Unit 3 : TRANSMISSION SYSTEMS

Module 4 : Rear axle, Hotchkiss Drive and Torque Tube Drive.

Hotchkiss drive;

The Hotchkiss drive is a system of power transmission. It was the dominant form of power transmission for front-engine, rear-wheel drive layout cars in the 20th century. The name comes from the French automobile firm of Hotchkiss, although it is clear that other makers (such asPeerless) used similar systems before Hotchkiss.

During the early part of the 20th century the two major competing systems of power transmission were the shaft-drive and chain-drive configurations. The Hotchkiss drive is a shaft- drive system (another type of direct-drive transmission system is the torque tube, which was also popular until the 1950s).

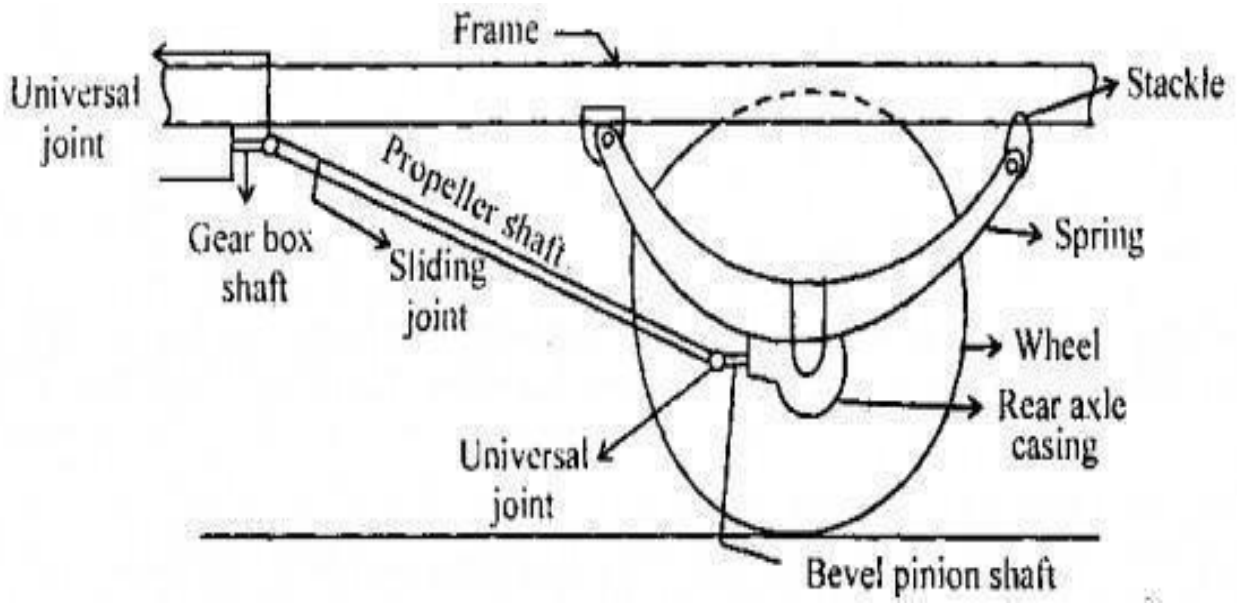
All shaft-drive systems consist of a driveshaft (also called a "propeller shaft" or Cardan shaft) extending from the transmission in front to the differential in the rear. The differentiating characteristic of the Hotchkiss drive is the fact that it uses universal joints at both ends of the driveshaft, which is not enclosed. The use of two universal joints, properly phased and withparallel alignment of the drive and driven shafts, allows the use of simple cross- type universals. (In a torque-tube arrangement only a single universal is used at the end of the transmission tail shaft, and this universal should be a constant velocity joint.)

In the Hotchkiss drive, slip-splines or a plunge-type (ball and trunnion u-joint) eliminate thrust transmitted back up the driveshaft from the axle, allowing simple rear-axle positioning using parallel leaf springs. (In the torque-tube type this thrust is taken by the

torque tube to the transmission and thence to the transmission and motor mounts to the frame. While the torque-tube type requires additional locating elements, such as a Panhard rod, this allows the use of coil springs.)

Some Hotchkiss drive shafts are made in two pieces with another universal joint in the center for greater flexibility, typically in trucks and specialty vehicles built on truck frames. Some installations use rubber mounts to isolate noise and vibration. The 1984–1987 RWD Toyota Corolla (i.e., Corolla SR5 and GT-S) coupe is another example of a car that uses a 2-part Hotchkiss driveshaft with a rubber-mounted center bearing.

This design was the main form of power transmission for most cars from the 1920s through the 1970s. Presently (circa 2012), it remains common in pick-up trucks, and sport utility vehicles.



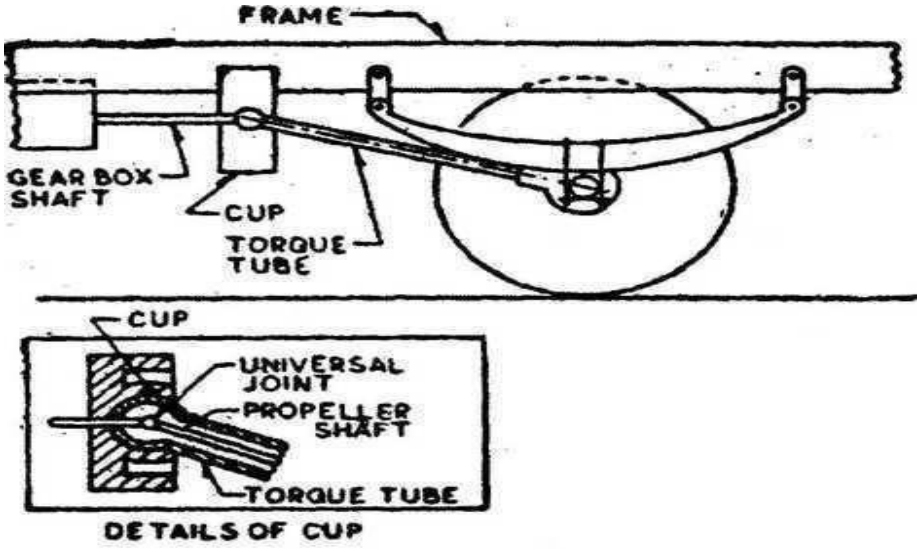
Torque tube Drive

A torque tube system is a driveshaft technology, often used in automobiles with a front engine and rear drive. It is not as widespread as the Hotchkiss drive, but is still occasionally used to this day. Drive shafts are sometimes also used for other vehicles and machinery.

The "torque" that is referred to in the name is not that of the driveshaft, along the axis of the car, but that applied by the wheels. The design problem that the torque tube solves is how to get the traction forces generated by the wheels to the car frame. The "torque tube" transmits this force by directly coupling the axle differential to the transmission and therefore propels the car forward by pushing on the engine/transmission and then through the engine mounts to the car frame[citation needed].

In contrast, the Hotchkiss drive has the traction forces transmitted to the car frame by using other suspension components such as leaf springs or trailing arms. A ball and socket type of joint called a "torque ball" is used at one end of the torque tube to allow relative motion between the axle and transmission due to suspension travel. Since the torque tube does not constrain the axle in the lateral (side-to-side) direction a pan hard rod is often used for this purpose. The combination of the pan hard rod and the torque tube allows the easy implementation of soft coil springs in the rear to give good ride quality.

In addition to transmitting the traction forces, the torque tube is hollow and contains the rotating driveshaft. Inside the hollow torque ball is the universal joint of the driveshaft that allows relative motion between the two ends of the driveshaft. In most applications the drive shaft uses a single universal joint which has the disadvantage that it causes speed fluctuations in the driveshaft when the shaft is not straight. The Hotchkiss drive uses two universal joints which has the effect of canceling the speed fluctuations and gives a constant speed even when the shaft is no longer straight.



Rear Axle in Automobile

Between the differential and the drive wheels is the rear axle to transmit the power from the differential to the drive wheels. It is clear from the construction of the differential that the rear axle is not a single piece but is in two halves connected by the differential, one part known as the driveshaft.

The inner end of the drive shaft is connected to the differential sun gear. and the outer end of the drive wheel. In rear-wheel-drive vehicles, the rear wheels are the driving wheels. Whereas, in front-wheel drive vehicles, the front wheels are the driving wheels. Almost all rear axles of modern passenger cars are live axles, that is, they rotate with the wheels.

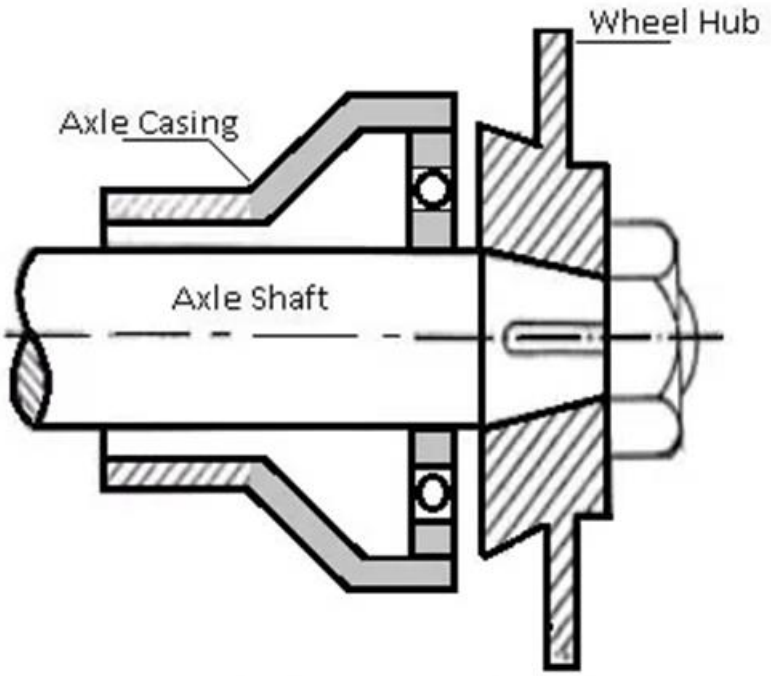
Dead axles simply remain stationary, they do not move with the wheels. A housing completely encloses the rear axles and differential, protecting them from water, dust, and injury, as well as mounting their internal bearings and providing a reservoir of lubricant.

Types of Rear Axles in Automobile Systems

Depending upon the methods of supporting the rear axles and mounting the rear wheels, the **three types of rear axles are as follows:**

- Semi-floating axle
- Full-floating axle
- Three-quarter floating axle

Semi-Floating Axle



Semi-Floating Axle

A semi-floating axle has a bearing located on the axle and inside the axle housing. It must support all the loads listed above. Therefore, it must be larger in size, for the same torque delivered than any other type. The inner end of the axle is supported by the differential side gear.

He is thus relieved of the task of supporting the weight of the car via the axle housing.

The outer end must support the weight of the car and absorb the final thrust. The inner end of the axle is splined to the differential side gear.

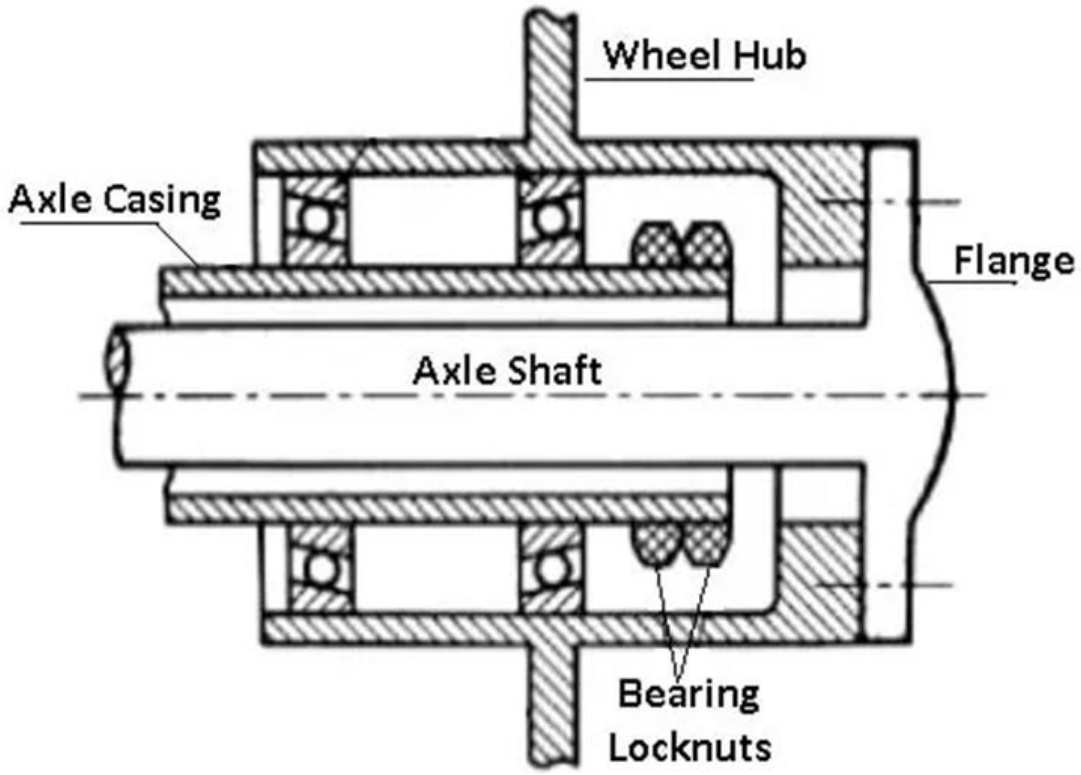
The outer end is flanged so that the wheel can be bolted directly to it. In some models, the wheel hub is keyed onto the outer end of the axle. The vehicle load is transmitted to the axle through the casing and bearing, which causes the axle to flex or shear. The semi-floating axle is the simplest and cheapest of all the other types and is widely used on cars.

Full-Floating Axle

A fully floating axle has two deep groove balls or tapered roller bearings, which are positioned between the axle housing and the wheel hub. The outside of an axle is flanged to which the wheel hub is bolted. The axis is not supported by a bearing at both ends and its position is maintained by the way it is supported at both ends.

In this way, the axle is relieved of any stress caused by the weight of the vehicle on the final thrust. It only transmits the engine torque. For this reason, it is called full floating. The axle can be removed from the housing without distributing the wheel by removing the nuts.

An added benefit of this design is the ability of the vehicle even if it has a broken axle. This type of axle is more expensive, and heavier than the other axle. It is usually mounted on commercial vehicles.



Full Floating Axle

Three-Quarter Floating Axle

This type of axle has a bearing positioned between the hub and the axle housing. Thus, the weight of the vehicle is transferred to the axle housing and only lateral thrust and drive torque are absorbed by the axle.

The axle is rigidly keyed to the hub, thus demonstrating the drive connection and maintaining wheel alignment. The inner end of this axle has the same construction as that of the semi-floating axle. Although the three-quarter floating axle is more reliable, it is not as simple as the semi-floating axle.