Design and Fabrication of Dual Clutch

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Abstract: This project deals with the design and fabrication of a dual clutch transmission to be fitted on to a motorcycle. In this project we intend to utilize our ideas and knowledge and show that it is possible to design and fabricate a dual clutch mechanism for a two wheeler and also to show the advantages and disadvantages of the dual clutch over the conventional clutch system. We have taken a two wheeler with a normal clutch mechanism and introduced a secondary lay shaft which will consist of the even gears and a secondary clutch assembly so that the even and odd gears can be engaged and disengaged separately with the help of their respective clutch assemblies. The main aim of our project is to reduce the shifting time of gears and increase the fuel efficiency.

Key words: Clutch transmission • Utilize our ideas and knowledge • Design and fabricate a dual clutch mechanism

INTRODUCTION

Clutch: A clutch is a mechanical device which provides driving force to another mechanism, typically by connecting the driven mechanism to the driving mechanism. Its opposite component is a brake, which inhibits motion.

Clutches are useful in devices that have two rotating shafts. In these devices, one shaft is typically attached to a motor or other power unit (the driving member) and the other shaft (the driven member) provides output power for work to be done [1].

In a drill, for instance, one shaft is driven by a motor and the other drives a drill chuck. The clutch connects the two shafts so that they can either be locked together and spin at the same speed (engaged), or be decoupled and spin at different speeds (disengaged).

Single Plate Clutch: This clutch has a simple construction as it has only one clutch plate. It has one driving member with one driven member. It transmits very less torque because of the number of clutch plates available. This is almost obsolete now.

Cone Clutch: A cone clutch serves the same purpose as a disk or plate clutch. However, instead of mating two spinning disks, the cone clutch uses two conical surfaces to transmit torque by friction. The cone clutch transfers a higher torque than plate or disk clutches of the same size due to the wedging action and increased surface area. Cone clutches are generally now only used in low peripheral speed applications although they were once common in automobiles and other combustion engine transmissions. They are usually now confined to very specialist transmissions in racing, rallying, or in extreme off-road vehicles, although they are common in power boats [2]. This is because the clutch doesn't have to be pushed in all the way and the gears will be changed quicker. Small cone clutches are used in synchronizer mechanisms in manual transmissions.

Centrifugal Clutch: A centrifugal clutch is a clutch that uses centrifugal force to connect two concentric shafts, with the driving shaft nested inside the driven shaft.

The input of the clutch is connected to the engine crankshaft while the output may drive a shaft, chain, or belt. As engine RPM increases, weighted arms in the clutch swing outward and force the clutch to engage. The most common types have friction pads or shoes radially mounted that engage the inside of the rim of a housing. On the center shaft there are an assorted number of extension springs, which connect to a clutch shoe. When the center shaft spins fast enough, the springs extend causing the clutch shoes to engage the friction
face [3]. It can be compared to a drum brake in reverse. This type can be found on most home built karts, lawn and garden equipment, fuel-powered model cars and low power chainsaws. Another type used in racing karts has friction and clutch disks stacked together like a motorcycle clutch. The weighted arms force these disks together and engage the clutch.

When the engine reaches a certain RPM, the clutch activates, working almost like a continuously variable transmission. As the load increases the rpm drops, disengaging the clutch, letting the rpm rise again and reengaging the clutch. If tuned properly, the clutch will tend to keep the engine at or near the torque peak of the engine. This results in a fair bit of waste heat, but over a broad range of speeds it is much more useful than a direct drive in many applications [4].

Centrifugal clutches are often used in mopeds, underbones, lawnmowers, go-karts, chainsaws and mini bikes.

**Dual Clutch:** A twin-clutch gearbox, double clutch transmission or dual clutch transmission (DCT) is a semi-automatic transmission with separate clutches for odd and even gears. The outer clutch drives the odd numbered gears, while the inner clutch drives the even numbered gears. Shifts can be accomplished without interrupting power, by applying the engine's torque to one clutch just as the engine's torque is being disconnected from the other clutch. Since the synchronizers that select an odd gear can be moved while driving the car in an even gear and vice versa, DCTs have been configured which shift more quickly than Formula One and other cars equipped with single-clutch AMTs (automated-manual transmissions, a.k.a. single-clutch semi-automatics). Also, with a DCT, shifts can be made more smoothly than with an AMT, making a DCT more suitable for street-driving [5].

![Cross Section of Dual Clutch](image)

A twin-clutch gearbox eliminates the torque converter used in traditional automatic transmissions. Instead, dual clutch transmissions that are currently on the market use wet multi-plate clutches, similar to the clutches used in most motorcycle transmissions. A seven-speed version that uses dry clutches, like those usually associated with manual transmissions, has been introduced by VW in the 2008 Golf and Jetta (product codename DQ200). Getrag has a dry DCT under development and others are rumoured to be in development by several manufacturers.

Most people know that cars come with two basic transmission types: manuals, which require that the driver change gears by depressing a clutch pedal and using a stick shift and, automatics, which do all of the shifting work for drivers using, clutches a torque convertor and sets of planetary gears. But there's also something in between that offers the best of both worlds -- the dual-clutch transmission, also called the semi-automatic transmission, the "clutchless" manual transmission and the automated manual transmission [6].

In the world of racecars, semi-automatic transmissions, such as the Sequential manual gearbox (or SMG), have been a staple for years. But in the world of production vehicles, it's a relatively new technology -- one that is being defined by a very specific design known as the dual-clutch, or direct-shift, gearbox. The following literature will describe how dual clutch works, how it compares with other transmission types and how it will become the future.

**Difference Between Conventional Clutch and Dual Clutch:** A dual-clutch transmission offers the function of two manual gearboxes in one. To understand what this means, it's helpful to review how a conventional manual gearbox works.

When a driver wants to change from one gear to another in a standard stick-shift car, he first presses down the clutch pedal. This operates a single clutch, which disconnects the engine from the gearbox and interrupts power flow to the transmission. Then the driver uses the stick shift to select a new gear, a process that involves moving a toothed collar from one gear wheel to another gear wheel of a different size. Devices called synchronizers match the gears before they are engaged to prevent grinding. Once the new gear is engaged, the driver releases the clutch pedal, which re-connects the engine to the gearbox and transmits power to the wheels [7].

So, in a conventional manual transmission, there is not a continuous flow of power from the engine to the wheels. Instead, power delivery changes from on to off to
on during gearshift, causing a phenomenon known as "shift shock" or "torque interrupt." For an unskilled driver, this can result in passengers being thrown forward and back again as gears are changed.

**Dual-clutch Transmission Shafts:** A two-part transmission shaft is at the heart of a DCT. Unlike a conventional manual gearbox, this houses all of its gears on a single input shaft, the DCT splits up odd and even gears on two input shafts. How is this possible? The outer shaft is hollowed out, making room for an inner shaft, which is nested inside. The outer hollow shaft feeds second and fourth gears, while the inner shaft feeds first, third and fifth.

The diagram below shows this arrangement for a typical five-speed DCT. Notice that one clutch controls second and fourth gears, while another, independent clutch controls first, third and fifth gears. That's the trick that allows lightning-fast gear changes and keeps power delivery constant. A standard manual transmission can't do this because it must use one clutch for all odd and even gears [8].

**Past, Present and Future of a Dual Clutch:** The man who invented the dual-clutch gearbox was a pioneer in automotive engineering. Adolphe Kégresse is best known for developing the half-track, a type of vehicle equipped with endless rubber treads allowing it to drive off-road over various forms of terrain. In 1939, Kégresse conceived the idea for a dual-clutch gearbox, which he hoped to use on the legendary Citroën "Traction" vehicle. Unfortunately, adverse business circumstances prevented further development.

Both Audi and Porsche picked up on the dual-clutch concept, although its use was limited at first to race cars. The 956 and 962C race cars included the Porsche Dual Klutch, or PDK. In 1986, a Porsche 962 won the Monza 1000 Kilometre World Sports Prototype Championship race -- the first win for a car equipped with the PDK semi-automatic paddle-shifted transmission. Audi also made history in 1985 when a Sport quattro S1 rally car equipped with dual-clutch transmission won the Pikes Peak hill climb, a race up the 4,300-meter-high mountain.

Commercialization of the dual-clutch transmission, however, has not been feasible until recently. Volkswagen has been a pioneer in dual-clutch transmissions, licensing BorgWarner's DualTronic technology. European automobiles equipped with DCTs include the Volkswagen Beetle, Golf, Touran and Jetta as well as the Audi TT and A3; the Skoda Octavia; and the Seat Altea, Toledo and Leon.

Ford is the second major manufacturer to commit to dual-clutch transmissions, made by Ford of Europe and its 50/50 joint venture transmission manufacturer, GETRAG-Ford. It demonstrated the Power shift System, a six-speed dual-clutch transmission, at the 2005 Frankfurt International Motor Show. However, production vehicles using a first generation Power shift are approximately two years away.

**CONCLUSION**

The dual clutch mechanism was designed, fabricated and finally the model was displayed. A secondary lay shaft was fabricated and coupled with the main shaft and also a secondary clutch was fitted on the shaft extended from the original clutch. Since the actual change in performance could be calculated by a dynamometer and a theoretical value was calculated. When we compare the usual clutch with the dual clutch mechanism, the advantages of the former has over the latter are; the increase in torque transmitted and power transmitted which is visible from the ride and calculations; the shift time for gears is reduced and which is visible during riding and an increase in fuel efficiency is noted.

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