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Design & Installation of Hydraulically operated clutch

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Abstract - *In general the hydraulic clutch is used in four wheelers for smooth and light weight functioning. But now days in super bikes this clutch is used for faster transmission and less effort. While in common bikes the mechanical clutch is used which takes more efforts and sluggish transmission, with more wear and tear of cable comparatively.*

So our purpose of using hydraulic clutch in common bikes is to reduce the effort by driver required for transmission and reducing transmission time thus increasing transmission efficiency of gear box. Life of hydraulic clutch is more than cable clutch because it's self lubricating. It also helps in reducing the weight of clutch when compared with mechanical clutch.

Key Words: **Compressed Fluid, Highly efficient, Designation, Fabrication, Installation, 2 Wheeler vehicle**

1. INTRODUCTION

The term Hydraulic means that science , supplied to energy transfer and control by Using oil as working medium . In Hydraulic systems oil is empowered by using Hydraulic pump and power of oil used to obtain mechanical advantage i.e. useful Work. Hydraulic systems work on Pascal's law. Hydraulic clutch which uses hydraulic energy created by way of pressurizing hydraulic oil to control the clutch plate movements. Mostly the Hydraulic clutches are used in Four Wheeler , but now a days this are also used in super bikes to reduce efforts of transmission effort of driver or rider . In common bikes i.e. .Hero , TVS , Bajaj uses mechanical clutches having more wear and tear thus effort are required more for transmission because of loosening of cable. So we have thought that of using Hydraulic clutch for reducing effort required for transmission of gears and smooth changing gears. The transmission time and weight of clutch is reduced. Life of clutch also increased. We got the inspiration from super bikes and thought of converting normal bike transmission to superbike like transmission. The technology is not new but we are installing it in a normal bike like Discover112 , we are just modifying the wire operated clutch , with the use of hydraulic components. Hydraulic components that we are using are lever , reservoir (Master cylinder) for Oil storage , slave cylinder.

1. Literature Review

1.1 *Julio Cesar De Luca, David* Girard (2002)*:-*

This work presents some results of a research on the vibrations of clutch pedal that is underway in Renault Automobiles. A brief summary of the types of the related NVH phenomena and available literature is presented as well. Some measurements in a vehicle equipped with a 4 cylinders Diesel engine, dual mass flywheel, and a hydraulic release bearing clutch command, were carried out. The correlation between the hydraulic pressure and clutch pedal vibrations was determined and analyzed, and some conclusions drawn.

1.2 *Wagner Matos Santos, Alvaro Costa Neto* (2012)*:-*

The clutch actuation system is directly linked to vehicle easy of operation and ergonomics. For passenger cars, a comfortable pedal force is considered light when it is under 100 N and hard if over 130 N. For Commercial vehicles, about 170 N are considered acceptable. This work looks forward to obtain a pedal curve in Excel which simulates the real one and can slow down actuation systems developing time. For in such way, it points to cares about master cylinder actuation geometry, stroke and pedal effort variations in the way that it is comfortable for the driver, works on low hydraulic pressure and is able to keep functionality during whole clutch plate and disc life. Some calculations about lever and master cylinder push rod dimensions are realized in the way of keeping actuation angles drawing limits.

1.3 *Max P. Gassman(1990):-*

Many types of mechanical linkages are in use on fluid power equipment. Linkages are often used in hydro mechanical servomechanisms and in actuator powered machine members used to accomplish desired working functions. Agricultural and construction equipment have many examples of linkages in use with fluid power systems. The motion of hydraulically actuated linkages is usually quite complex, because of the versatility of fluid power machinery. This paper explores some helpful concepts from kinematics to describe motion analysis of linkages. Linkage position, velocity, and acceleration may be covered by the method.

1.4 *Alex Tarasow, Christian Bohn,* Guido Wachsmuth(2012):-

For control of most automatic transmissions with wet clutches (e.g. dual clutch transmission), it is important to know the kiss point with high accuracy. The kiss point describes the value of the control variable for which the friction clutch begins to

transmit torque. Another significant value during the filling process of a wet clutch is the takeoff point. This is the hydraulic pressure which causes the clutch piston to begin to move. This paper presents an innovative approach that enables the joint determination of the kiss point as well as the takeoff point in only one identification procedure.

2. Problem Statement

1] Driving a car with mechanical transmission requires greater degree of skill and application, but in the hydraulic transmission makes it easy.
2] The impossibility of a smooth change of gear ratio which can be acquired through hydraulic operated clutches.
3] In mechanical operated clutch maximum amount of friction occurs which makes an annoying sound while operation this can be covered in this type of clutch.
4] In the manually operated clutch the user has to pour oil for better processing of the linkages.
5] There occurs unpredictable wear and usually tear of the mechanical operated clutch.
6] In today's world where most of the vehicles uses mechanical transmission it doesn't gives accurate result after a particular
7] Period of time, the gears get stuck in between dog gears and lay shaft gears.
8] The main purpose of fitting a hydraulically operated clutch (as in most cars) is to overcome the often high leverage pressure needed to disengage the clutch.

3. Methodology

First we had gone through the survey for the models which are already been patented by the help of social media and have also be visiting some of the companies, foundry where this type of machining is done. Then we had compared all the places we have been searching for our patent then analyze the chosen components and moved for further step. Then we went for the market survey of the components which we have used for our project then some moved for further steps. The following components are;

1. *Clutch lever*
2. *Left hand side clutch pump*
3. *Master reservoir*
4. *Hydraulic hose*
5. *Hydraulic slave cylinder*
6. *bolts*
7. *Copper washers*
8. *DOT brake fluid*
9. *Clamps (U shaped /L shaped)*

Before purchasing we had plan for how and what are we going to fabricate, then should go for purchasing of the components.

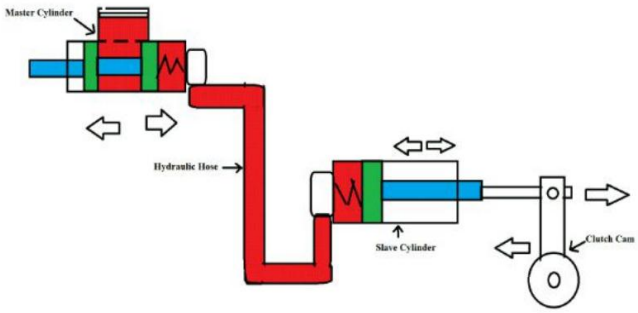

Fig-1 Block diagram

4. Working of Hydraulic Operated Clutch

The hydraulic clutch has the following parts: master cylinder, lever, slave cylinder, clutch fork, clutch release bearing, flywheel, pilot bearing & pressure plate. When you depress the pedal, it pushes a rod attached to the master cylinder. The mechanical pressure is applied by the pedal is transformed to hydraulic pressure. The master cylinder is connected to a reservoir containing hydraulic fluid which will be forced via the brake line in the clutch slave cylinder. Typically, a clutch assembly is provided between a power source, such as an engine or a motor, of a vehicle and a transmission system of the vehicle to provide a smooth shift between gears and to facilitate transfer of power from the power source to the transmission system. The clutch assembly generally includes clutch plates, a clutch release pin, a clutch shaft, and clutch springs. The clutch assembly can be actuated by a clutch actuation assembly, for example, a cable clutch actuation assembly or a hydraulic clutch actuation assembly. The cable clutch actuation assembly includes a clutch lever and a clutch cable. When a driver of the vehicle manually imparts a force on the clutch lever, the clutch cable gets drawn. The clutch cable actuates the clutch assembly by separating the clutch plates from each other, which results in disengagement of the clutch assembly. Accordingly, when the rider releases the clutch lever, the clutch springs bring the clutch plates back to their normal position, thereby re- nagging the clutch assembly. In the engaged state, the clutch assembly facilitates the transfer of power from the power source to the transmission whereas, in the disengaged state, the clutch assembly facilitates gear shifting. In vehicles having a high torque output, a high frictional force is required to maintain engagement of the clutch. This high frictional force is generated by combining clutch plates, having a high coefficient of friction and large contact areas, with relatively high stiffness clutch springs. The high stiffness clutch springs are used for applying a necessary load on the clutch plates. Due to high friction and high load, a large manual force is required to actuate the clutch assembly and to separate the clutch plates. The force required to disengage the clutch increases with the separation of clutch plates due to increasing relative compression or extension of the clutch

springs. The manual force required also increases as the size of the clutch plates increases, for example due to use of engines with high power output. However, the force that can be applied by the rider is limited. Additionally, the clutch cable has parasitic drag, is prone to degradation especially when exposed to high load applications, and its operation requires frequent adjustment of wear. Therefore, usually, for high torque/high power output, a hydraulic clutch actuation assembly is used. The hydraulic clutch actuation assembly includes a manual clutch lever, a master cylinder, a slave cylinder, and an expandable hose adapted to transfer hydraulic fluid between the master and slave cylinders. When the clutch lever is retracted, the fluid inside the two cylinders gets pressurized and acts upon the clutch plates, thereby disengaging the engine from the transmission. As a result, better leverage ratio, and better clutch lever feel are obtained, but by making the overall assembly more expensive than the cable clutch actuation assembly. Additionally, the response of the hydraulic clutch gets affected because of the use of expandable hose and resultant transmission losses.

5. Design of Master Cylinder

Calculations for designing left hand side pump assembly.

Assumed data-

*Force required to operate lever is **6kg**.*
Stroke(S) =15.6mm
Force required=6kg
$= 6*9.81=$ ***58.86 N***

To prevent buckling, let us calculate the minimum piston rod diameter

$$K = (3.14^2EI)/(FL^2)$$

Where,

E = modulus of elasticity, kg/cm^2
= $2.1*10^6$ kg/cm^2 for steel
I = $(3.14*d^4)/64$ cm^4 (for solid circular piston.)
d = rod diameter (cm)
L = buckling length (cm)
F = Factor of safety =3.5 assume

So,

K = 6 kg

*L= 2*15.6*

L =3.12 cm

K = $(3.14^2 EI)/(FL^2)$

$6 = \{(3.14^2*2.1*10^6)/3.5*3.12^2\}*\{3.14\ d\text{^}4/64\}$

$d^4 = 2.0092*10^{-4}$

***d** = 0.119058cm=* **1.1905 mm**

We have assume rod diameter on safe side= ***2 mm***

*Assume **5 bar** maximum pressure*

Effective area (A_f) = F/P
$= 6*9.81/5*10^5$
$= 1.1772*10^{-4}$ m^2
= **117.72 mm^2**
$A_f = 3.14\ D^2/4$

D = 12.25mm Piston diameter.

Let's assume spring force(F_S) = 9.81 N

F_A = 58.86 N
F_S = 9.81 N

***Effective force** (F_E) = F_A-F_S*
= **49.05 N**

***Workdone** = F*S*
$= 49.05*(15.2*10^{-3})$
= **0.7456 Nm**

Lets required velocity V =3 cm/sec

***Flow** (Q) = A*V*
$= \{3.14*D^2/4\}*V$
$= \{3.14*12.25*10^{-3}/4\}*\{3*10^{-2}\}$
$= 3.534*10^{-6}$ m^3 /sec
***Q =* $3.534*10^{-3}$ lit/sec**

6. Conclusions

We mounted the hydraulic clutch in Honda stunner got idea from super bike hydraulic clutch. After mounting all parts and components we tested the bike. We found that it has reduced effort required for transmission of gear and very less noise while meshing the gear is found. As compare to mechanical clutch the effort required is very less because mechanical or cable operated clutch requires more pressure for engagement and disengagement of clutch. As we know hydraulic clutch is self lubricating, less number of moving parts ,smoother, light in weight and mainly very easy to operate and requires very less effort. So we finally conclude that hydraulic clutch is very efficient and easy to operate then mechanical, but it is quietly expensive. Mounting the hydraulic clutch is very useful good and efficient. Additionally, combining both the typical mechanical and hydraulic operations the system is easy. The clutch actuation assembly of the present subject matter is compact, efficient, and economical. Moreover, manual force required to shift gears is low, thus reducing driver fatigue.

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