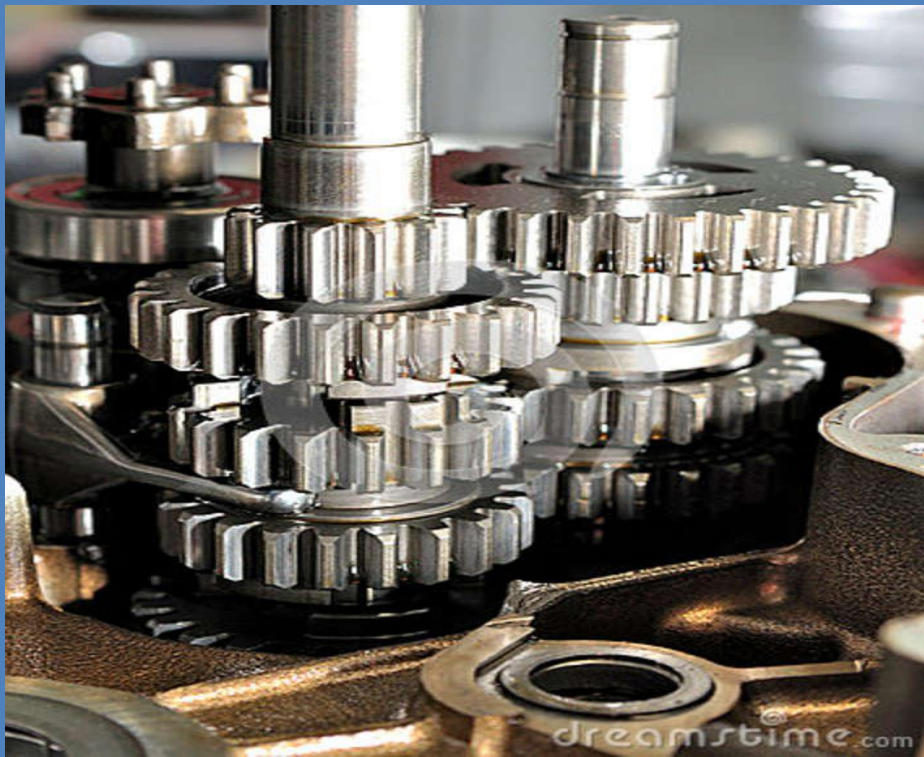


DEVELOPMENT OF AUTO GEAR TRANSMISSION WITH USE OF MAGNETIC CLUTCH



Patel Bhavik R(10ME10)
Patel Chandresh J(10ME11)
Patel Jaimin M(10ME12)
Patel Drumil P(10ME13)

Guide: Mr. Manoj Rajpara

Department of Mechanical
engineering,
Smt. S. R. Patel Engineering College,
Dabhi,Unjha-384170

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Smt. S. R. PATEL
ENGINEERING COLLEGE

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Introduction.....

There is already invention has been done of gearbox for motorcycle for transmit the torque from engine crankshaft to the rear wheel of the motorcycle. The gearbox is used for increase or decrease the torque as required for motorcycle riding positions. The gearbox increases the required torque for start the ride and put the motorcycle into motion. After the starting the running of the motorcycle there is no need of high torque so now gear box is transmits the optimum torque to the rear wheel at high speed. For the operation of gearbox and shifting the gear there is need of some effort of driver of motorcycle. There is foot paddle in the left side of the engine near to left leg for shifting the gear in most of the motorcycles. And there is clutch mechanism for engage-disengage between engine crankshaft and input shaft of gearbox. So for flawless and jerk less driving of motorcycle there is need of timing in operating the clutch and gearbox. Without experience of driving motorcycle and shifting its gear driver cannot drive motorcycle jerk less. So there is need of auto transmission for rapid shifting of gear and increase the efficiency of engine.

The topic of current interest in the area of controller development for automatic transmissions with a finite number of gearshifts which transmits the gears automatically with respect to speed. Gearshifts in automatic transmissions involve a change in the power flow path through the transmission. Advantages of these automatic transmissions include simplicity of mechanical design and savings in transmission weight and size, which are beneficial in terms of fuel economy and production costs.

Aim of Project...

Our main aim of project is modify the motorcycle engine by replacement of manual gear transmission to automatic gear transmission which is operate by the application of magnetic clutch and DC motor. And by this invention rise the comfortability of rider by modify the engine.

Till Now What We Have Done!!!!

▪ **Final selection of body of engine...**

We have seen the many types of engine and finally select the bike engine of Hero CD100 and decide to do experiment on it.

▪ **Final selection of magnetic clutch...**

For the auto transmission in order to gain variable speed that's required continuously and rapid engagement and disengagement arrangement between engine crankshaft & input shaft of gearbox and so for this reason we decide to replace the friction clutch by magnetic clutch.

▪ **Final selection of required engine parts...**

For our experiment required some engine suitable parts like the gearbox arrangement gear shifter and clutch arrangement that we select. We choose most of all engine parts

▪ **Final selection of exact mechanism...**

For improve the riding efficiency with more comfort ability of motorcycle in variable driving condition. so as our aim to reach the engine as requirement we choose our new idea of engine with the application of magnetic clutch and DC motor.

▪ **Final selection of high torque DC motor...**

In our experiment we want to give the torque to the paddle attached with the input shaft of gear shifter fork for changing the gear by automatic according to speed variation and for that required some special mechanism like hydraulic, pneumatic or DC torque motor and we decide to use the DC torque motor because DC torque motor is capable to give sufficient torque for rotating the fork of shifter shaft for gear shifting.

▪ **Final selection of all configuration and model...**

As per our acceptance for the project that main oriented on the automatic variable transmission in the motorcycle engine. so as per calculation of requiring torque for the magnetic clutch and DC torque motor for shifting gear automatically we choose proper magnetic clutch and DC torque motor for the proper engine.

Problems That We Had Faced Till Now!!!

- There are many options for selection of engine body among them we select hero CD100 engine for experiment..
- For effective rapid operation of our project we choose magnetic clutch for engagement and disengagement between crank shaft and input shaft of gear box.
- There is a problem in the fitting of magnetic clutch into the original engine body of hero CD100 so at that moment we have to make some changes in to the standard engine body of CD100.

How actually the project will come into picture!!!!

▪For improve efficiency...

Present time in automobile motorcycle that general in running use by people almost use the manual gear shifting mechanism and in that mechanism some time at low speed high gear running for example suddenly from the high speed to brakes and vehicle come low speed and try to run at low speed and not shift the gear lower that time more power consumes for the rotating the high gear ratio and chance for brake gears and decrees the engine efficiency for that problem solve we are trying to automatic gearing by which at low speed gear shift automatically and save the power which consumes by engine and increase the efficiency.

▪For improve average...

according to previous problem the power saving mode come in engine and at small amount of input fuel increase the output in term of long way travelling.

▪ **Reduce the driver effort...**

In manual gear shifting arrangement every time for shifting the gear required human effort and we also try to reduce it. so there is not clutch lever in the driver's hand so he is free from the operating the clutch lever.

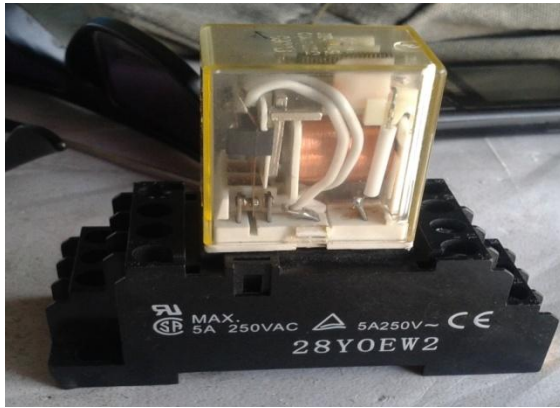
▪ **Automatic clutch operation for driver conformability...**

For the gear change of shift from lower to higher or higher to lower must in gear box disengage required and for that engage and disengagement clutch is work but we are using the magnetic clutch by which that clutch is also work automatically according to speed and give batter conformability to driver from the clutch arrangement.

Important Components of this project...

In this project working and model some extra devices are used which are not generally use in the motorcycle and for gear shifting.

1. Magnetic clutch:
2. Relays
3. High torque motor(wiper motor)



Relay



Wiper motor



Magnetic clutch



DC motor

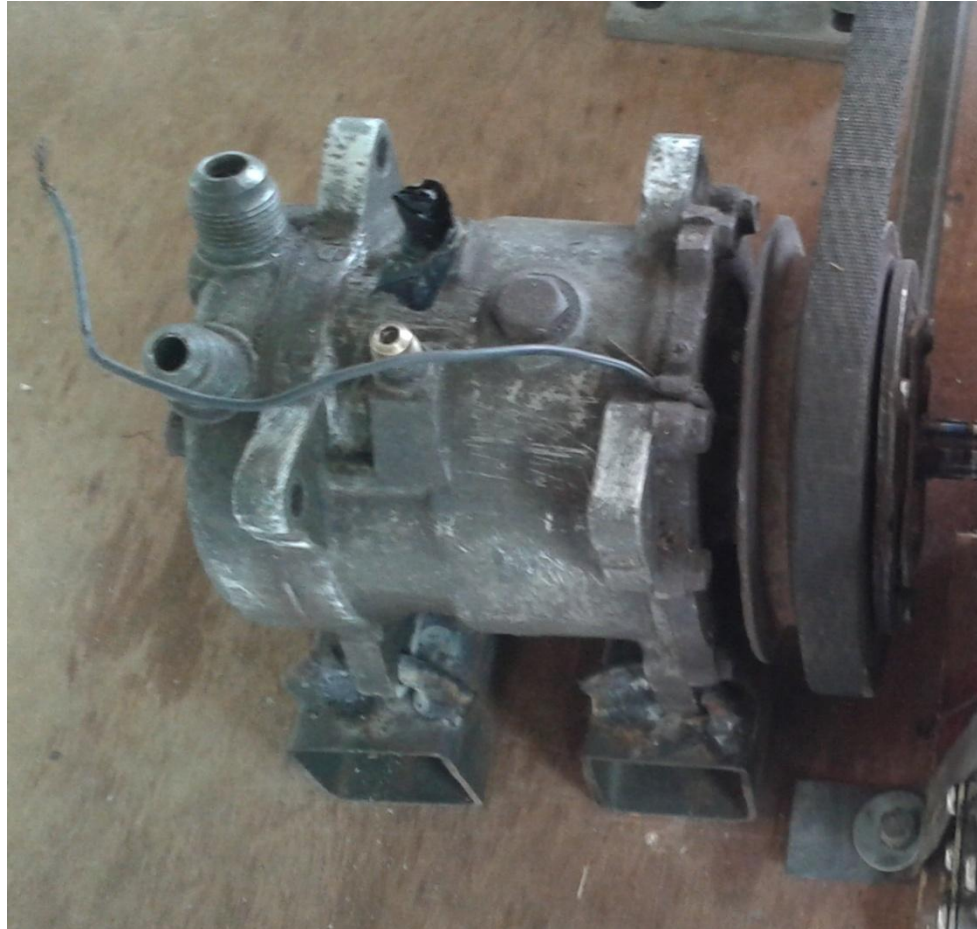
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1. Magnetic clutch

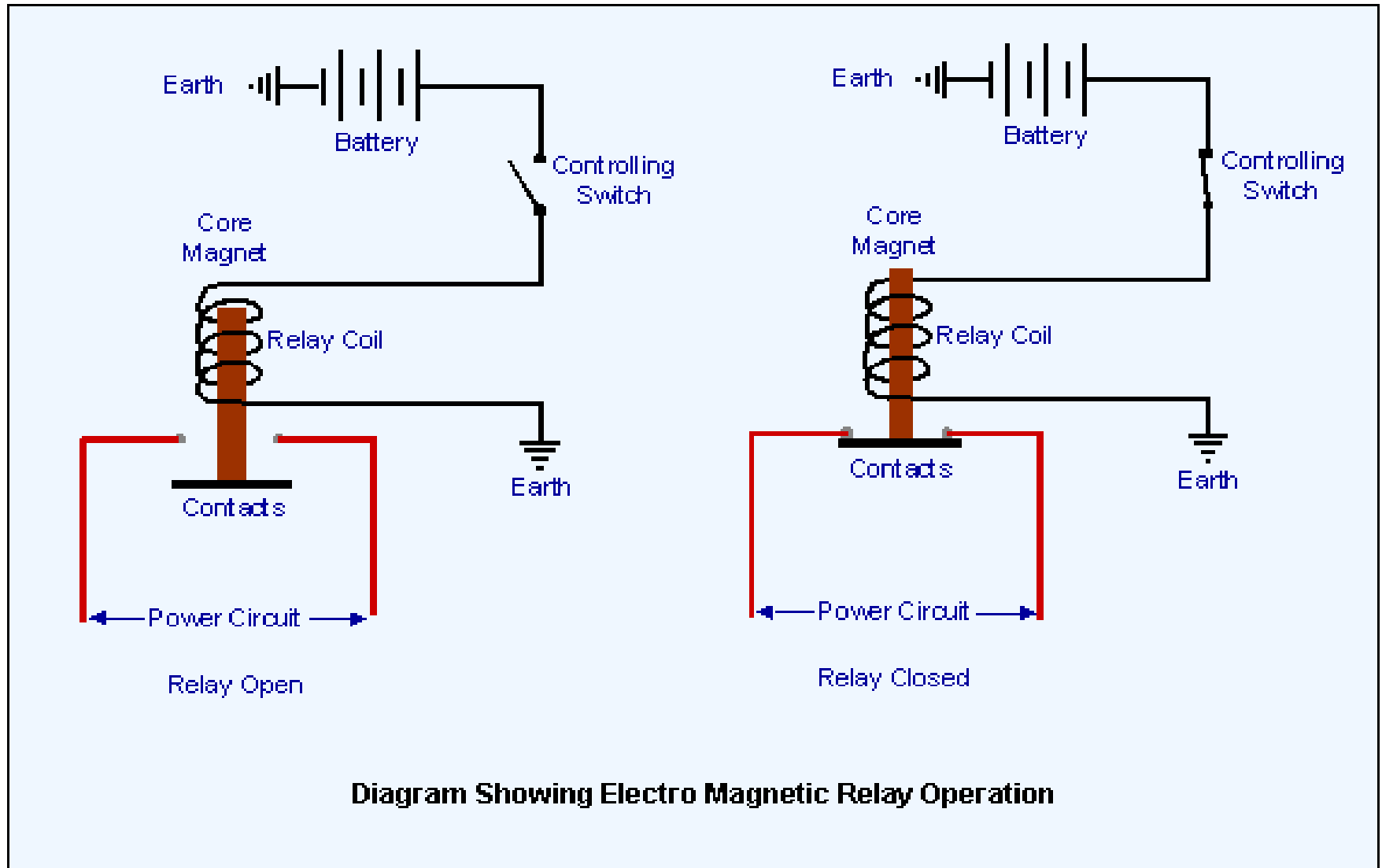


In this experiment we use the magnetic clutch at replacement of friction clutch in manual gearing arrangement. Which is operate automatically and work by sensors which operate on motion sensing. the computer control programming is used for working of sensors and magnetic clutch simultaneously.

For this type of magnetic clutch we take that clutch from the car AC compressor because it have sufficient magnetic field which can run the engine power as a driving.



2. Relays



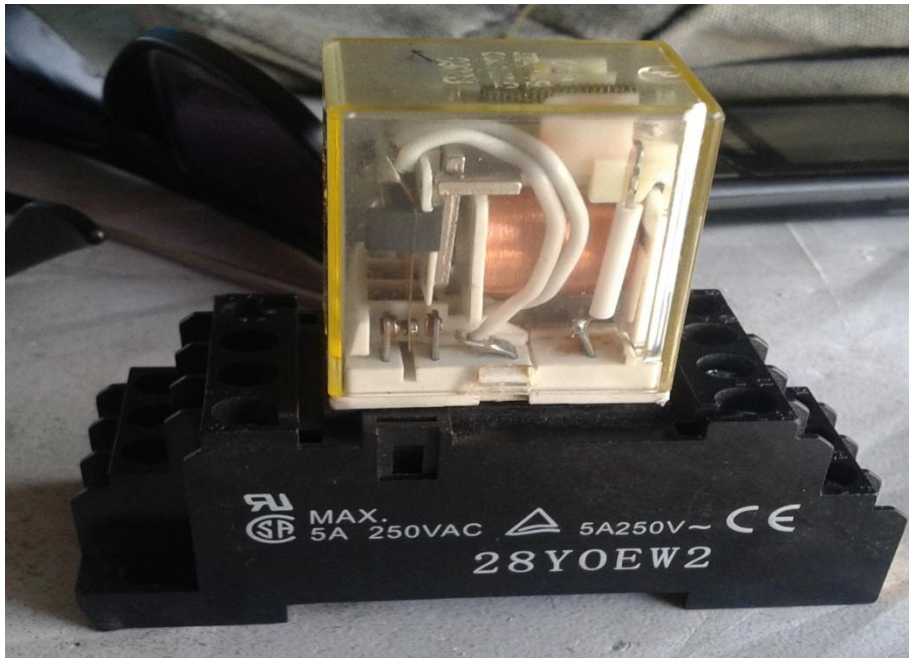
Relays come in various configurations for their switch contacts, as well as different DC voltages for to operate their coil. They may be as simple as an on/off switch or as complex as integrating several switches into one unit. In a "double-pole" configuration, one switch terminal toggles between two different output terminals. Regardless of the configuration, each switch on a relay can be "normally open" (NO) or "normally closed" (NC); that is, when the coil is at rest and not energized, the switch contacts are NO or NC. In an open circuit, no current flows, similar to a wall light switch in the "Off" position. In a closed circuit, metal switch contacts touch each other to complete a circuit, and current flows, similar to turning a light switch to the "On" position.

Rated load : 12-28VDC

Coil resistance : ≤ 100 m ohms

Coil rated voltage : 3-24VDC

For two way electricity supply there is requirement of two pole relay with 24 voltage like the image.



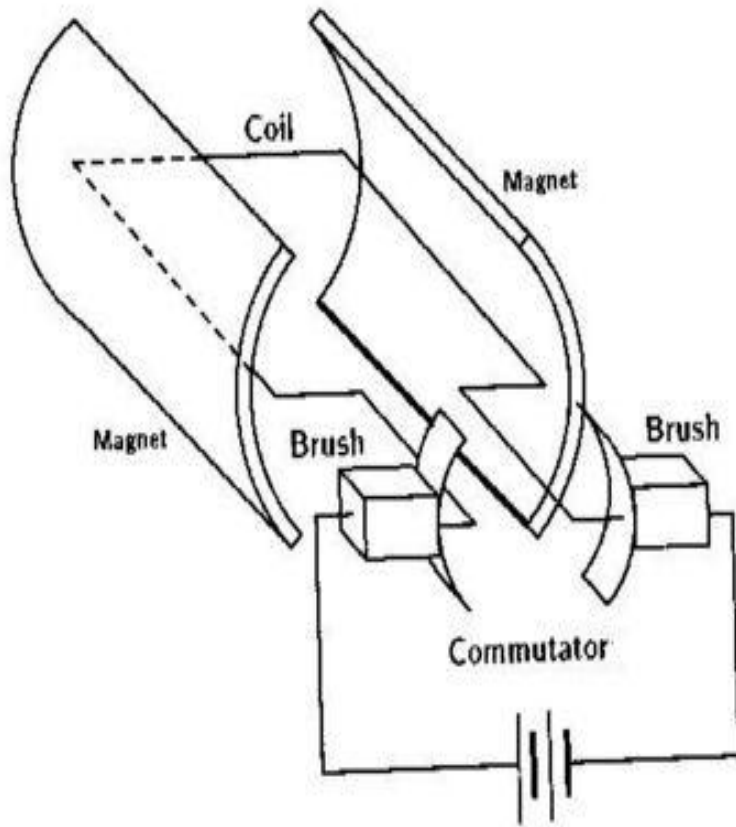
3. High torque motor(wiper motor)

For the gear shifting of engine the foot shifter is replaced by high torque motor for that requirement we use the car wiper motor.



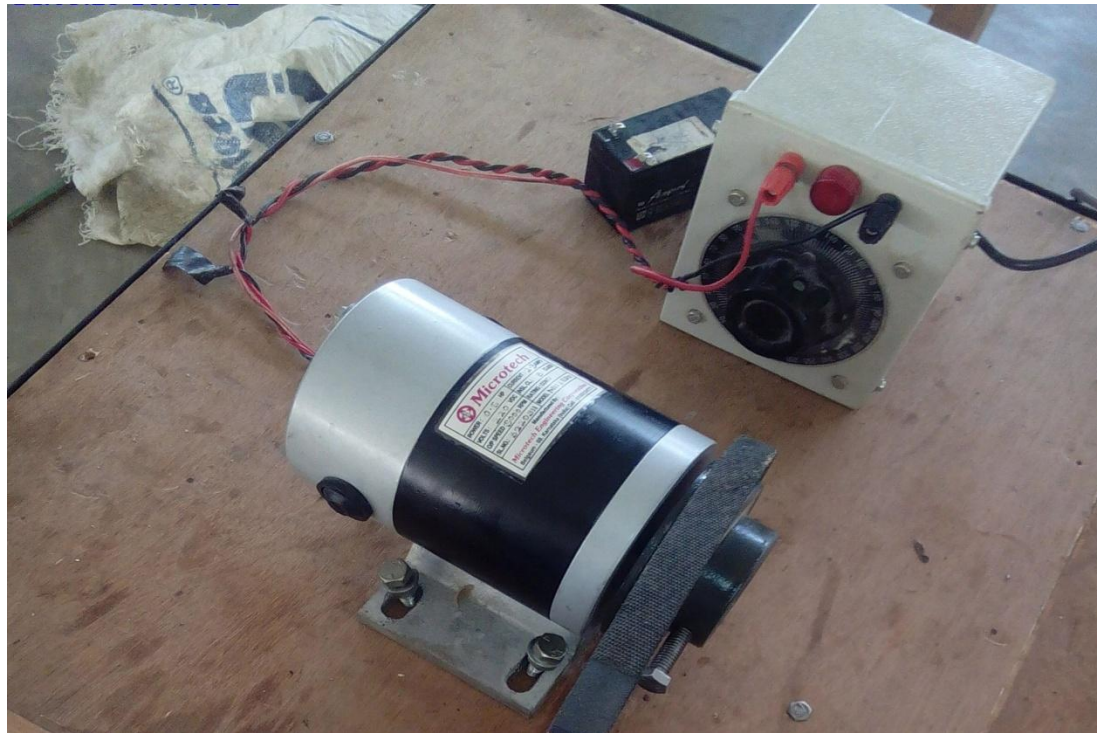
Torque:100 N.m
Speed: 25-35rpm

4. DC Motor



The DC motor has two basic parts: the rotating part that is called the armature and the stationary part that includes coils of wire called the field coils. The stationary part is also called the stator. The armature is made of coils of wire wrapped around the core, and the core has an extended shaft that rotates on bearings. The ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the commutator, and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine. The stator coils will be referred to as field coils they are connected in series or parallel with each other to create changes of torque in the motor.

For the power transmission to the input shaft of engine through magnetic clutch is done by 0.5 HP DC motor by belt drive and pulley mechanism. This is varying speed motor which maximum speed 5000 rpm which is control by regulator.

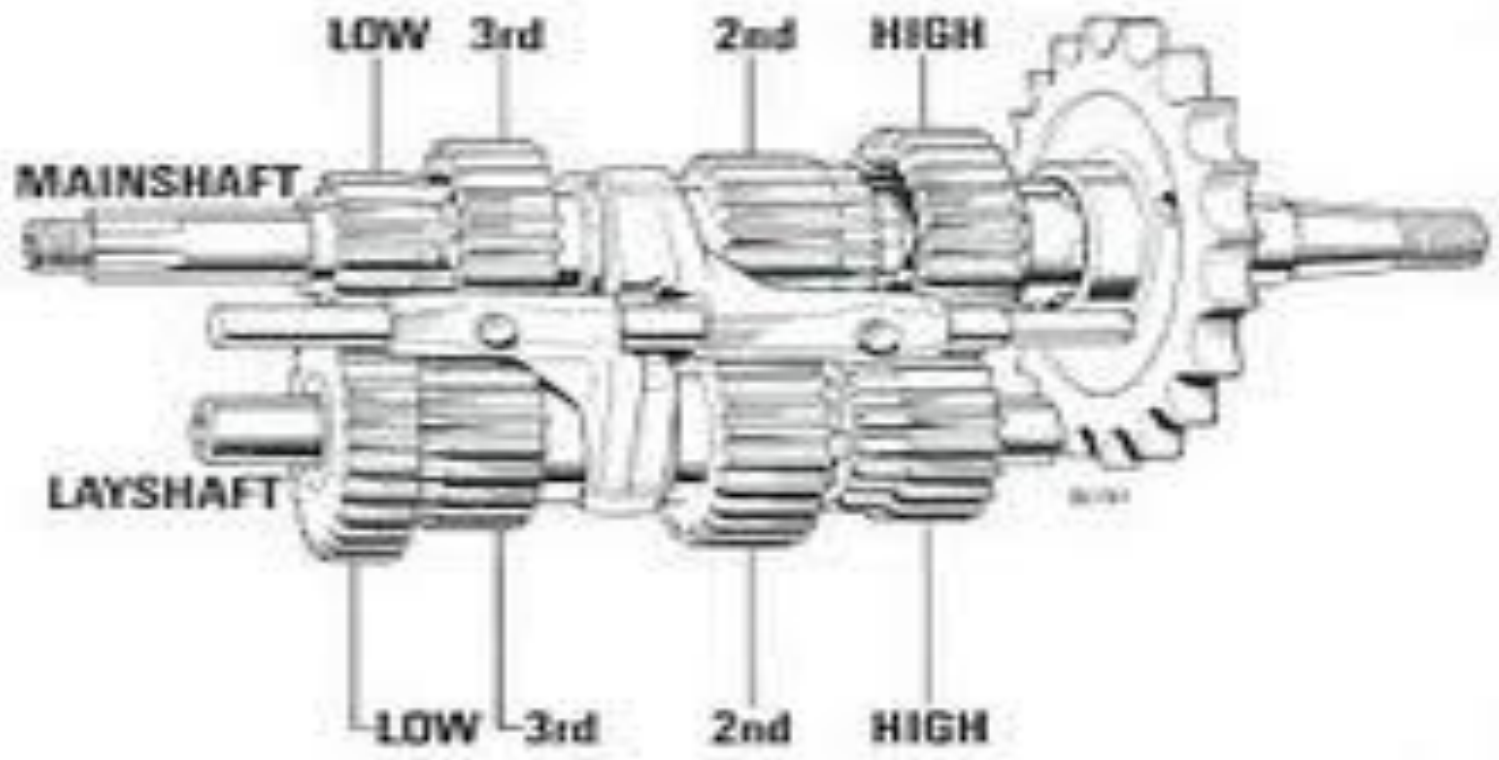


Torque calculations of Gearing...

We have motorcycle engine gear of 4-speed manual transmission of hero CD100 .For the proper measurement of how much torque required to the magnetic clutch from engine crankshaft .

Consider the gear numbers approximate according to smaller diameter to bigger diameter and give the number from 1 to 8 which are placed in actual gearbox.

That gear box gear arrangement shown in figure and according to that we require the gear ratio in term of torque or speed and it is calculated by the equation which calculation given in next slide. And all dimension and number of teeth of gears are including in table.



Gear box arrangement

Number of Gear	Outer diameter of gear (d) In mm	Number of teeth (N)
1	23.3	11
2	33.4	17
3	43.10	22
4	43.6	22
5	47.10	24
6	47.60	26
7	56.4	29
8	66.4	34

Table. 1

In Hero CD100 engine all gear shift lower to higher only one side and its arrangement shown in figure.

In first gear 1 of input and 8th of output gear engage and power transmit to input to output. So there for required torque ratio of T1/T8.

Thus for all gear arrangement torque calculation done by same equation.

$$T_1/T_2 = d_2/d_1 = N_2/N_1$$

By this equation we can find the all gear ratio from input to output power in term of torque or in term of rpm because Torque is directly proposals to the rpm. And that calculated value insert in table.

Torque ration of gear transmit by using number of teeth

Gear engagement	Input (engine torque)	Output	Torque ratio equation	Calculated ratio
1 st	T_1	T_8	$T_1/T_8 = N_8/N_1$	3.09
2 nd	T_2	T_7	$T_2/T_7 = N_7/N_2$	1.70
3 rd	T_3	T_6	$T_3/T_6 = N_6/N_3$	1.56
4 th	T_4	T_5	$T_4/T_5 = N_5/N_4$	1.09

Table. 2

By this calculation we can observe that the from the lower to higher gear shifter engagement the power transmission ratio increase.

Speed range of gearing and vehicle...

Now here we calculate the range of speed of gearbox output power and range of all minimum and maximum rpm of the gear box shaft in every gear mashing condition...

If we consider the speed for first gear is 0 km/h to 20 km/h for second 20 km/h to 30 km/h for third 30 km/h to 45 km/h and for greater than 45 km/h take forth gear mashing.

Here, we have the range in term of speed in km/h now converting the vehicle speed in rpm for that use the equation.....

$$N = V * 60 / 3.14 D$$

where N= speed in rpm

V= speed in m/s

D= tire diameter in m

Take, D=0.80 meter tire diameter

Thus by using this equation we can find the our speedometer speed km/h can convert in revolution per minute (rpm)

We have the gearbox output shaft diameter is 16.40mm. we want the speed in rpm of the output rear but all output gears are fixed on shaft so the shaft speed is also speed of the gear and that also calculate the equation by using the ,

$$N=V*60/3.14 D$$

But here D is diameter of the output shaft and it is 16.40mm.

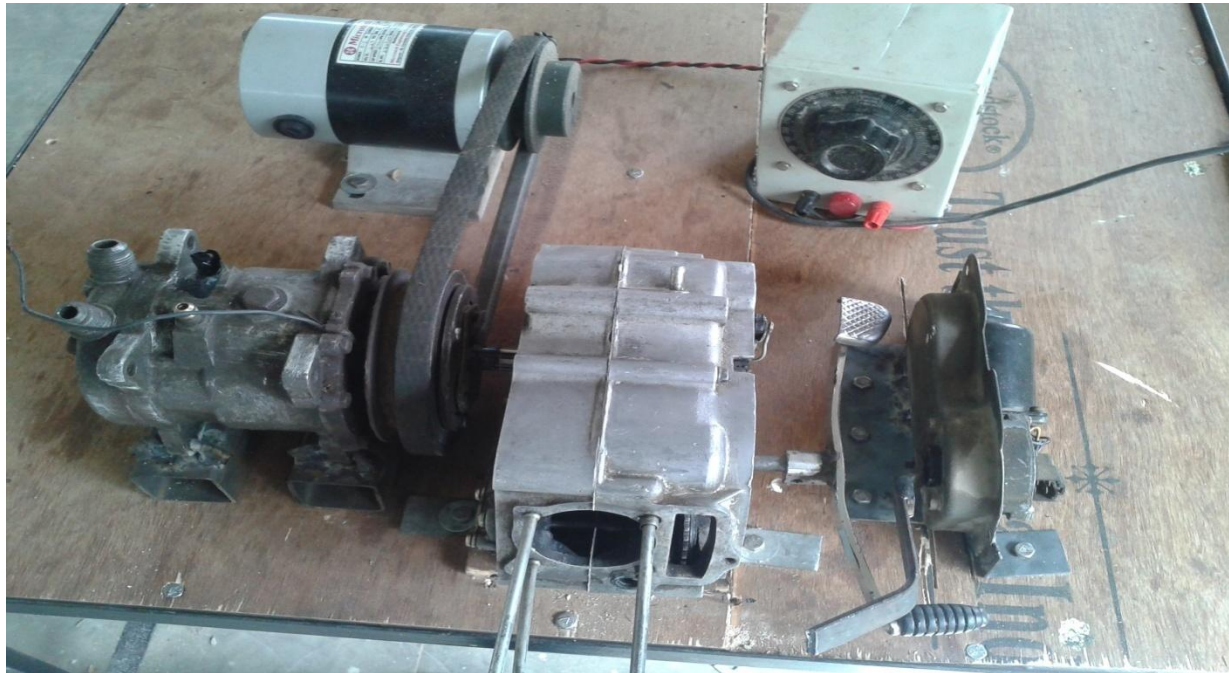
This all calculated range of gear is shown in table 3.

Gear engagement	Speed on vehicle in km/hour.		Speed on vehicle in rpm		Speed on output shaft of gear box in rpm.	
	minimum	maximum	Lower	Higher	Lower	Higher
1st	0	20	0.00	132.314	0.00	1308.58
2nd	20	30	132.314	199.47	1308.58	1972.75
3rd	30	45	199.47	298.70	1972.75	2954.14
4th	45	120	298.70	796.88	2954.14	7881.14

Table. 3

Arrangement of all components...

According to image, power is supply for the driving to the engine DC motor with 5000rpm is attach to the magnetic clutch through belt drive. Magnetic clutch is attach front to the engine with 5mm gap. And engine and wiper motor connect with one small link mechanism for the gear shift.



Working of this model...

There is some automation is carried out by computer programming and IC relay electric circuits.

First the electric power is supply to DC motor which rotate the magnetic clutch. For the driving of the engine the magnetic clutch is engage with input of engine plate and for that 12 volt DC current apply to the clutch and engine start to run. According to the speed variation that variation sense by the proxy sensor and send the signals to clutch & stepper motor at the time of disengage of clutch that time gear is shift by motor mechanism.

Programming of this experiment.....

- For the automation of gear transmission require computer or PLC circuit and programme coding. At the proper time clutch engage-disengage at the time of gear shift, this type of proper timing and automatic working require code. And this type of work programme done, which is describe bellow....


```
Option Explicit
Dim Value As Integer
Dim PA As Integer
Dim rs1 As Recordset
Dim a As Integer
Dim inC As Integer
Dim ca As Integer
Dim da As Double
Dim ab As Integer
Dim k As Integer
Private Sub Command1_Click()
End Sub
Private Sub Command4_Click()
Text5 = Inp(&H379)
End Sub
```

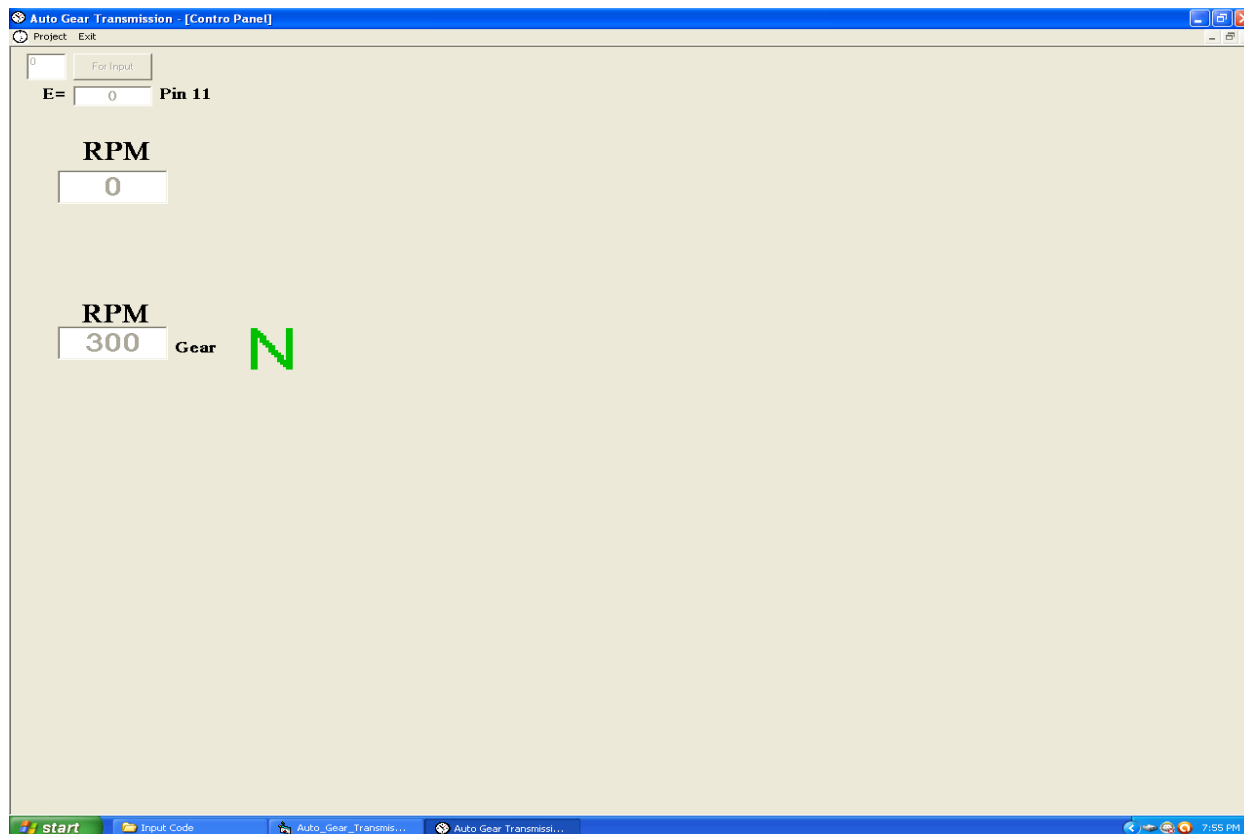
```
Private Sub Form_KeyDown(KeyCode As Integer, Shift As Integer)
    If KeyCode = vbKeyDown Then
        Text1 = Val(Text1) - 1
        k = Text1
        If k = 310 Then
            Out PA, 2
            Timer2.Enabled = True
            abc.Caption = "N"
        ElseIf k = 350 Then
            Out PA, 2
            Timer2.Enabled = True
            abc.Caption = "1"
        ElseIf k = 400 Then
            Out PA, 2
        End If
    End If
End Sub
```

```
Timer2.Enabled = True
    abc.Caption = "2"
ElseIf k = 450 Then
    Out PA, 2
    Timer2.Enabled = True
    abc.Caption = "3"
End If
```

```
ElseIf KeyCode = vbKeyUp Then
    Text1 = Val(Text1) + 1
    k = Text1
    If k = 310 Then
        Out PA, 1
```

```
Timer1.Enabled = True
  abc.Caption = "1"
  ElseIf k = 350 Then
    Out PA, 1
    Timer1.Enabled = True
abc.Caption = "2"
  ElseIf k = 400 Then
    Out PA, 1
    Timer1.Enabled = True
  abc.Caption = "3"
  ElseIf k = 450 Then
    Out PA, 1
    Timer1.Enabled = True
  abc.Caption = "4"
```

from this programmable coding generate this type of page in which E =number of detect per second. First box of rpm is measured by the proxy sensor but there is some technical problem for that we set up the second rpm according to increase that rpm change the gear and operate the clutch.



Problem faced.....

- At the engine input actually in real application done by the piston and cylinder arrangement but in this modal and for just experiment that is so difficult to handle high vibration and it's mounting on table so used the DC motor for the input power.
- According to above description speed of engine shaft is rotate at high speed but that speed is difficult to handle on table mounting as well as motor for that reason we take limit up to 1000 rpm.
- For the gear shifting by the wiper motor when gear forward or back but foot paddle require to back small distance but this motor can't reverse automatically without power supply for that sufficient time reverse connection of motor also require but that problem difficult to provide timing in controlling program.
- Because of some limitation of proxy sensor fluctuation is arise in sensed speed or rpm which is problematic for programming.

Real world application...

- There is already research carry on automatic transmission in bike.

ex. TVS (two wheeler company) already continue search on CVT(continues variable transmission) but we try to invent one step ahead than TVS.

- The auto transmission system is most of used in generally cars but in the motorcycle this is new experiment because there are some motorcycle engine invented with auto transmission but it is not liked by motorcycle riders so our project is to make the auto transmission in motorcycle user friendly.

- Without clutch lever the driver is free from operating the clutch so he has free left hand.

Scope of project...

- If there is success to run the project as expectation then there is possibility of auto transmission in bike with advance modification...
- Our project is for getting revolution in shifting of gear automatically in bike...

Advantages.....

- Fuel efficient.
- Simple driving control.
- Reduce fuel consumption.
- Less fatigue to driver.
- Noiseless gear shifting.
- No shocks or jerky during driving.
- Due to automatic gear change, smooth running under all conditions.
- Improved acceleration and hill climbing.
- Increase life.

- Easier to drive in stop-and-go traffic and available in most cars, an automatic transmission has definite benefits
- The main benefit of automatic transmissions is that they are simply easier to use.

Future scope.....

- Used wiper motor for shifting the gear by applying force on the foot shifter. There is option of use of other high torque more powerful more efficient motor. For the better operation of gear shifting so there is possibility of more quick operation of automatic gear shifting.
- If the high performance proxy is utilized to sense the rpm of motor than there is increase in accuracy of automation of project. We use regular class low performance proxy sensor which has difficulty of sensing the rpm above the 1000 sometimes.
- There is requirement of proper mounting of project elements like magnetic clutch, wiper motor, varying speed motor. Otherwise it creates more noise and vibration. If there is arrangement of proper mounting of such elements than there is possibility of low noise and vibration.

Conclusion.....

- Until this project work we conclude that according to today's driving requirement automation is most suitable for the two wheel vehicle.
- By using some extra devices like use of magnetic clutch rapid operation of engagement and disengagement possible for automation is possible and reduce the human effort and fuel consumption also.
- And after this invention inexperienced person also drive the vehicle easily because there is not required proper timing for gearing, thus give better comfort ability to driver.
- Also this mechanism gives the safety to the gear box from failure. This invention has also some drawbacks like they require the proper safety for electric devices in engine because in engine heat generate and it causes the short-circuit also.

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THANK YOU.....