

TRANSMISSIONS, CLUTCHES, AND FINAL DRIVE SYSTEMS

PRIMARY DRIVE SYSTEMS.....5

Chain Primary Drives

Belt Primary Drives

Gear Primary Drives

CLUTCHES.....11

Clutch Overview

Multiple Plate Clutches

Wet Clutches

Dry Clutches

One-Way Sprag Clutches

Centrifugal Clutches

Slipper Clutches

TRANSMISSIONS.....18

Transmission Overview

Direct-Drive Transmissions

Transmission Gears: Fixed, Freewheeling, Sliding

Gear Shifting Components

Indirect-Drive Transmissions

GEAR RATIOS.....31

Computing Transmission Gear Ratios

Primary Drive Ratio

Transmission Gear Ratios

Secondary Drive Ratio

Final Drive Ratio

OTHER TYPES OF TRANSMISSIONS.....39

Automatic Transmissions

Belt-Driven Transmission With Centrifugal Clutch

Dual Range Transmissions

FINAL DRIVES.....45

Chain-Driven Final Drives

Belt-Driven Final Drives

Shaft-Driven Final Drives

Adjusting Final Drive Ratios

TEST QUESTIONS AND ANSWERS.....51

PRIMARY DRIVE SYSTEMS

Motorcycles use a primary drive, clutch, transmission and final drive to transfer the power generated by the engine to the rear wheel in order to move the motorcycle forward.

Engine power is transferred to the rear wheel in two stages – the primary drive and the final drive.

The first stage is the *primary drive*. The primary drive transfers power from the engine crankshaft to the transmission with a primary chain, a belt, or gears.

The second stage is the *final drive*. The final drive transfers the power from the transmission to the rear wheel with a chain, a belt, or a shaft drive.

The transmission uses gears to gradually increase the speed of the turning torque applied to the rear wheel. For example, the transmission will turn the rear wheel faster in 5'th gear than in 1'st gear.

A clutch is used to facilitate the disengaging from one gear and then the engagement of the next gear.

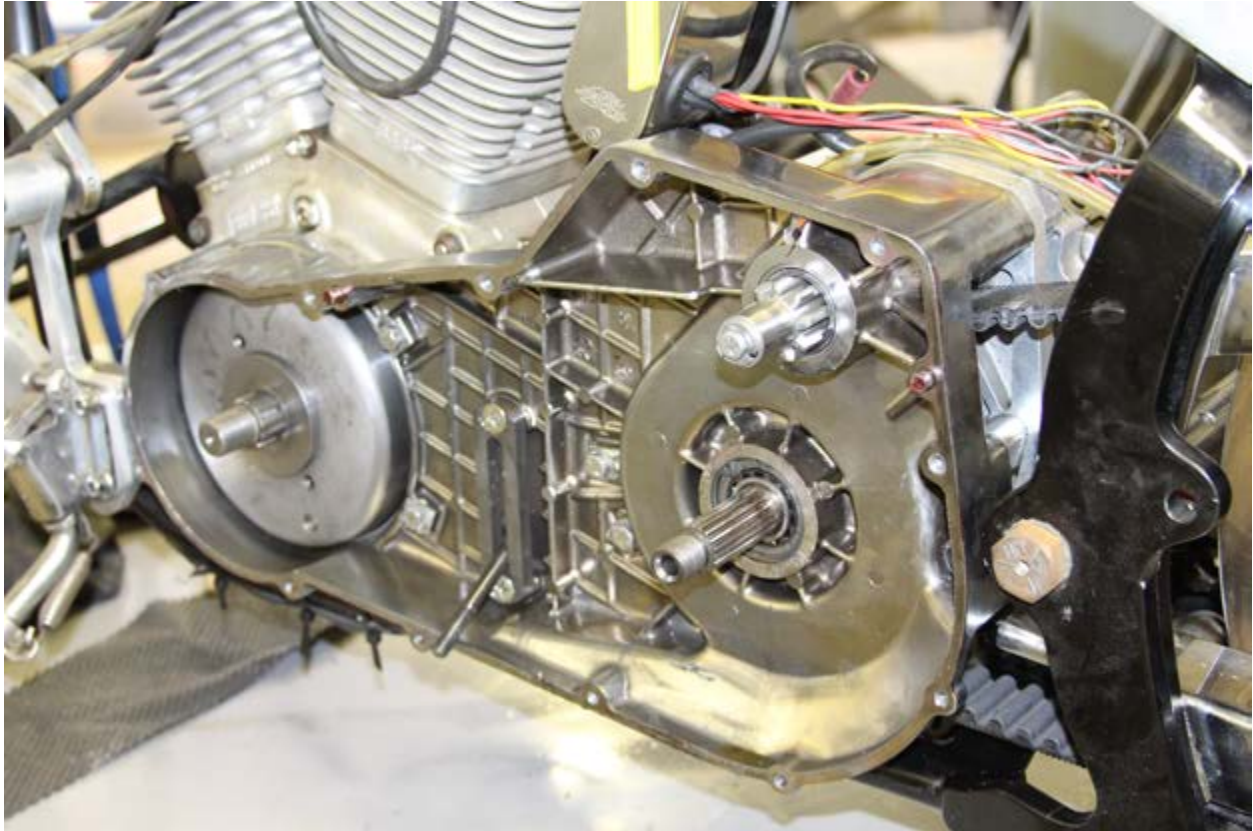
When the engine and transmission are separate components, and located apart from each other in the motorcycle frame, a chain or belt is needed to transfer power from the engine to the transmission.

In this type of bike, the engine and transmission are typically housed in separate cases. Primary drives using chains or belts is not a typical design used in high rpm engines.

When the engine and transmission are mated together in a common case, as with most motorcycles and ATV's, the primary drive is most often driven by gears. Gear-driven primary drives are the most suitable for high rpm engines.

Chain Primary Drives

A chain primary drive uses a chain and chain sprockets to transfer power from the engine to a transmission that is housed separate from the engine.



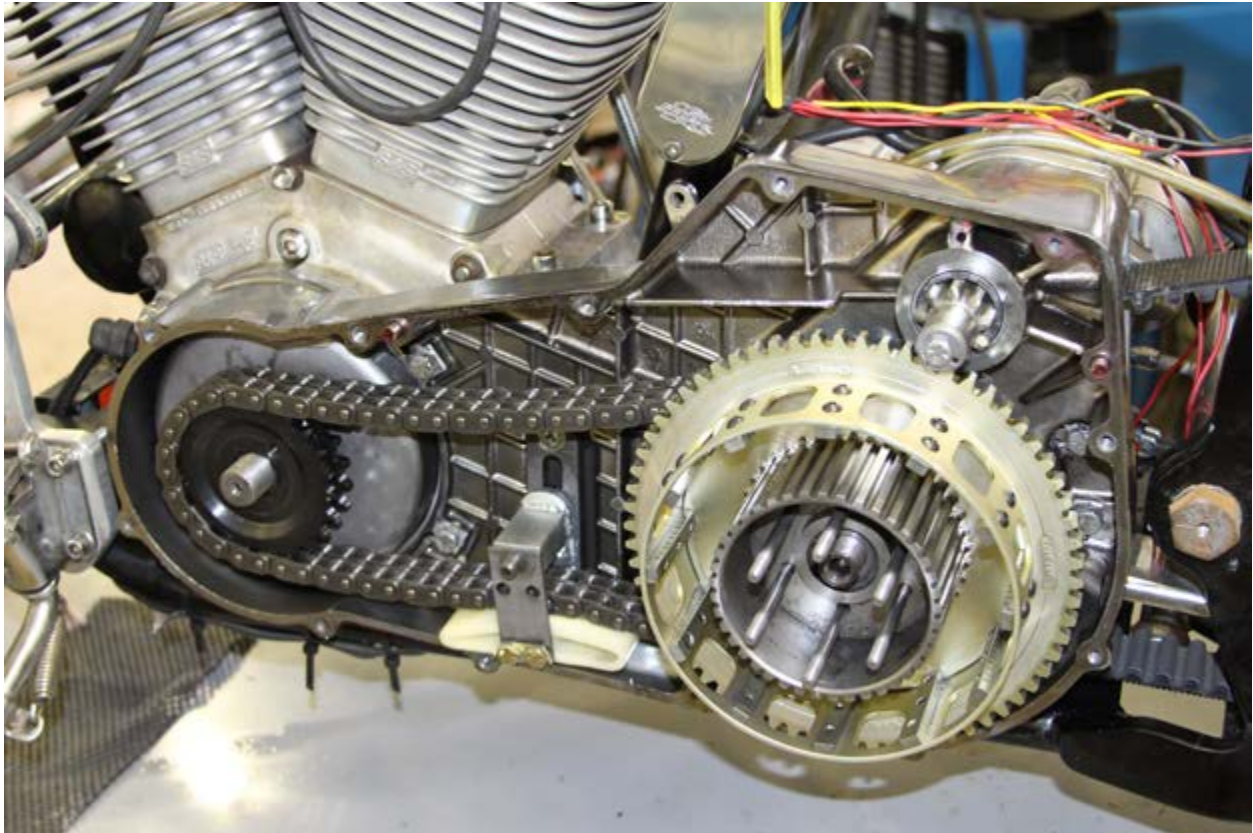
The primary drive will stretch from the engine shaft (front) to the transmission mainshaft (rear). The inner primary cover is seen here. It is bolted to the engine case with four bolts, and also bolted to the transmission case with four bolts.

The front chain sprocket is attached to the engine shaft that comes out of the engine. It is referred to as the “engine sprocket”. The engine shaft is commonly called the “sprocket shaft”.

The rear chain sprocket of the primary drive is typically built into the outside of the clutch basket. Chain sprocket teeth are machined into the outside of the clutch basket. This transforms the outside of the clutch basket into a large sprocket, commonly referred to as the “clutch sprocket”. The clutch

plates are located inside the clutch basket. The clutch basket is also commonly referred to as a clutch shell, or clutch housing.

The chain primary drive is commonly seen on motorcycles such as Harley-Davidsons where the engine and transmission may not share a common case. The transmission is separate from the engine, and has its own case.



A double-row primary chain connects the engine chain sprocket with the sprocket on the back of the transmission clutch basket. The outer primary cover will cover this chain primary drive assembly to keep dirt out and hold one quart of primary oil for the wet clutch. The clutch plates will rotate in a bath of primary oil. Note the starter jackshaft gear that will engage the clutch basket “ring gear” to turn over the engine. Notice also the white chain tensioner below the lower chain row.

The engine sprocket is smaller than the clutch sprocket and turns faster. This initial gearing ratio allows the engine to produce maximum torque at the engine shaft, while the power reaching the transmission shaft is initially

reduced so that it can be harnessed in a linear manner using transmission gearing ratios inside the transmission.

Primary chains in larger bikes are typically double row chains, and the chain sprockets have double rows of chain teeth. Chain primary drives must receive lubrication for the chain and sprockets due to friction. For example, Harley primary drives require a quart of primary oil to lubricate the primary chain and wet clutch plates. Primary chains rely on a chain tensioner to regulate chain tension.

The primary drive components of the engine sprocket, chain, clutch hub / sprocket, clutch plates, and starter jackshaft are all mounted inside a sealed primary drive cover. The primary drive cover is made up of an inner primary cover and an outer primary cover.

The *inner primary cover* is bolted to the engine case and the transmission case. The engine shaft and transmission shafts protrude through the inner primary cover. The primary drive components are then attached to the engine shaft and the transmission shaft.

The *outer primary cover* sits on the outside of the primary components and is attached to the inner primary cover with screws. When the inner and outer primary covers are attached together, they create an “*enclosed primary*”.

The enclosed primary term differentiates this type of primary drive from an “*open primary*”. An example of an open primary is an “open belt drive” primary which is not enclosed with a primary cover.

Some enclosed primary drives use a belt instead of a primary chain, but the primary chain is more common.

Belt Primary Drives

The belts on a belt-driven primary drive are typically used on large cruisers and touring bikes. They run quieter than chain drives and do not have to be lubricated. However, belts are not as strong as a chain.

