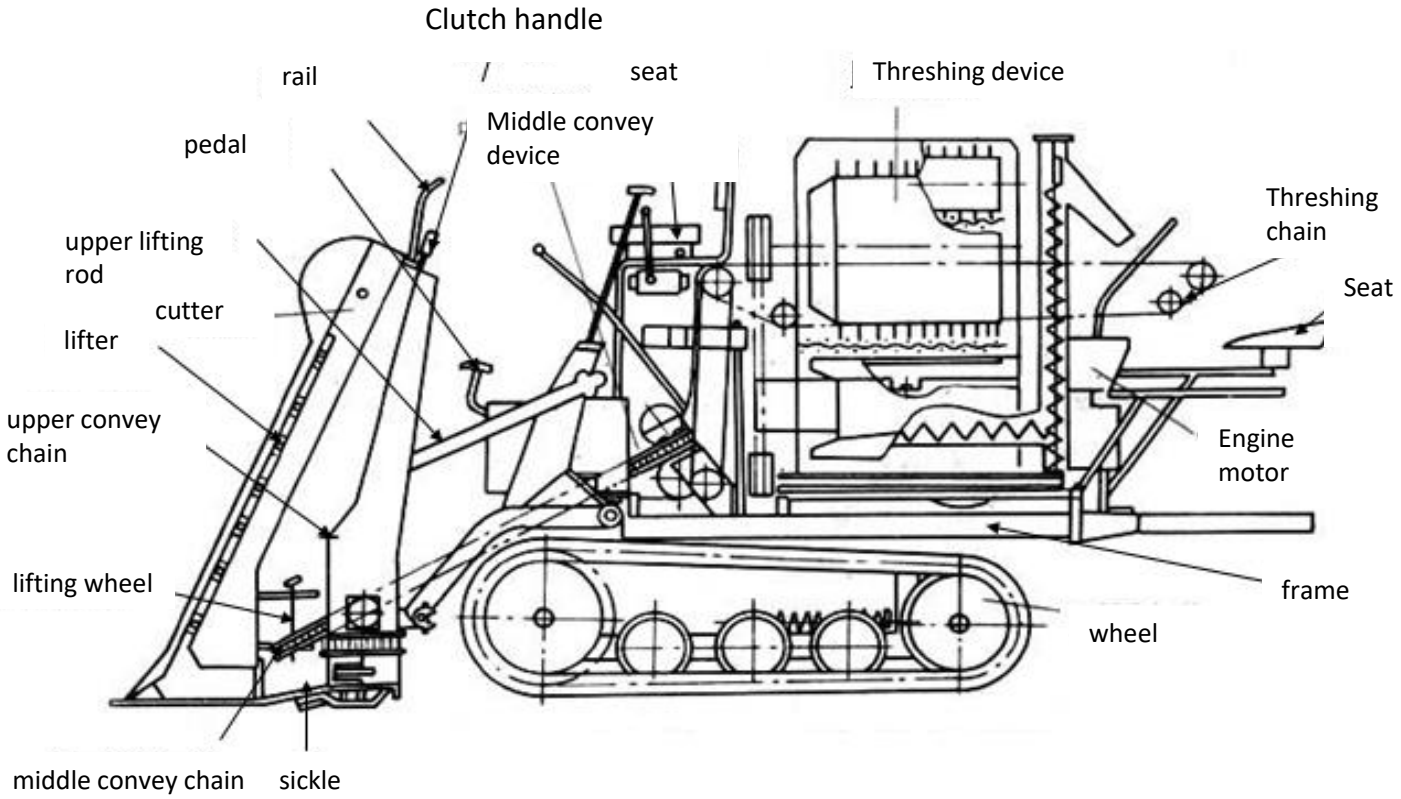
2.3 Structure of rice cleaning machinery and its working principle

➢ Picking by weight

Weight of different materials are different, it applies to their inertial force as well, rotation by eccentric wheel can be used for picking.

2.4 Rice Combine Harvester

- **Semi-feed combine harvest**

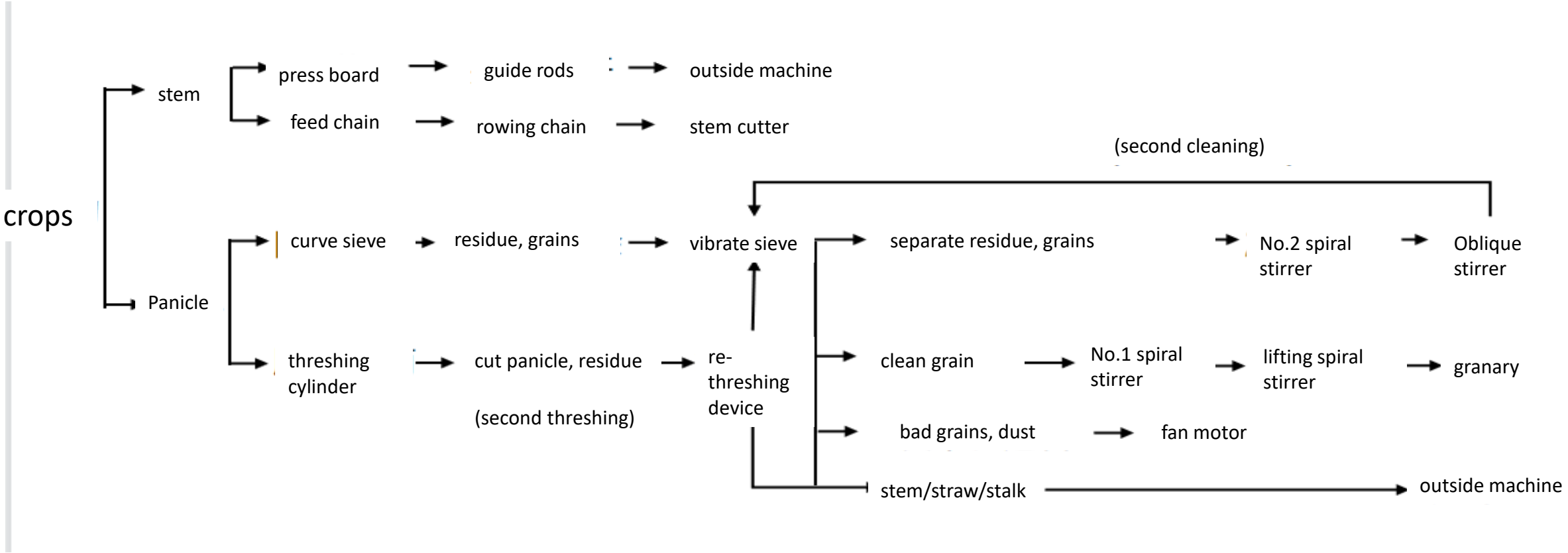


Components: Cutting compartment, conveying compartment, threshing and cleaning compartment, grain collecting and discharging compartment, motor engine

Feature: Only receive rice panicles into the threshing device, low power consumption, cleaning quality is relatively higher than that of a full-feed combine harvester, rice straw can be kept in whole and uncut for reuse; Vertical cutter, strong plant lodging capacity, complex straw conveying device and structure, high price, only used for rice harvesting.

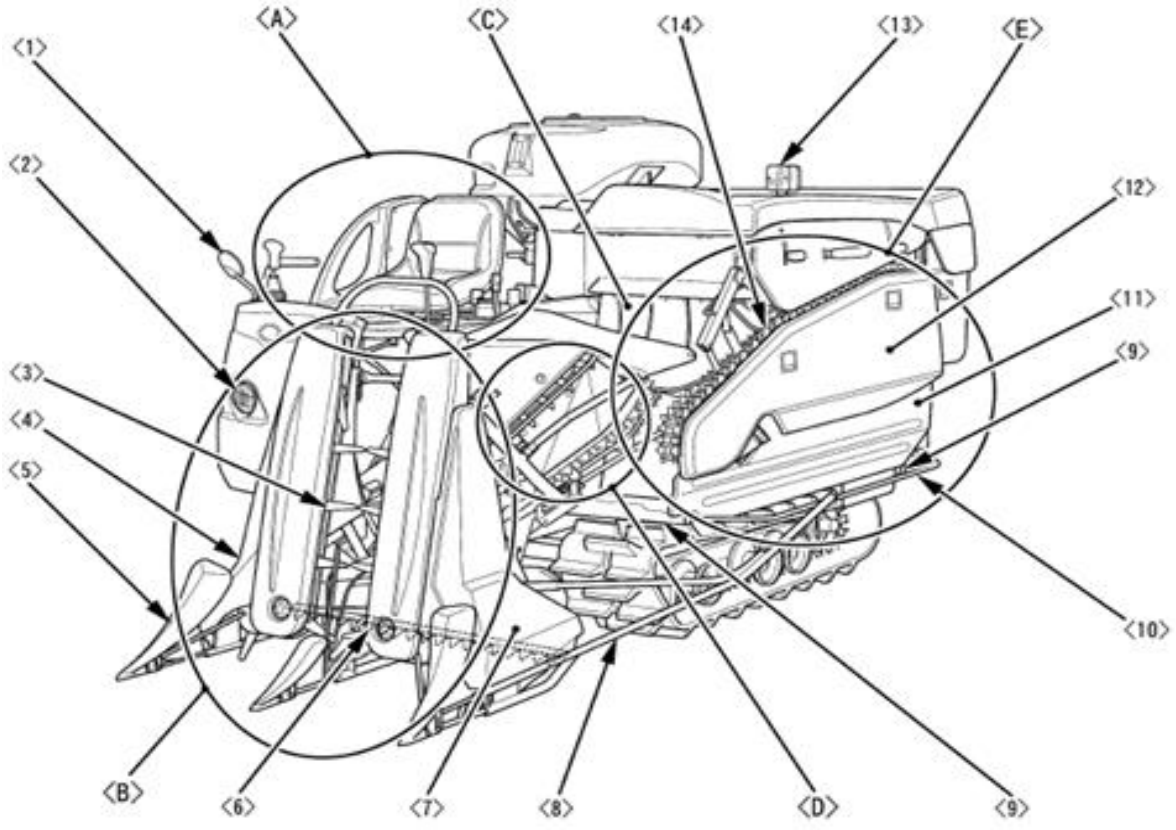
2.4 Rice Combine Harvester

➢ Semi-feed combine harvester

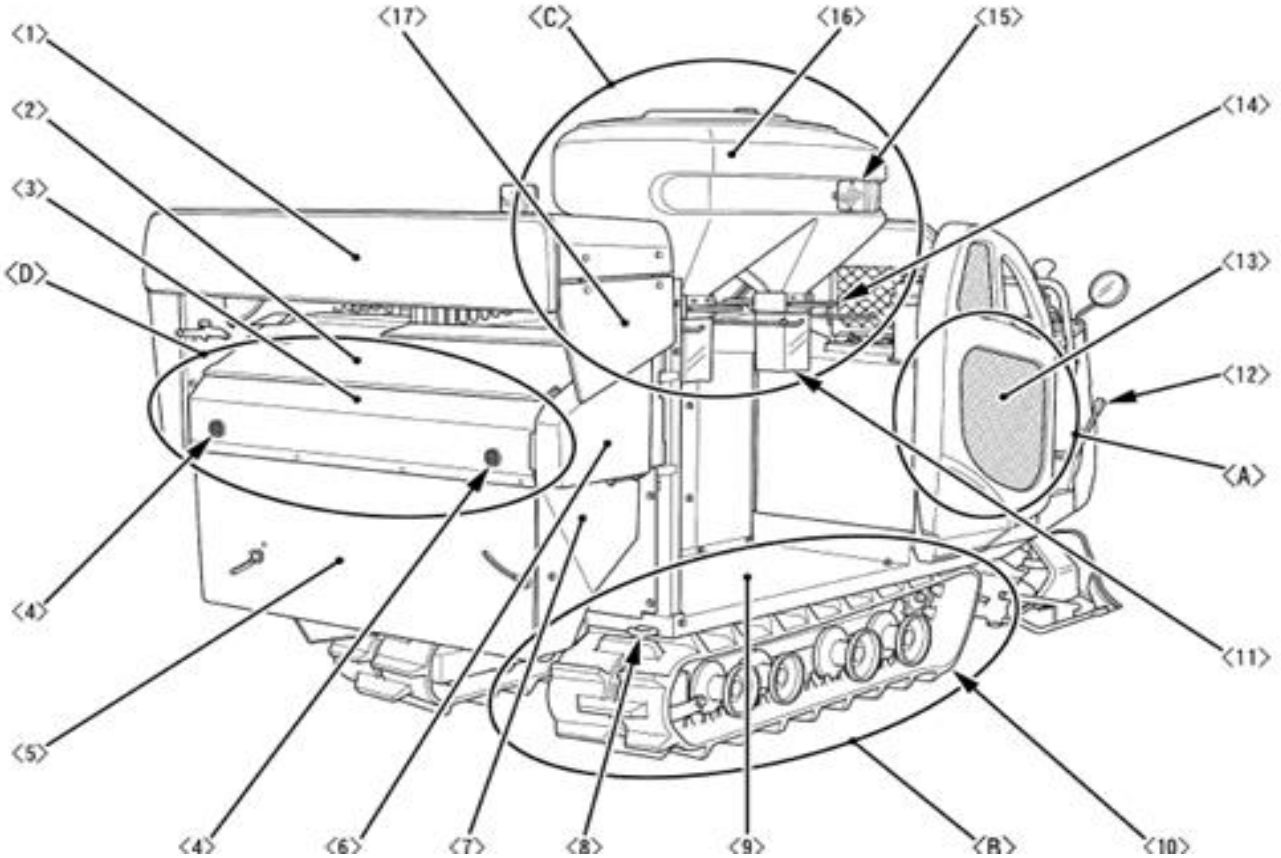


2.4 Rice Combine Harvester

➢ Semi-feed combine harvester



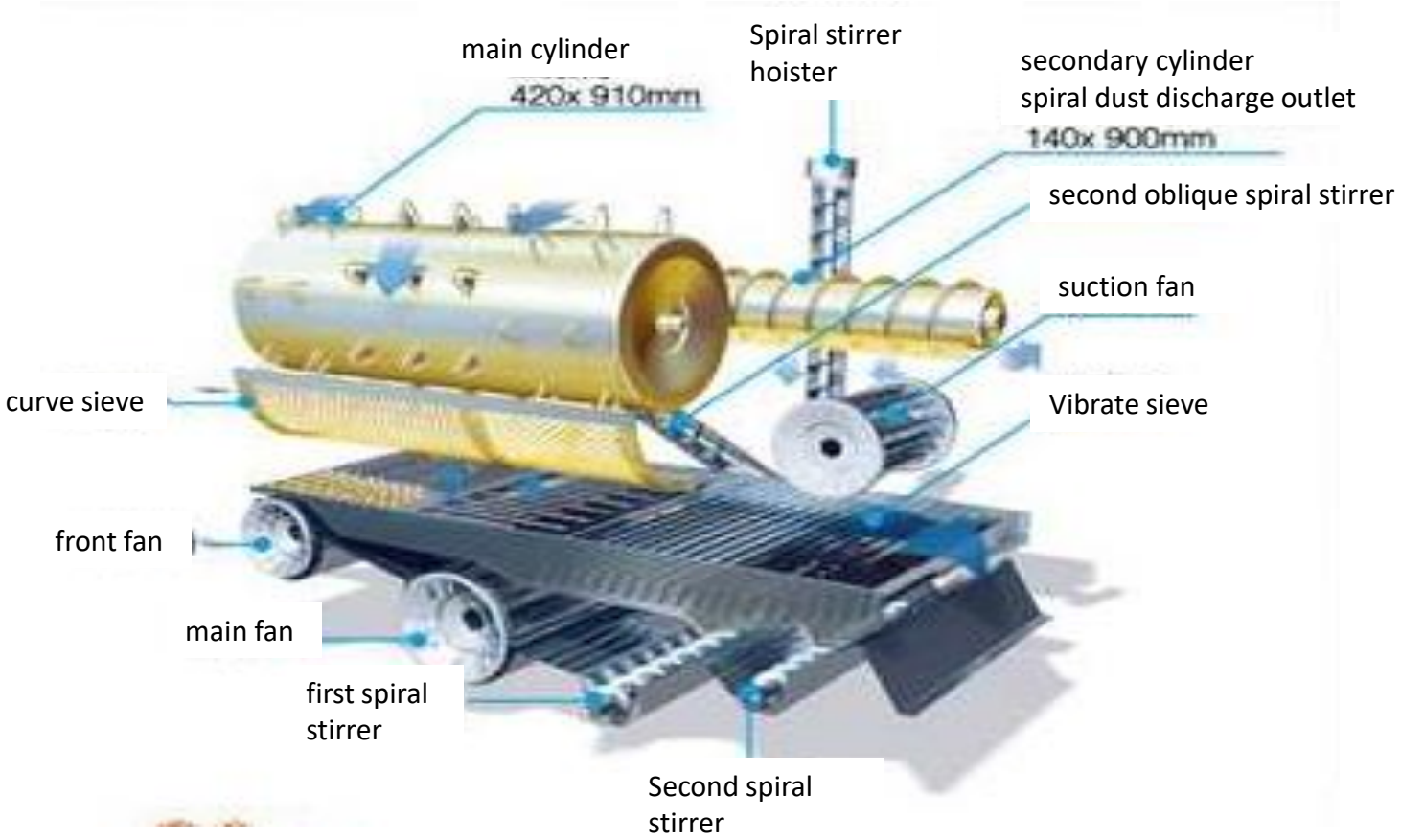
1-rear mirror 2-head light 3-crop straighter 4-straightener right lid 5-divider 6-cutter 7-straightener left lid 8-left front grass dividing rod 9-rope hook 10-left rear grass dividing rod 11-lower left lid of threshing device 12-upper left lid of threshing device 13-direction indicator 14-conveyor chain A-driver operation compartment B-cutter C-feed inlet of threshing device D-supply conveyor section E-threshing device

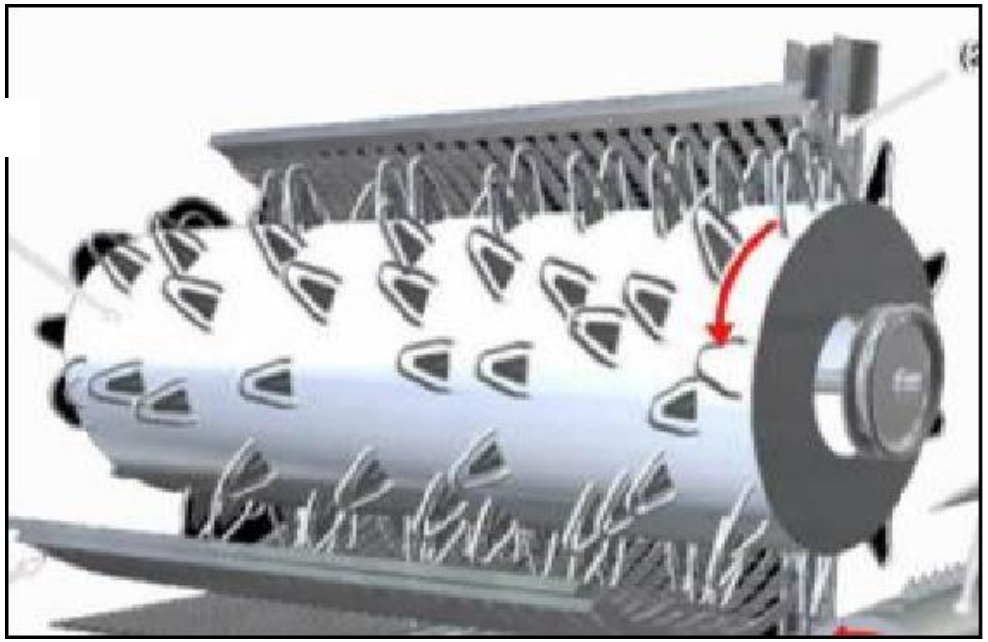


1-blade upper lid 2-blade switch lid 3-blade 4-reflector 5-rear discharge device 6-blade right lid 7-side discharge device 8-rope hook 9-grain bag loading platform 10-track 11-grain outlet 12-brake handle 13-engine cover 14-grain outlet lid 15-direction indicator 16-grain tank 17-panicle lid

2.4 Rice Combine Harvester

➢ Semi-feed combine harvester





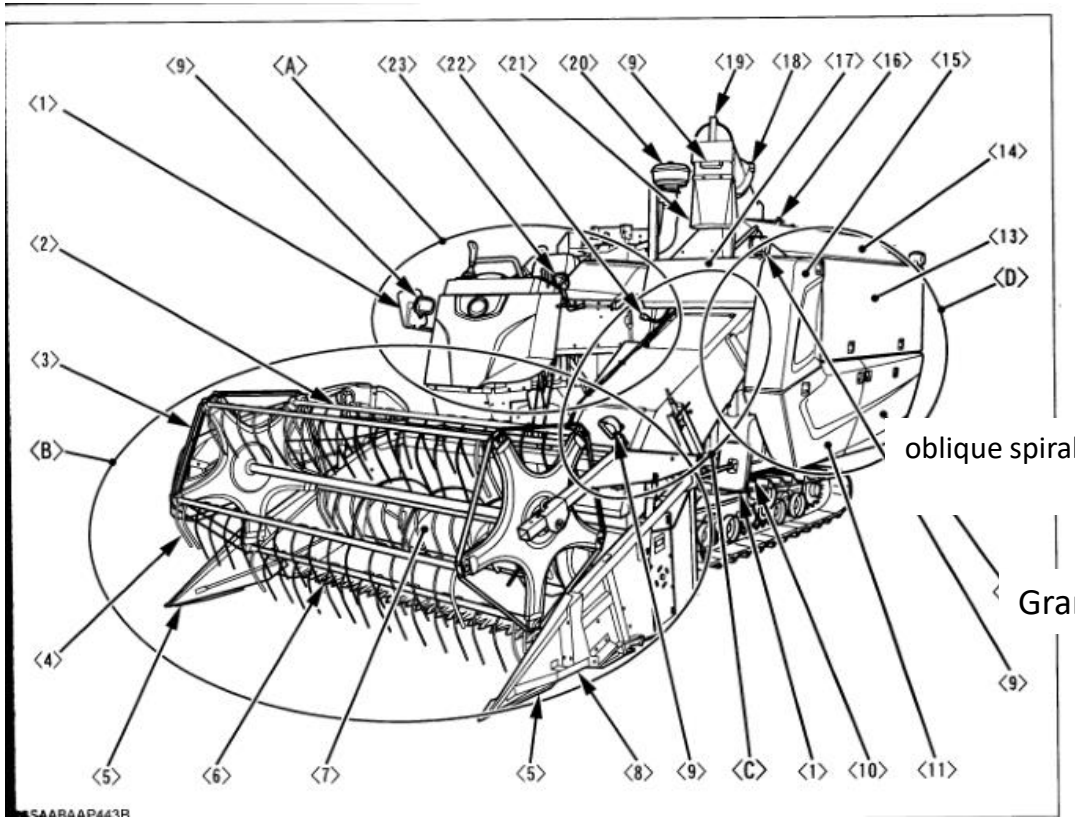
2.4 Rice Combine Harvester

- **Full-feed combine harvester**

Features: Simple structure, wide application range, such as in harvest of rice, wheat, soybean and other grains. Full feed combine harvester is high in power consumption but low in price, there are both wheel models and crawler models.

2.4 Rice Combine Harvester

➢ Full-feed combine harvester



Crops->lifting wheel->cutter->feed to spiral stirrer->middle conveyor

Second cleaning

oblique spiral stirrer<-No. 2 spiral stirrer<-separate residue and grain<-vibrate sieve<-grains and residue

Granary<-lifting stirrer<-No.1 stirrer<-clean grain

Threshing cylinder

outside the machine<-straw cutter<-straw/bad grain/stem/stalk/etc.

1-rear mirror 2-crop straightener rod 3-crop straightener wheel 4-crop straightener teeth 5-crop divider 6-cutter 7-spiral stirrer feeder 8-left straw divider 9-working lamp10-rope hook11-left lid of threshing device2 12-left lid of threshing device3
13-side lid of threshing cylinder 14-top lid of threshing cylinder 15-left lid of threshing device1 16-dust discharge handle of threshing device17-front lid of threshing device 18-bracket of grain discharge device 19-grain discharge device 20-filter 21-grain outlet 22-reversing clutch handle 23-headlight

2.4 Rice Combine Harvester

- **Full-feed combine harvester**

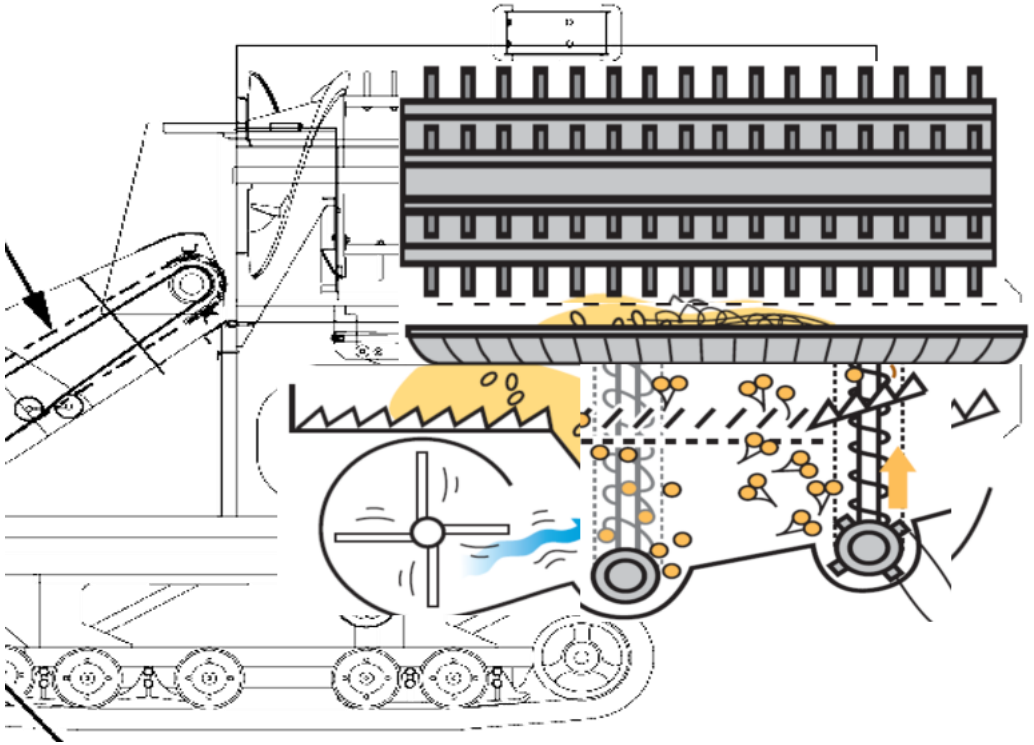
lifting and feeding device

cutting device

2.4 Rice Combine Harvester

- **Full-feed combine harvester**

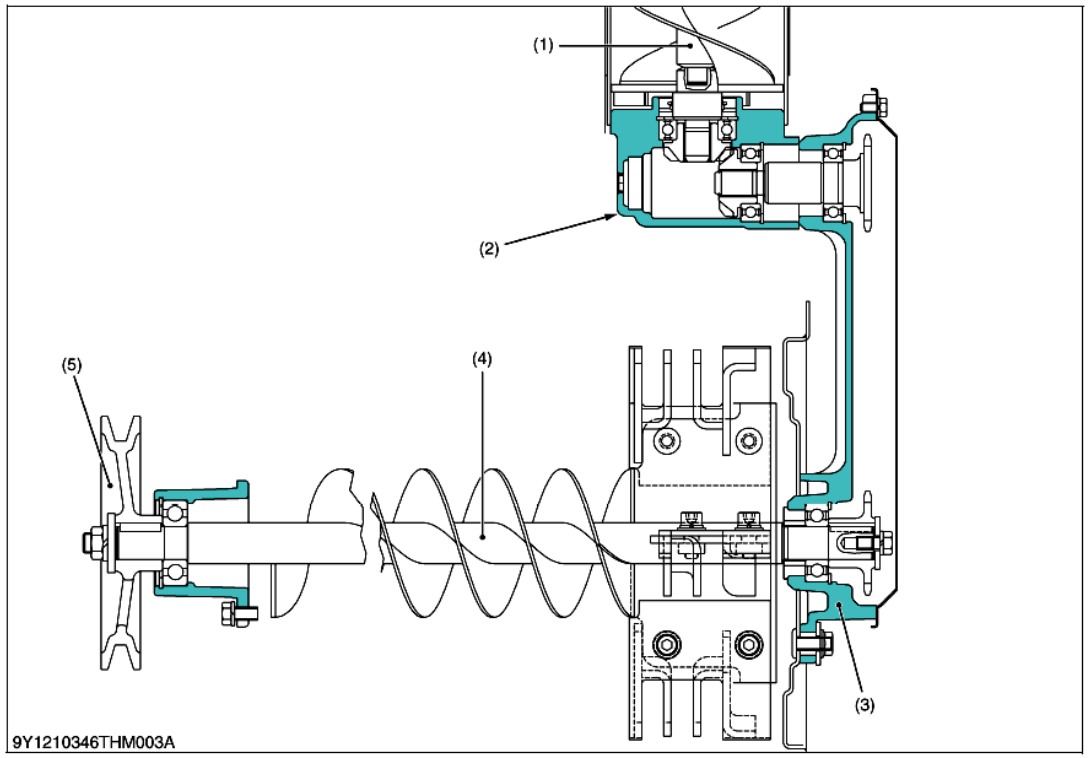
middle conveying device



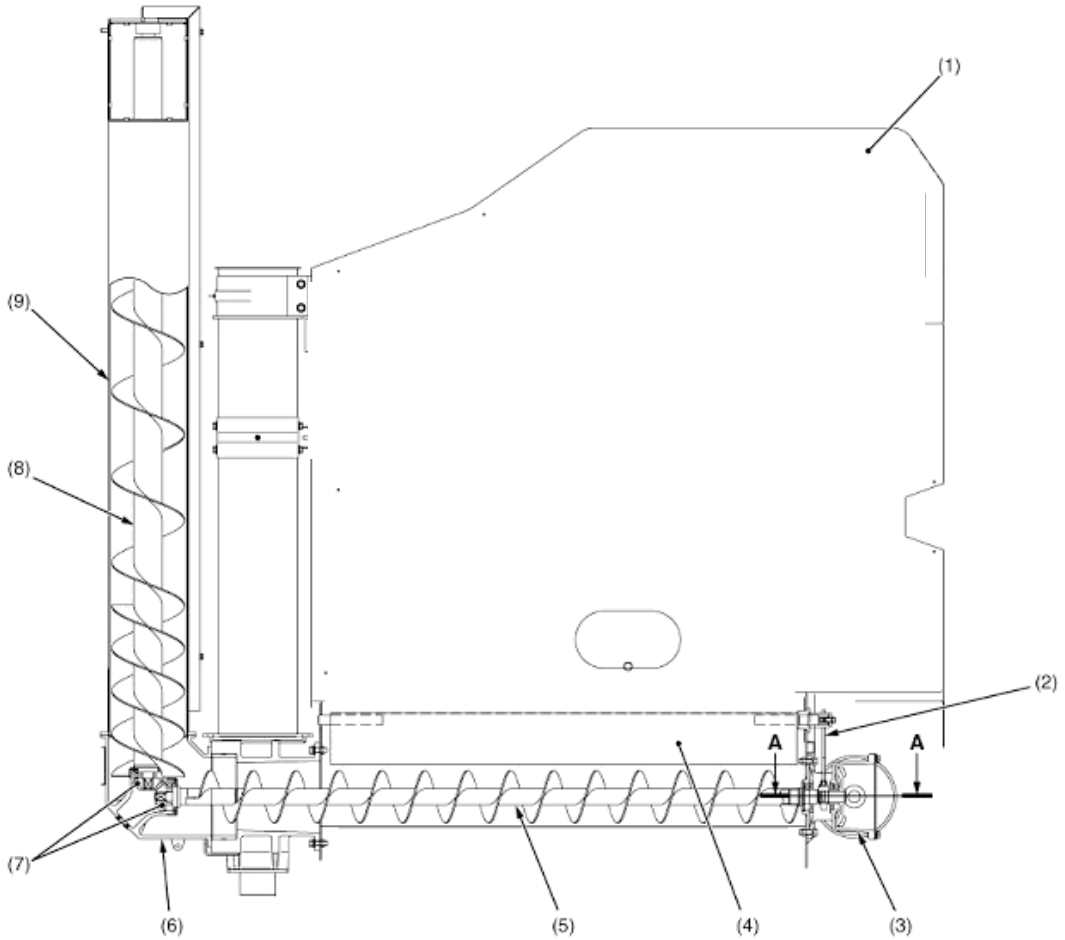
threshing and cleaning device

2.4 Rice Combine Harvester

- **Full-feed combine harvester**



re-threshing device



grain discharge device