## 9.2 Gear shaper

### Gear shaving machine

It is a machine that processes tooth surface and other units of different tooth shape with hobbing cutter based on generating method. Classified by structure layout, it has two types: vertical and horizontal type. The former is most widely used type and it is mainly used in processing multi-linking gear and internal gear, and it can also process rack if accessories are added. When processing helical gear, it makes the helical shaper cutter rotate correspondingly along the up and down movement through the helical guide rail installed on the main shaft. With special tool in hand, it can also process non-circular gear, partial gear and inside and outside shaping surface. The processing precision can reach Class 7-5 and the maximum processing diameter can reach 12m. The outline drawing of Y54 type gear shaper can be seen from Figure 9-3.

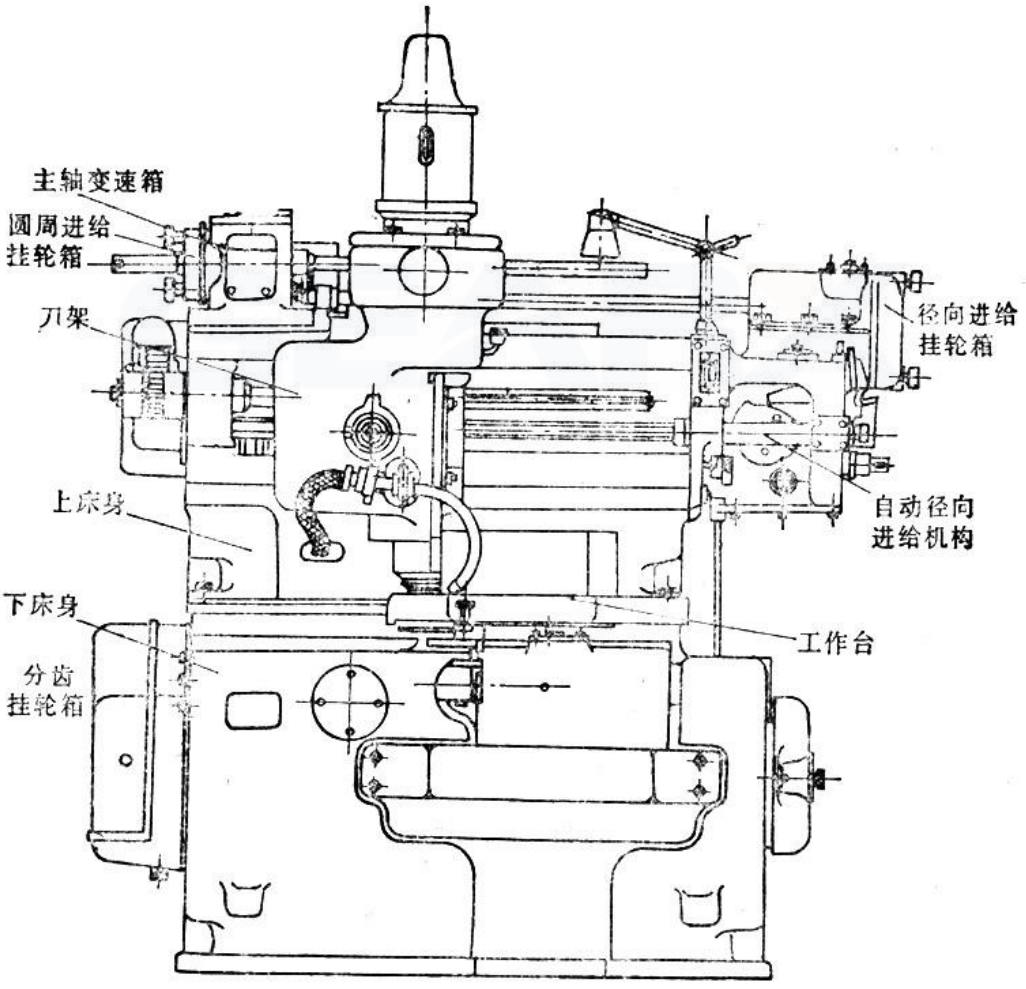


图 9-3

### Horizontal gear shaping machine

It is one of the machines processing tooth surface with hobbing cutter based on generating method. The structure layout of the machine is horizontal, and it has two independent tooling main shafts. It makes movement horizontally and is mainly used in processing herringbone gear without tool withdrawal groove and various shaft gears. The process precision can reach Class 7~5 and the surface roughness is $R_a$ 0.63~0.32 $\mu_m$.

## Vertical gear shaping machine, gear slotting machine

It is one of the machines processing tooth surface with hobbing cutter based on generating method. The structure layout of the machine is vertical. It has two work forms: cutter relieving and workpiece relieving. Generally, high speed and large scale gear shaping machine use cutter relieving while small and medium sized use workpiece relieving. The gear shaper cutter is installed on the main shaft of tool and makes rotational movement and up-and-down reciprocation movement at the same time. The workpiece is installed on the working table and makes rotational movement. The working table (or tool rest) can make radial cut-in movement in a lateral way. When the tool is returning stroke, the tool post needs to swing backwardly to realize relieving or let the working table make relieving motion. The application scale of vertical gear shaping machine is large, especially when processing multi-linked gear, internal gear, rack, non-circular gear, partial gear and inside and outside shaping surface. The process precision can reach Class 7~5 and the surface roughness is $R_a$ 0.63~0.32 $\mu_m$. Currently, the maximum processing diameter is 12m. The outline drawing of vertical gear-hobbing machine can be seen from Figure 9-4.

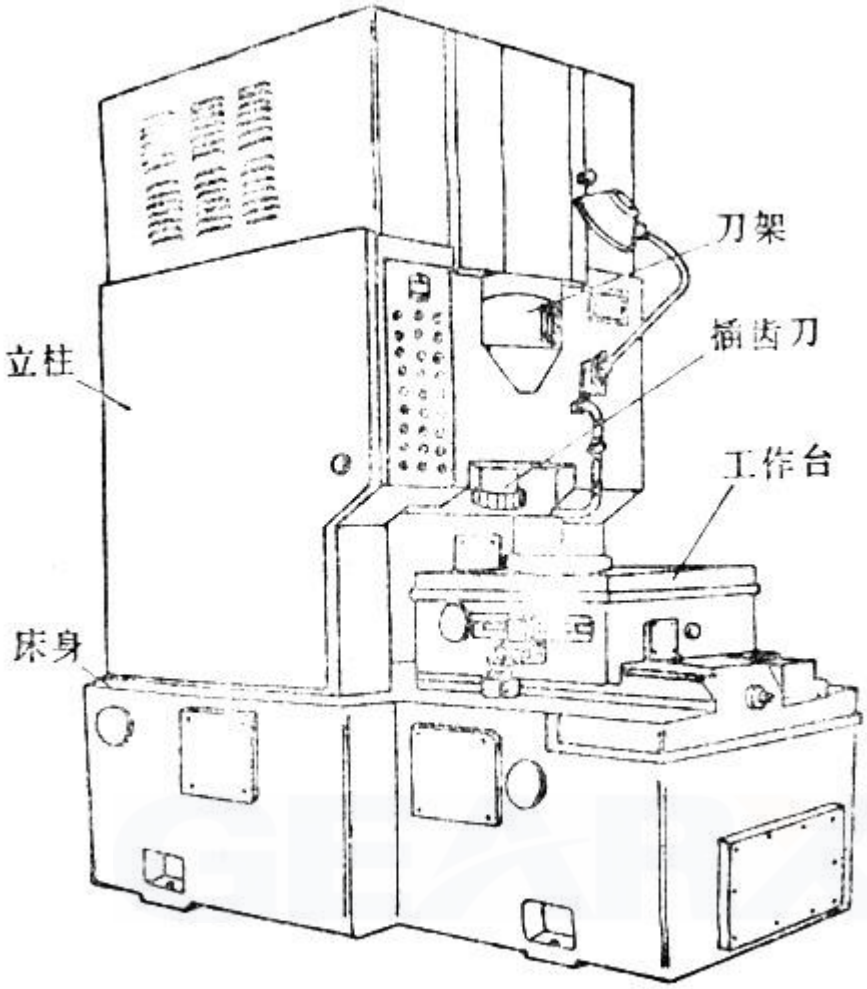


图 9-4

## High speed gear shaping machine

It is one of the machines processing tooth surface with hobbing cutter based on generating method. The structure characteristics are that it applies hydrostatic bearing and hydrostatic slide block; it uses tool rest realizing swinging relieving to reduce impact. This kind of machine is a kind of high-speed cutting machine which adapts hard alloy gear shaper cutter. The stroke number of the main shaft of tool can reach 2000/min. It is mainly used in processing medium and small module and small and medium diameter gear. The gear structure, type, range is same to that of common gear shaping machine. The process precision can reach Class 6~5 and the surface roughness is $R_a$ 0.63~0.32 $\mu_m$ .

## Rack cutter gear shaving machine

It is the machine processing tooth surface with rack gear shaper cutter. When it

works, the gear shaper cutter makes reciprocating motion and relieving motion, and the workpiece rotates correspondingly and make straight line movement in the direction of the pitch line parallel to the gear shaper cutter. The two constitutes generating motion. It is used in processing external engaged straight, helical and herringbone gear, especially those with relative large module. If processing internal gear, parts should be replaced by pinion type cutter-hub type tool rest. The tooth profile of the tool used in rack cutter gear shaping machine is a straight line with easy shape. It is easy to get high precision but it needs indexing after processing several teeth, so the productivity is low and it is rarely used.

## NC（numerical program control）non-circular gear shaping machine

It uses NC（numerical program control）system to cut the tooth surface of non-circular gear. In short, it is called NC non-circular gear shaping machine. NC（numerical program control）non-circular gear shaping machine can signal digital number to each part of the machine under the guidance of the speculated program. So it can work automatically. Besides, it also adopts hydrostatic guide rail, hydrostatic bearing, and hydrostatic screw, controllable silicon stepless speed adjusting for the main motion, photoelectric tool pre-set and semi conductor refrigeration. The merits are high precision, high productivity and high level of automation. It is also easy to operate.