CHAPTER 10 SUSPENSION SYSTEM

I.

I. GENERAL DESCRIPTION

The suspension system is located between the frame and axles; it is designed to mitigate and reduce impact and vibration from the ground, at the same time to transfer different kinds of forces and toques acting on the wheels and frame. It plays a relatively important role for the vehicle's performances (such as smoothness, operation stability, fuel economy and trafficability characteristics).

When an automobile runs on a rough road surface，the vertical reaction force on the wheels by the road surface is normally of an impact nature. Especially when it runs on a bad road, the impact may reach a very high value. As the impact force is transferred to the frame and body, the driver and passengers will feel very uncomfortable, and the cargo may also be spoiled, and the automobile's parts or mechanisms will be prematurely worn or damaged. In order to mitigate the impact，besides applying elastic pneumatic tires, there must be elastic elements in the suspensions to realize an elastic link between the frame and wheels or axles. Meanwhile, vibroshocks shall be installed in parallel connection with elastic elements in the suspension. In general，good elastic elements and effective anti-vibration devices have contributed to smooth driving and resultant faster speed.

II. STRUCTURES AND PRINCIPLES

China Heavy-duty Automobile Corporation produces Steyr, HOWO, and Yellow River series automobiles with various kinds of suspensions, but they have a similar structure mainly composed of two parts: front suspensions and rear suspensions.

1. Front Suspensions

Fundamental type of the front suspensions is formed with longitudinal parabolic curved leaf spring with cylinder type vibroshock and stabilizer bar, as shown in Fig. 10-1. Longitudinally seated front leaf spring is composed of a number of spring leaves with different lengths, which are fastened together by central bolts and fixed onto the front axle by U-shaped studs. The front spring eyes are connected with the frame via bracket pins and front brackets, so the spring is able to sway fore and aft, and thus enables the distance between the two spring eye center lines to vary with the spring's distortion.

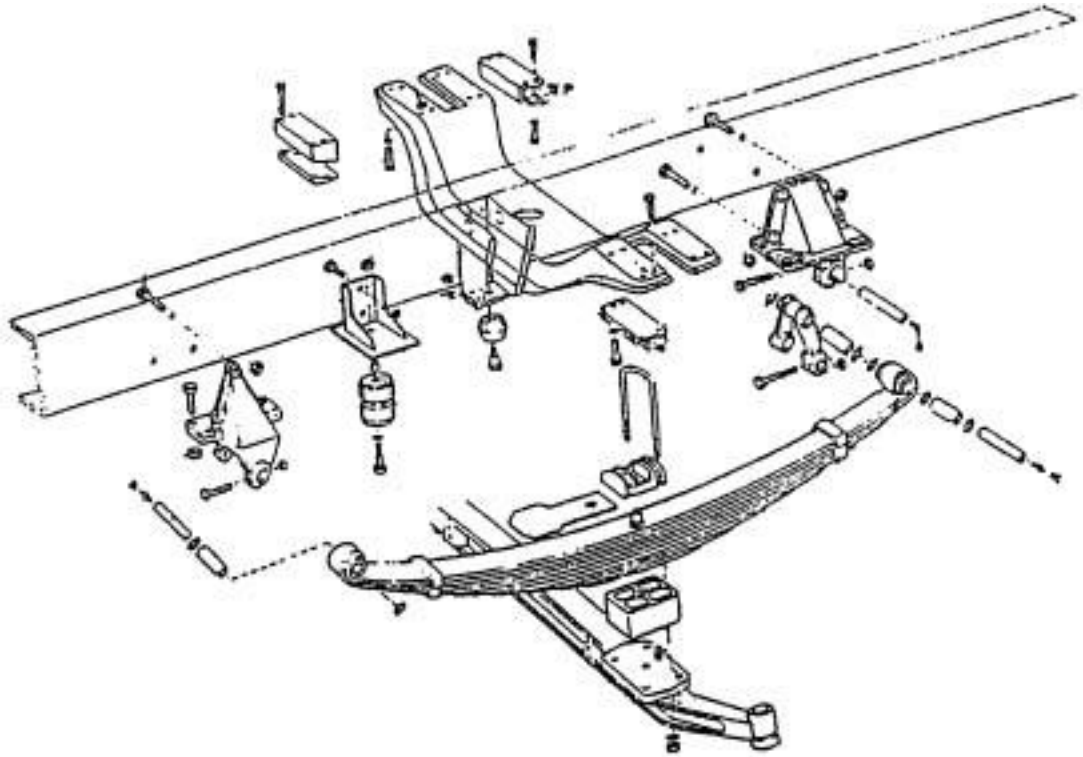

Fig. 10-1 Structure of the front suspensions

The front leaf spring is typically long and soft，with minimal rigidity 156.8×10 Newton/meter; maximal rigidity 333.3×10 Newton/meter, so that not only the free running frequency of the suspension is reduced, but spring stress is also reduced, thus increasing the spring strength and allowing for less change of the distance between the two spring eyes, as well as less change of the king pin backward caster angle with the wheels jumping up and down, thus the running smoothness is improved.

Another feature of the front spring is that a reverse arc up to 10～30 mm will normally be formed when the front spring is under full load. In some cases the difference of free arc between the left and right spring may be up to 10 mm, while other parameters remain the same. In view of the design, the reverse arc can increase the spring camber, lower the free running frequency and increase comfort. The difference of the free camber is based on consideration that the load on the left may differ from that on the right (the difference is about 150 kilograms).

In order to ensure running smoothness of the automobile, Steyr models are designed with the leaf springs in lower vertical stiffness, which will result in larger heeling angles. To solve such a contradiction，a stabilizer bar is equipped. The elastic stabilizer bar itself tends to impede the suspension elastic deformation with the moment of resistance when lateral tilt occurs, thus reducing the side inclination and side vibration and increasing the running stability of the vehicle. It is possible to enhance the control ability of the self-dumping truck and other engineering trucks by adding more leaves to the front spring so as to increase the rigidity as shown in Fig. 10-2. Double steering and two axle suspensions are fundamentally the same, as shown in Fig. 10-3

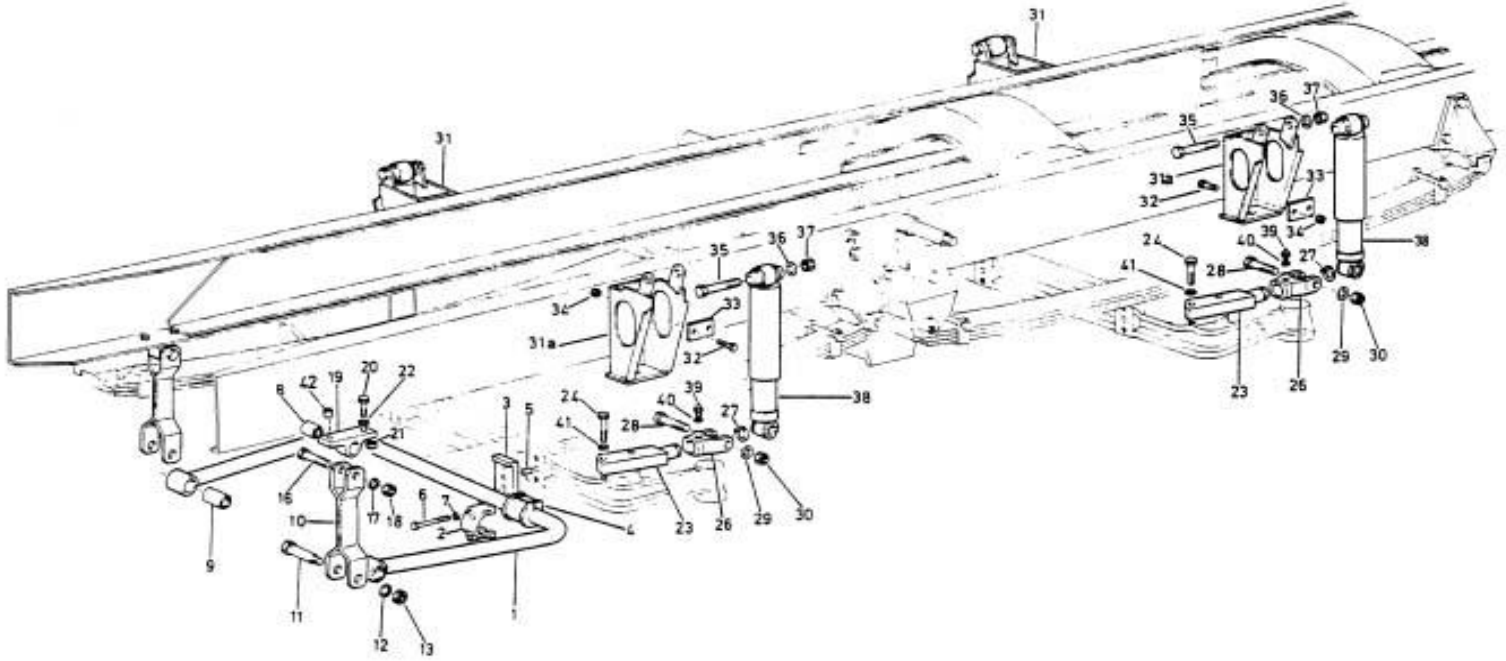

Fig. 10—2 Front stabilizing axle and the vibroshock

1. Stabilizer bar 38. Shock absorber

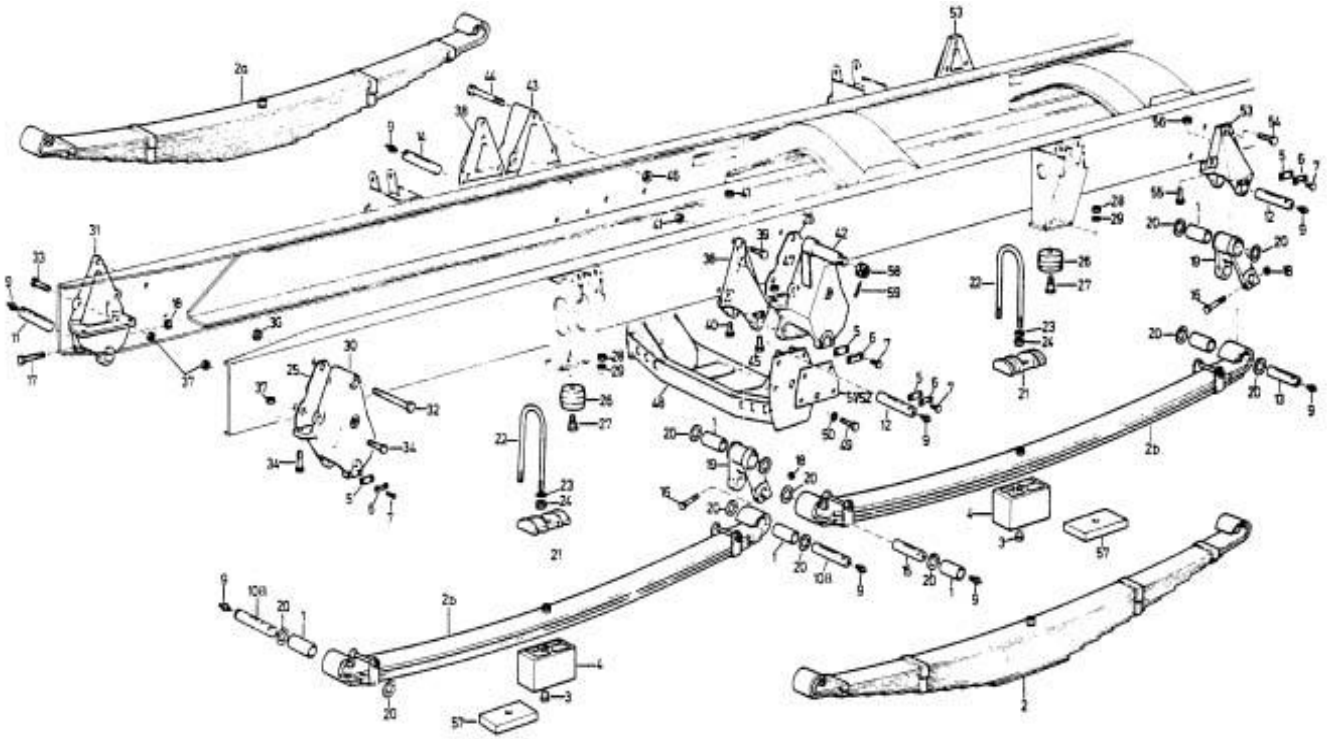

Fig. 10-3 Double axle steering front suspension structure

2.Rear Suspensions

Structure of the rear suspensions varies largely with the vehicle load. Rear suspensions of most two-axle vehicles have adopted master-supplementary spring type, as shown in Fig. 10-4. In the case of a vehicle with less load, the supplementary spring does not bear any load, leaving the master leaf spring working separately. While in heavy-duty or full load conditions, the frame moves down relatively with the axles, with the bracket on the frame in contact with the supplementary spring, so both the two springs bear the load together, and the suspension stiffness is enlarged. Automobile rear suspensions of 6×4, 8×4 or 6×6 drive types normally adopt conventional counteraction suspensions, as shown in Fig. 10-5.

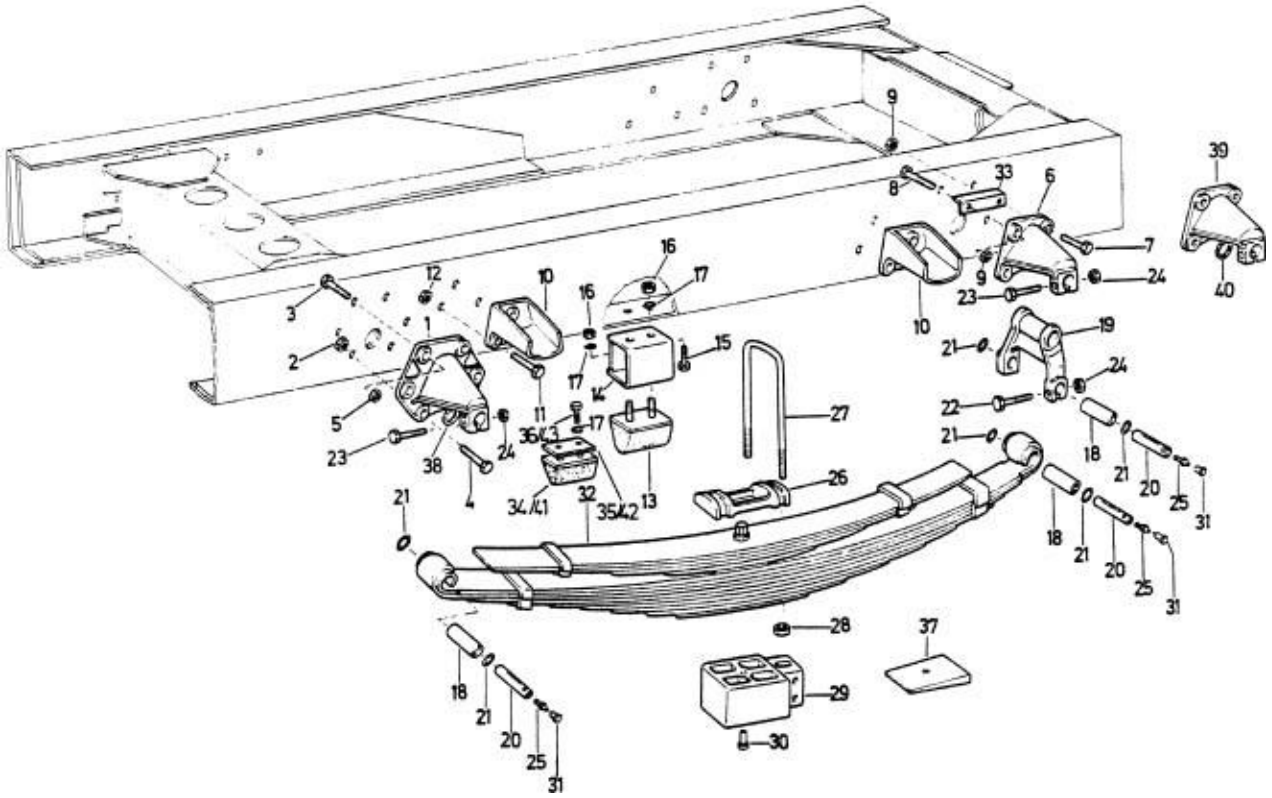

Fig .10-4 4×2 rear suspension structure

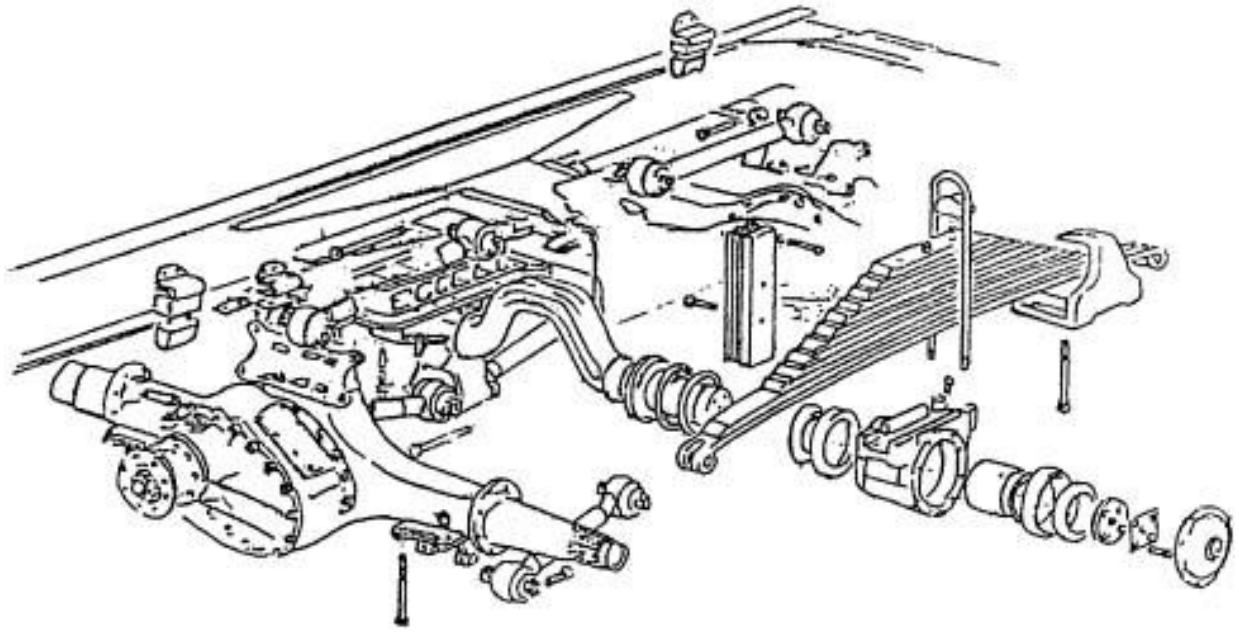

Fig. 10-5 Duplex axle drive type rear suspension structure

The drive-through axle and rear axle are connected with the both ends of the counteraction leaf spring，while the center bolts and the U-studs are fixed on the balanced bearing seats. The related positions of the drive-through axle and rear axle are determined by the six thrust levers up and down. In this way the drive-through axle and rear axle wheels can be in contact with the road surface all the time, furnishing the loads on the drive-through axle and rear axle wheels equally. In order to ensure the drive-through axle and rear axle positions and actual dimensions, six thrust levers are used to position the axle and frame for the drive-through and rear axles. In this way not only the power transfer is enabled between the axles and the frame, but the plane motion between the axle and frame is also furnished, thus ensuring the axle moving in correct contrail. Moreover, guide plates are installed on the frame sides to play the guiding role when the leaf springs jump up.

In order to confine excessive distortion of the leaf spring and the driving axle jumping up，rubber stoppers have been installed on the longitudinal girder bottom surface against the axle.
To avoid excessive movement up and down of the axles, and to avoid the interference phenomenon between the wheel and the body when running on very rough road surface, the leaf spring jumping self-confining is achieved by design of the slide in such a way that when an axle jumps a little to a certain position, the slide seat can hamper the movement and prevent it from further jumping down by movement interference action by the structure.

III. REQUIREMENTS OF ASSEMBLING

For fastening the front suspension leaf spring bracket and rear suspension counteraction shaft seat to the frame, the tightening torque shall be 190 - 260 Nm.
U-bolts of the front leaf spring must be tightened in uniformity when the spring leaves are pressed horizontally, with tightening torque 260-330 Nm; U-bolts of the rear leaf spring should be tightened in uniformity with tightening torque 660 -650 Nm.
When assembling the brace rod onto the counteraction suspension and connecting the brace rod with bolts and nuts, the tightening torque shall be 250-300 Nm.
Lubricant must be fully filled in the connecting hole in the front suspension leaf spring bracket and around the joint pin, and inside the rear suspension leaf spring seat.

IV. SERVICE AND MAINTENANCE

1.Check the parts connection condition in the suspension system before putting the vehicle into operation.

2.In running in period and when the vehicle has run for 200km and 500km，perform a specific check of the torque of the U-bolts and nuts respectively under full load, and tighten them if necessary.

3.After running in and before starting service, or after replacing the leaf spring assembly，check the torque respectively according to the specifications for totally three times under full load condition, and tighten the U-bolts and the nuts when necessary.

4.After the vehicle has run for 1,500-2,000km, check the torque according to the specifications under full load, tighten the bolts and nuts exposed and apply lubricant.
5.Add lubricant after the vehicle has run for 2,500-3,500km.
6.After the vehicle has run for 6,000-8,000km, besides the above-mentioned inspections, check the shock absorber condition, replace shock absorber check and lubricate the leaf spring if necessary.
7.Perform frequent inspections of the leaf spring brackets and the counteraction shaft bracket fastening bolts and nuts for specified tightening during the vehicle-running period.

V. COMMON TROUBLES AND REMEDIES

Phenomena	Causes	Solutions
Axle misalignment	① Wrong assembling of the thrust bars ② Thrust bar rubber seat damage ③ Counteraction shaft bush damage and oil leakage	① Replace ② Replace ③ Replace
Vehicle body vibration abnormal	① Vibroshock damage and oil leakage	① Replace
Vehicle body tilt left or right	① Misassembled spring leaves ② Spring leaves too soft.	① Replace and adjust ② Replace