

8.3 Output mechanism

Output mechanism

In planetary gear drive with few tooth difference, the mechanism that make the rotational motion of planetary gear transmit with constant angular velocity to output element is called output mechanism. Since the axis of planetary gear doesn't have collinear with input and output shaft. Therefore, this kind of output mechanism must have the capability to output motion of different axis. That's why it is also called W mechanism. Output mechanism that has this character often be classified as following: rod pin output mechanism, floating disc output mechanism, output mechanism of oldham coupling, universal coupling output mechanism, mechanism of internal gear with zero tooth difference and corrugated tube W mechanism etc.

Pin-hole type output mechanism

Pin-hole type output mechanism is composed of output axial disk 1, cylindrical pin 2, rod pin cover 4 and pin hole 3 on the planetary gear. There are rod pin covers on rod pin cylindrical pin and the covers are evenly distributed on the output axial disk. They are inserted in the corresponding rod pin on planetary gear and the diameter of pin hole is equal to four times of the center distance of internal gear pair, while the diameter of rod pin cover is two times of the center distance. Rolling contact between rod pin cover and pin hole must be secured when planetary gear drive with few tooth difference is working. In the Figure, $O_bO_cO_kO_s$ form a mechanism of parallelogram, so constant angular velocity and torque output can be realized.

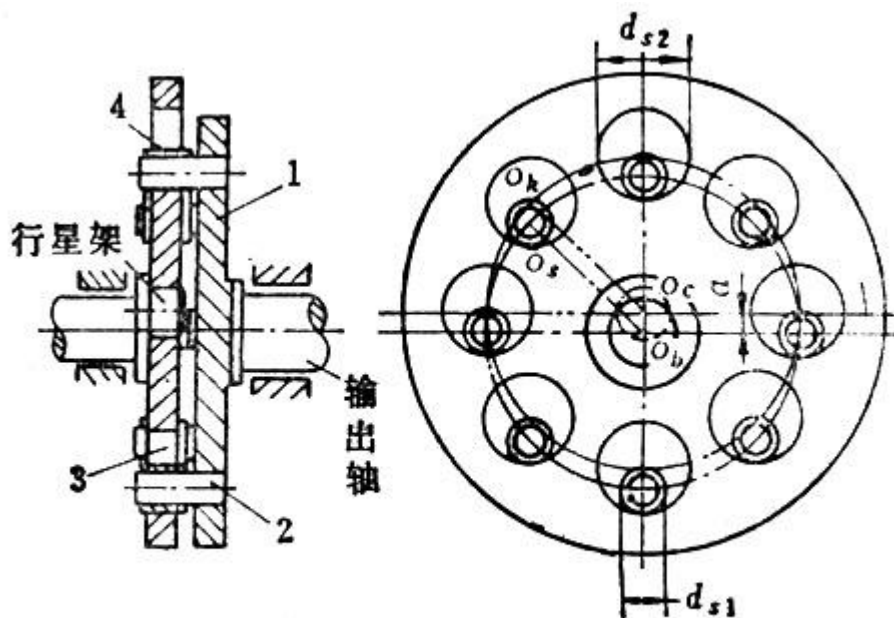


图 8-44

Output mechanism of oldham coupling; sliding block type output

mechanism

It refers to output mechanism that has the function of output mechanism oldham coupling in K-H-V planetary gear train. From Figure 8-45, one can see circular disk 1 and 4 with recess are installed on the right end of planetary gear 1 and the left end of output shaft 5. They are linked by floating disc 3. There is a rectangular tenon on both sides of the floating disc along diameter direction and the two are perpendicular to each other. They are embedded in the recess of two circular disks respectively. When the speed reducer is working, floating disc are sliding in two recesses. After movement analysis, we learn that the center of floating circular disk makes not only simple harmonic motion but also circling motion. It is the acceleration speed existing on floating disk that brings about vibration. In order to reduce the weight of floating disc and lower its force of inertia, the circular disc can be hollowed and made by engineering plastics.

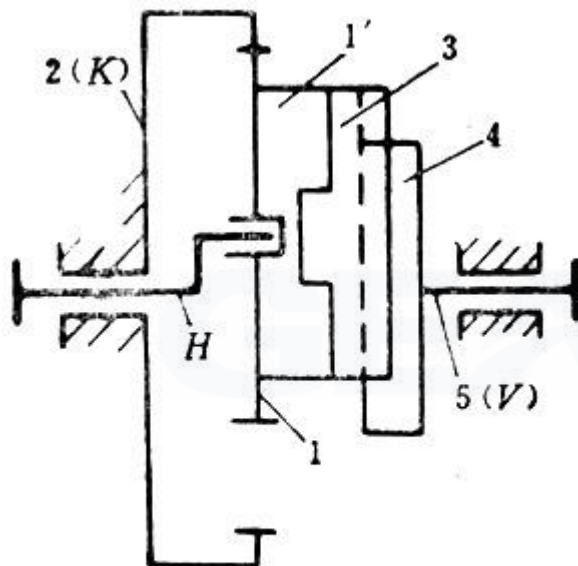


图 8-45

As there is slide between tenon and recess, the efficiency is not high. This kind of mechanism has simple structure. It is easy to process and assemble. It always applied in light loading, small power or low speed and discontinuous running conditions.

Output mechanism of internal gear pair

Output mechanism of internal gear pair belongs to 2K-H type driving mechanism with few tooth difference composed of two internal gear pairs with few tooth difference. Generally, there are two situations. The first is external gear output, which means connecting the internal gears of output internal gear pair with coaxial line of planetary gear and connecting the external gear with coaxial line of output shaft (Figure 8-46a). The second comes to internal gear output, which means connecting the external gear with the coaxial line of planetary gear and connecting the internal gear with the axial line of output shaft in the output internal gear pair. (Figure 8-46b)

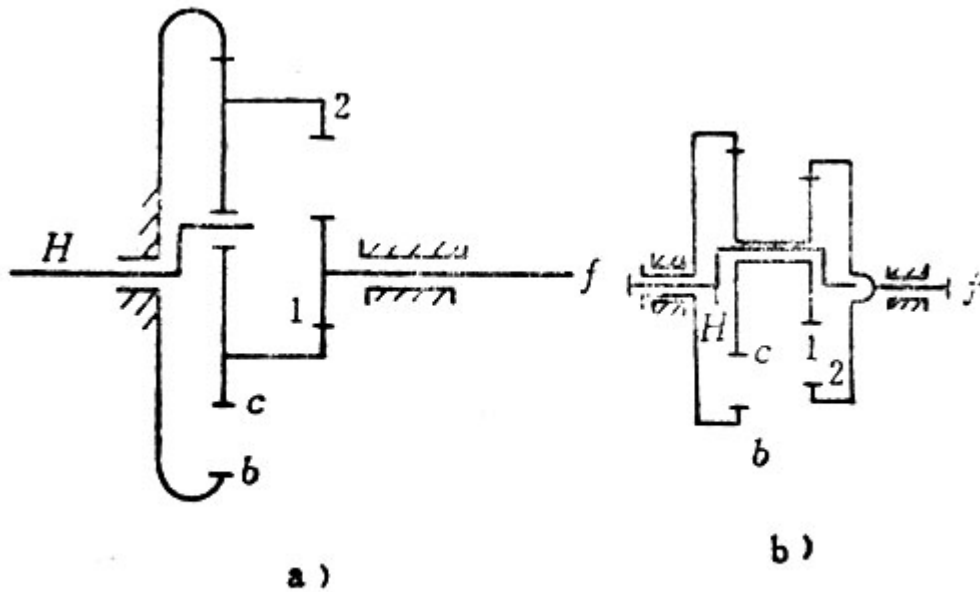


图 8-46

Zero tooth difference type output mechanism

It refers to output mechanism composed of internal gear pair (or bevel gear pair) which has relatively large normal backlash and equal tooth number (Figure 8-47). It is output mechanism which can be applied in planet gear with few tooth difference's output mechanism, in which the internal ring gear is fixed. Generally, the coaxial line of internal gear of gear pair with zero tooth difference often connects with planetary gear while the coaxial line of external gear connects with the output shaft. The eccentricity (center distance a) is controlled by adjusting the relatively large normal backlash. Most of them are used in planetary gear drive with 1 teeth difference whose eccentricity (a) is relatively small. The tooth difference eccentricity of 2, 3 and 4 are relatively large, so the normal backlash of internal gear pair with zero tooth difference should be increased correspondingly. At that time, it will bring about vibration noise and the efficiency may become lower.

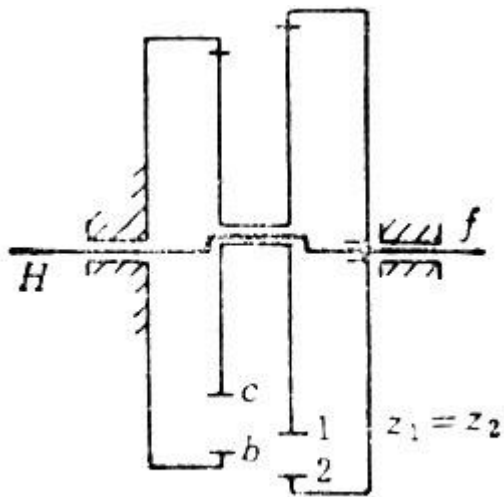


图 8-47

Universal joint type output mechanism

It takes universal coupling as its output mechanism. (Figure 8-18, Figure 8-48). In order to realize equal angular velocity output, double universal coupling must be applied and two conditions must be met. 1) The included angle between the driving shaft (and driven shaft) and the central shaft must be equal, which is $a_1=a_3$; 2) the two fork faces on central shafts should be on the same plane.

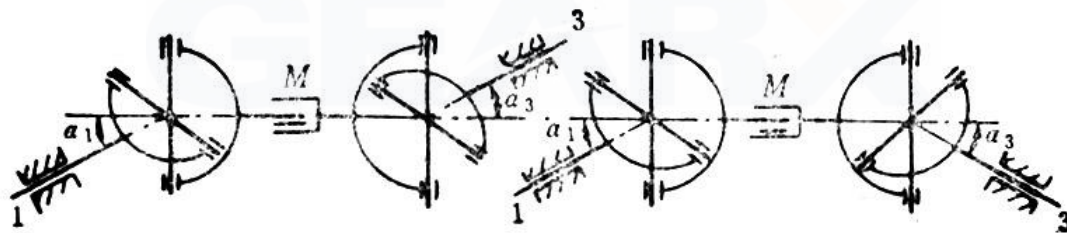


图 8-48

Floating disc type output mechanism

It takes floating disc mechanism as output mechanism to transmit parallel axis movement. This kind of mechanism is also applied in planetary gear drive mechanism with few teeth difference. It has the same working principle with pin-hole type output mechanism but with different structure. Floating disc type output mechanism adds a floating disc connecting the coaxial line of planetary gear. Pin hole is not on the planetary gear but on the floating disc.

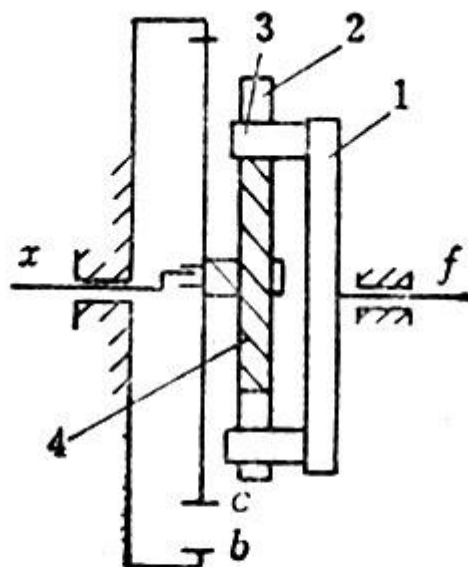


图 8-49

1—输出轴盘 2—销孔 3—柱销 4—浮动盘

Involute internal gear pair with zero tooth difference

It refers to involute internal gear pair whose internal and external tooth number is same. It is similar to gear coupling but the center to center distance is larger than zero. Therefore, in order to secure the installation and running process and make the center to center distance not being zero, comprehensive modified gear must be applied. This means tangent modified and radial modified need to be taken at the same time so as to increase the tooth space of internal gear to make the tooth thickness of external gear thinner and get relatively large backlash. The transmission ratio of internal gear with zero tooth difference is 1, which means the two gears operate in the same angular velocity. Since the tooth number and module of two gears are same so the two meshing pole are overlapped and the meshing line is the tangent line of the base circle.

Therefore, the maximum center distance $a' = (\Delta w_2 - \Delta w_1) / 2$ can be calculated, that is, the maximum center distance is equal to the half of the difference of common normal of two modified gears. Involute internal gear pair with zero tooth difference are mainly used in W output mechanism. To be specific, that is the output mechanism of planetary gear drive with 1 tooth difference.

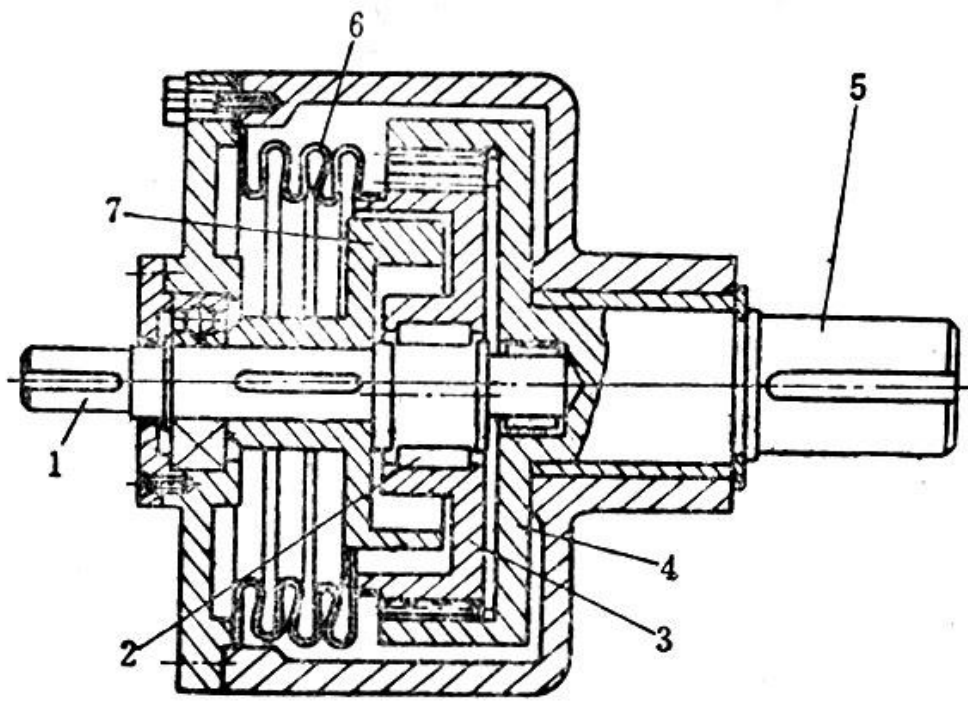
W mechanism

Mechanism that can transmit movement of two parallel axis (and not overlap) constant angular velocity is called, by a general name. W mechanism.

W mechanism with corrugated tube

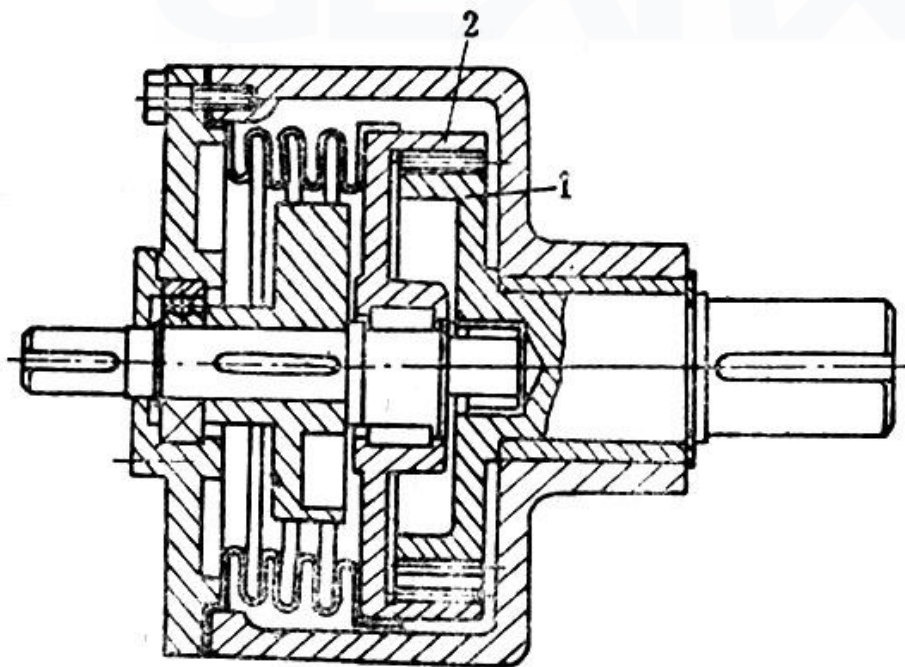
In W mechanism with corrugated tube, planetary gear connects the engine base through corrugated tube; the translation of external planetary gear is compensated by corrugated tube; the low speed running of external gear transmits power for internal gear output. This kind of mechanism has high transmission efficiency. We can also connect internal gear with corrugated tube, fix it on engine base and let the planetary gear bring output. This can be seen from Figure 8-50a, b.

GEARX



a)

1—输入轴 2—轴承 3—行星外齿轮 4—内齿
轮 5—输出轴 6—波纹管 7—平衡块



b)

1—外齿轮 2—行星内齿轮