Tiger Cub Transmission

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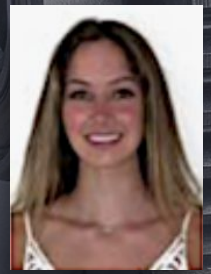
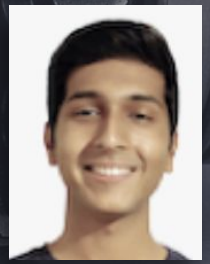
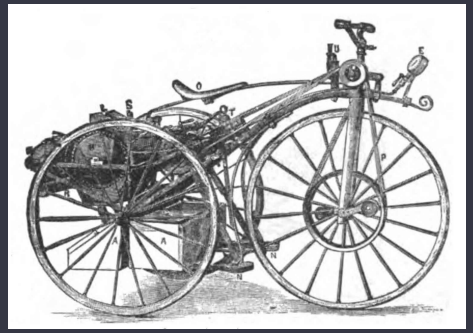


History of the Transmission

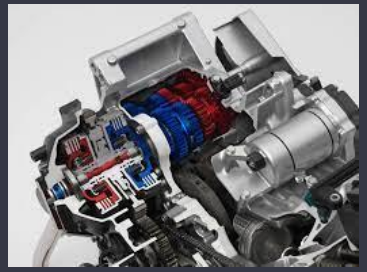


The First Motorcycle

The Transmission

- The first motorcycle only had one gear and could only reach 25 mph. It also needed pedal assistance from the rider when going up hills.
- In the 1920’s and 30’s motorcycle engines were adjusted and now had 3 speeds or gears which created more of a need for a transmission
- As motorcycle racing developed motorcycles came out with as many as 12 speeds
- Motorcycles continued to increase in speed and making more gears necessary
- There are two types of transmissions

Two Types of Transmission



Automatic

Pros
- Good for beginners
- Better acceleration
- Convenient in traffic

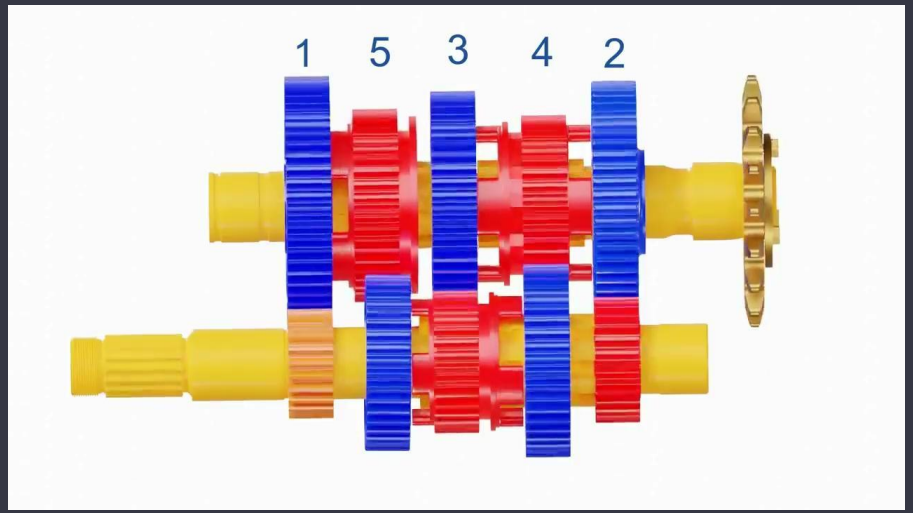
Cons
- More expensive
- Less control
- More fuel
- More maintenance

Manual

Pros
- More engaging
- Safer
- More reliable

Cons
- Pulls focus from the road
- Higher chance of stalling

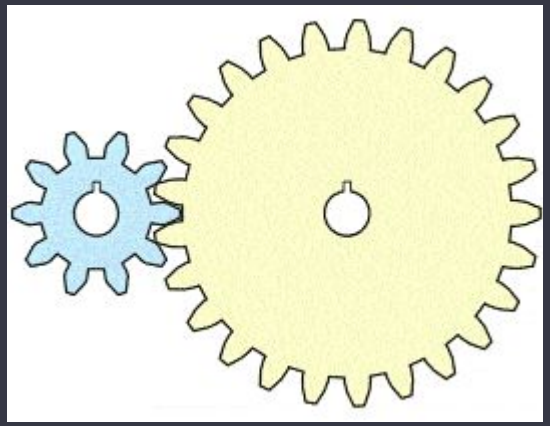
How It Works



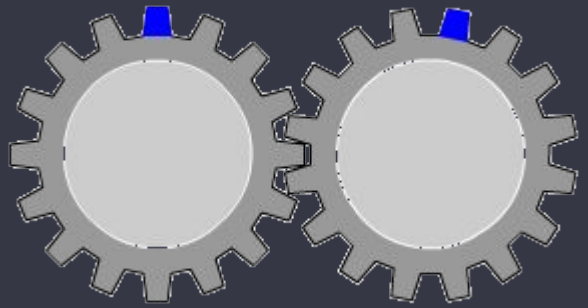
- Most vintage motorcycle transmissions have constant-mesh, sequential gearboxes
- Different torque and power needs
- Output shaft have gears that revolve freely around while those on the layshaft are fixed
  - Input shaft is connected to clutch and crankshaft
  - Output shaft connected to the backend
- The shifting forks are connected to sprockets and shift sideways to engage specific gears to produce a particular gear ratio

An Overview of Gears

A smaller wheel can rotate a bigger wheel easier but with less power



A larger wheel can rotate a bigger wheel with more power but it takes more work



THINK OF… BIKING UP A HILL OR IN A CITY

VS BIKING IN A BIKE RACE

Trade Off Between Speed and Torque

GEAR NUMBER	TRANSMISSION RATIO	ENGINE RPM AT CONSTANT SPEED
4th - “High Gear”	1x	4,000
3rd	1.3x	5,200
2nd	2x	8,000
1st - “Low gear”	3x	12,000

A 1:3 ratio requires three times as many RPMS to get to same speed as a 1:1

Gear Ratios

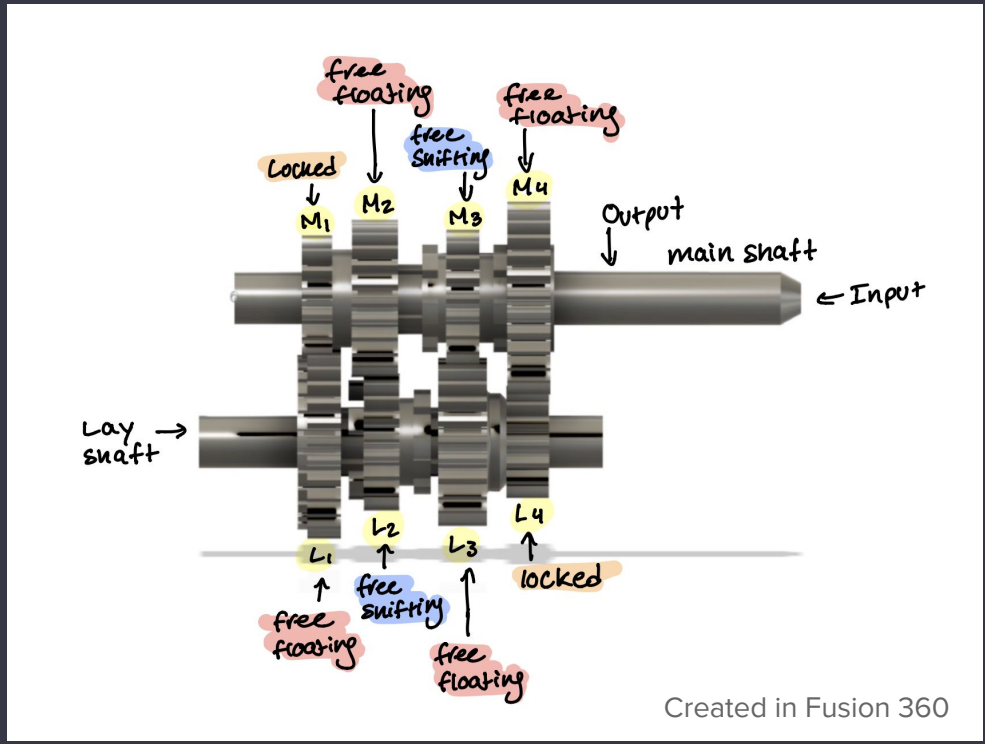
Certain vehicles lend themselves to a preference towards a closer or smaller gear ratio depending on whether it needs more speed or torque

Transmission type:		LOW (FIRST)	THIRD	SECOND	TOP (FOURTH)
Wide	Mainshaft	16	25	20	29
	Layshaft	29	20	25	17
Standard	**Mainshaft**	**16**	**25**	**20**	**28**
	Layshaft	**29**	**20**	**25**	**17**
Close	Mainshaft	16			
	Layshaft	29			
Extra Close	Mainshaft	16			
	Layshaft	29			
Ultra Close	Mainshaft	17	23	20	25
	Layshaft	28	22	25	20

Good for our needs because easy to stop/start and fast high speed not required

Gears

- Mainshaft and layshaft each have four gears
- M1, M3 are coupled to the mainshaft
- L2, L4 are coupled to the layshaft
- M2, M4, L1, L3 all rotate independently
  - Unless engaged by M3, L2 respectively
- Input power comes in through M1, M3
- Output power is sent out through M4
  - Connected to output sprocket (not shown)



CALCULATION OF GEAR RATIOS

First Gear: M1 - L1 (L2) - L4 - M4

29 ÷ 16 ÷ 17 × 28 = 203/68 = 2.985

Second Gear: M3 - L3 (L2) - L4 - M4

25 ÷ 20 ÷ 17 × 28 = 35/17 = 2.059

Third Gear: M2 (M3) - L3 - L4 - M4

20 ÷ 25 ÷ 17 × 28 = 112/85 = 1.318

Fourth Gear: M4 (M3)

M4 is directly driven: 1

Mainshaft	**16**	**25**	**20**	**28**
Layshaft	**29**	**20**	**25**	**17**

CALCULATION OF TOP GEAR (4th GEAR) MAX SPEED

minutes in hour

$$\text{Motorcycle Velocity} = \text{rear wheel speed} \times \text{wheel circumference} \times \frac{60_{min}}{63360_{in}}$$

inches per mile

$$\text{Rear wheel speed} = \text{engine speed} \times \frac{\left(\frac{\text{engine sprocket}}{\text{clutch basket}}\right)}{\text{Gear Ratio}} \times \frac{\text{output sprocket}}{\text{wheel sprocket}}$$

calculated:

$$RWS = 6500\,RPM \times \left(\frac{19}{48}\right) \div 1 \times \left(\frac{17}{46}\right) \cong 950.86\,RPM$$

Now calculated Motorcycle Velocity:

$$MV = 950.86\,RPM \times 73.83\,in \times \frac{60\,min}{63360\,in} \cong \boxed{66.48\,mph}$$

speed is dependent on gear ratio!

Power Curve

- As engine rpm climbs, the power does as well for a given torque
- Can inform about the characteristics of the motorcycle
  - Tradeoff: more power at a high RPM would make stopping and starting difficult
- Gear ratios come into play

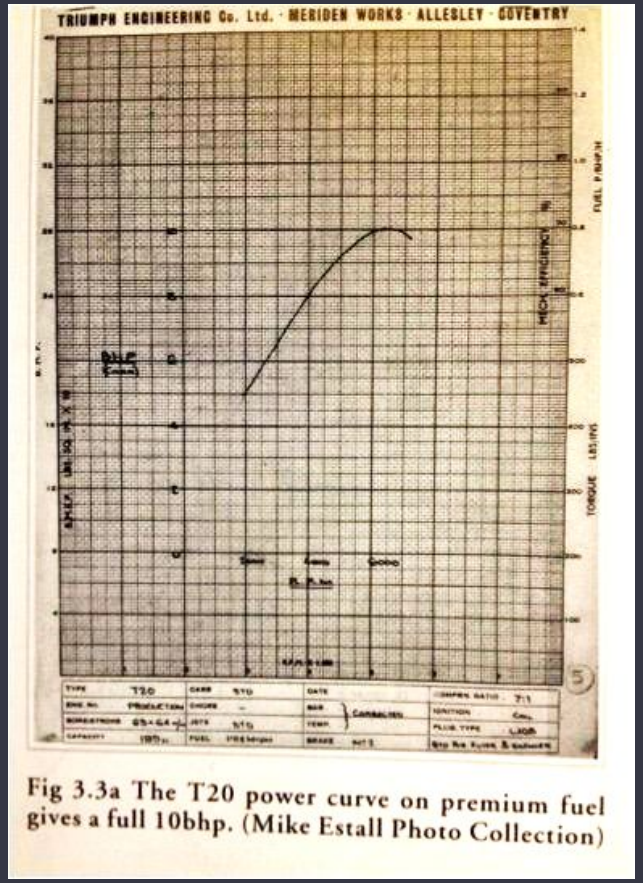
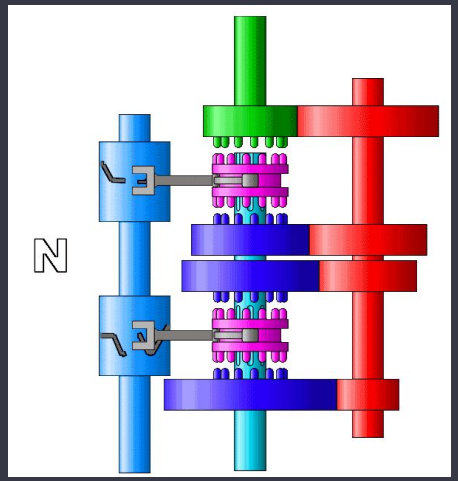


Fig 3.3a The T20 power curve on premium fuel gives a full 10bhp. (Mike Estall Photo Collection)

Tiger Cub

Clutch Lever. On the left side of the handlebar. The clutch lever should not be operated when the machine is in motion except to change gear and when bringing the machine to a halt.



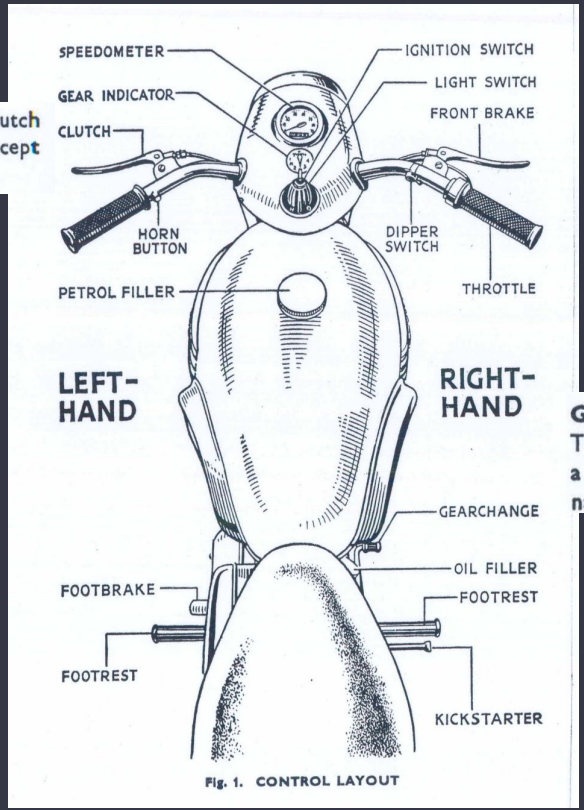


Fig. 1. CONTROL LAYOUT

Gearchange. A small foot lever in front of the right footrest. The lever is moved DOWN to select a low gear and UP to select a higher gear. The gear selected is shown by the indicator on the nacelle.

An Overview of the Physical Transmission

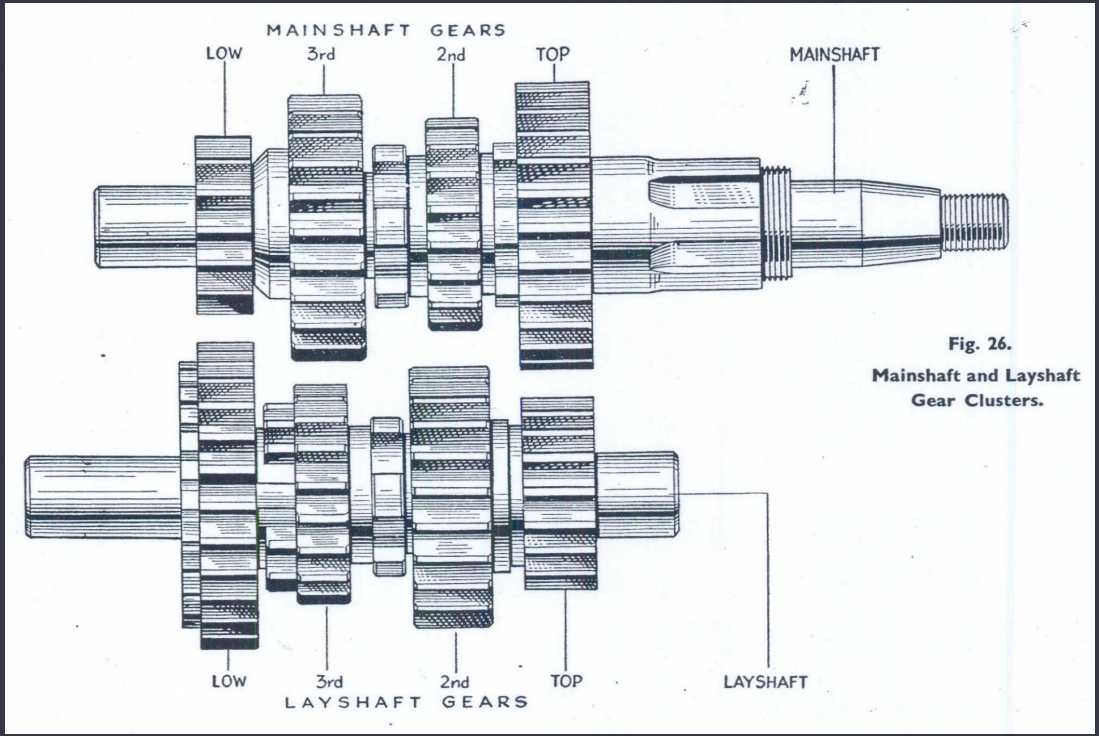
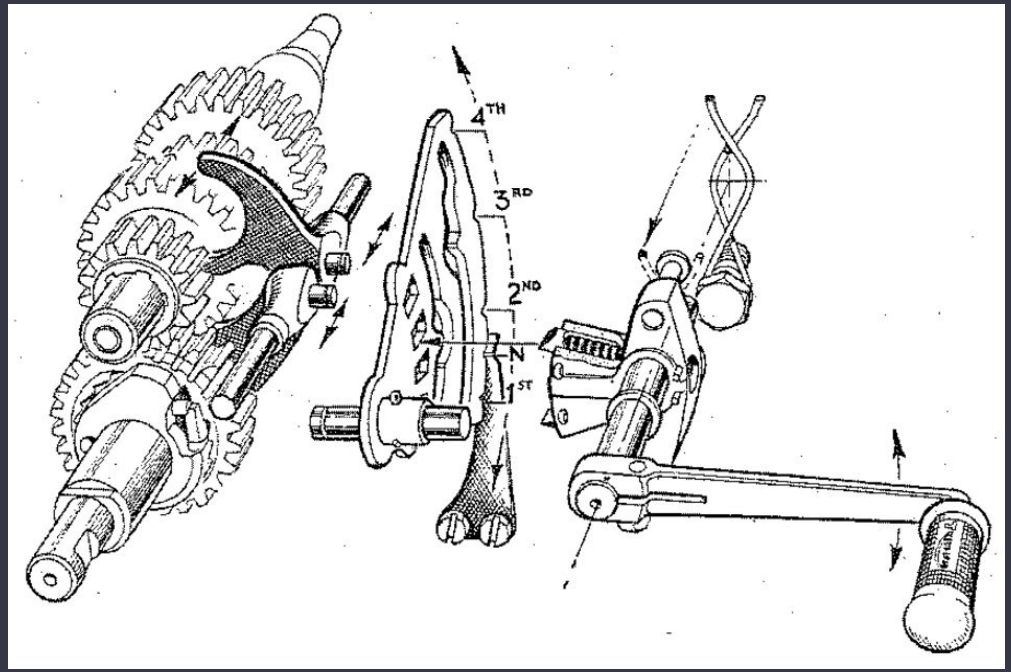


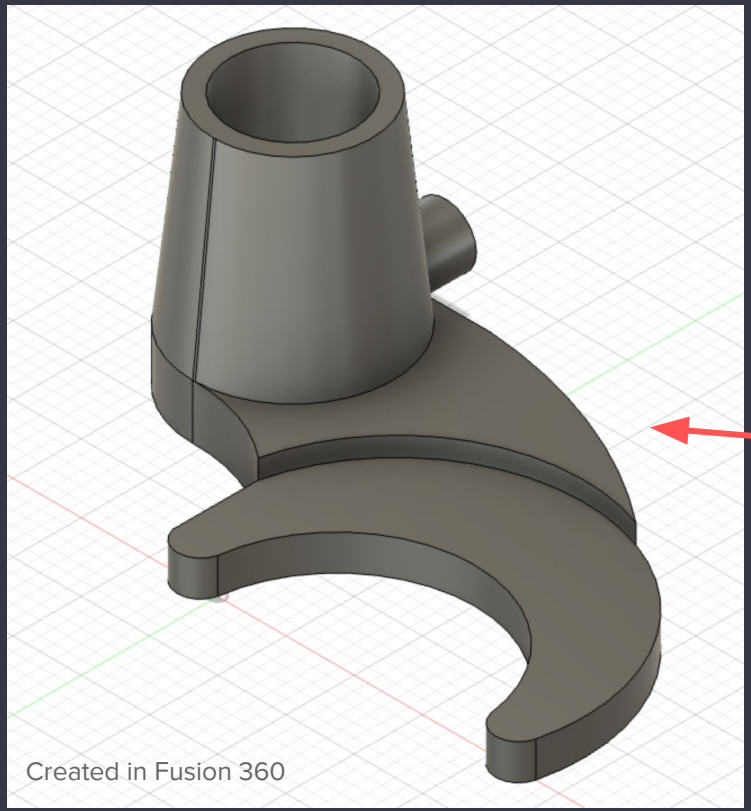
Fig. 26.
Mainshaft and Layshaft Gear Clusters.

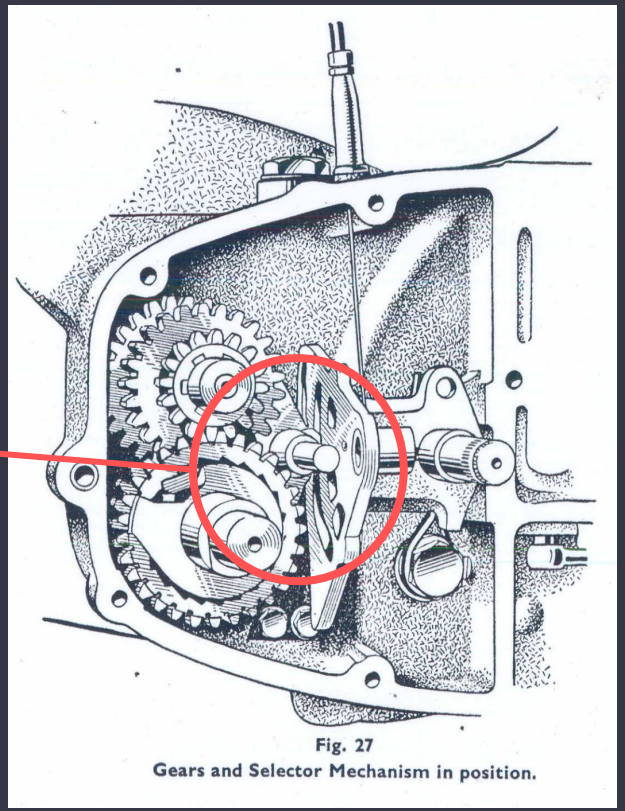
Shifter Plate

- The shifter plate on the Tiger Cub is controlled by the shifting pedal that allows the rider to shift between gears by moving the plate
- The shifter plate is what allows for the movement of the shift forks
- This is in turn what controls the movement of the sprockets along the shafts

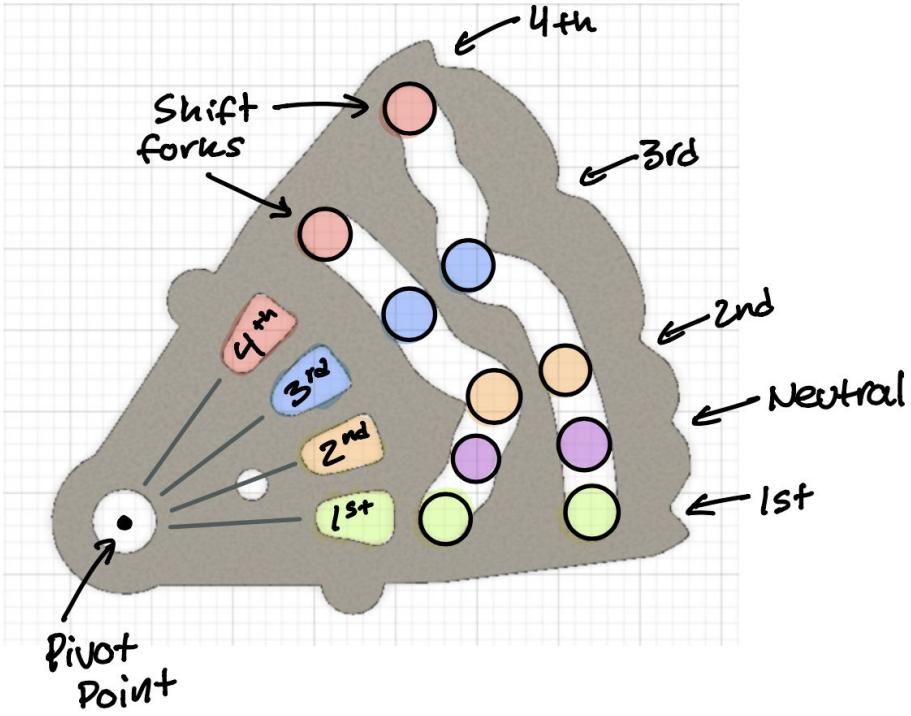


Shifter Forks



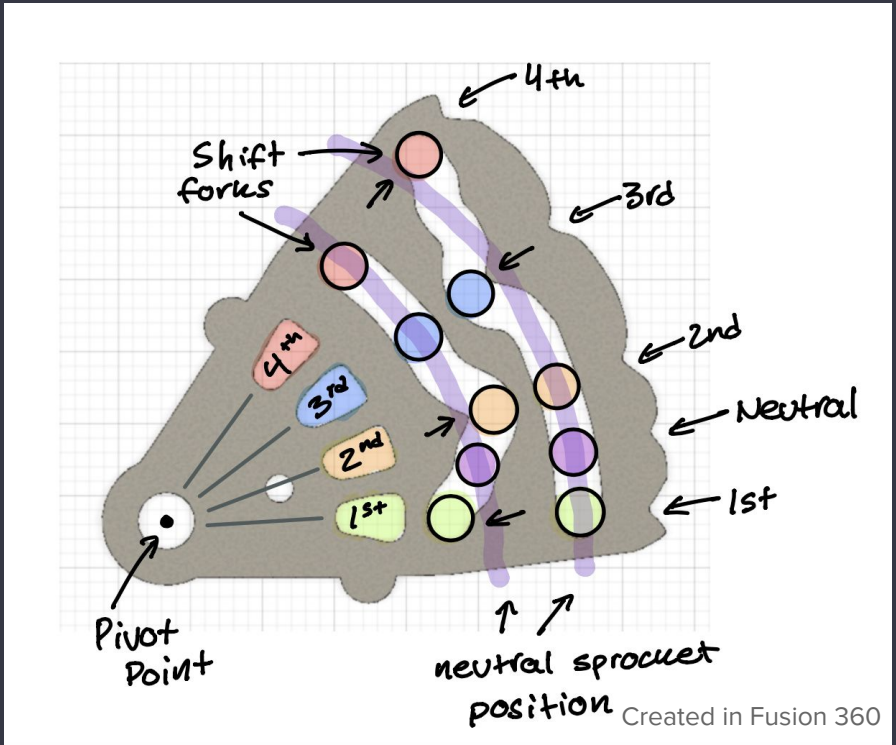


Model (made in fusion)



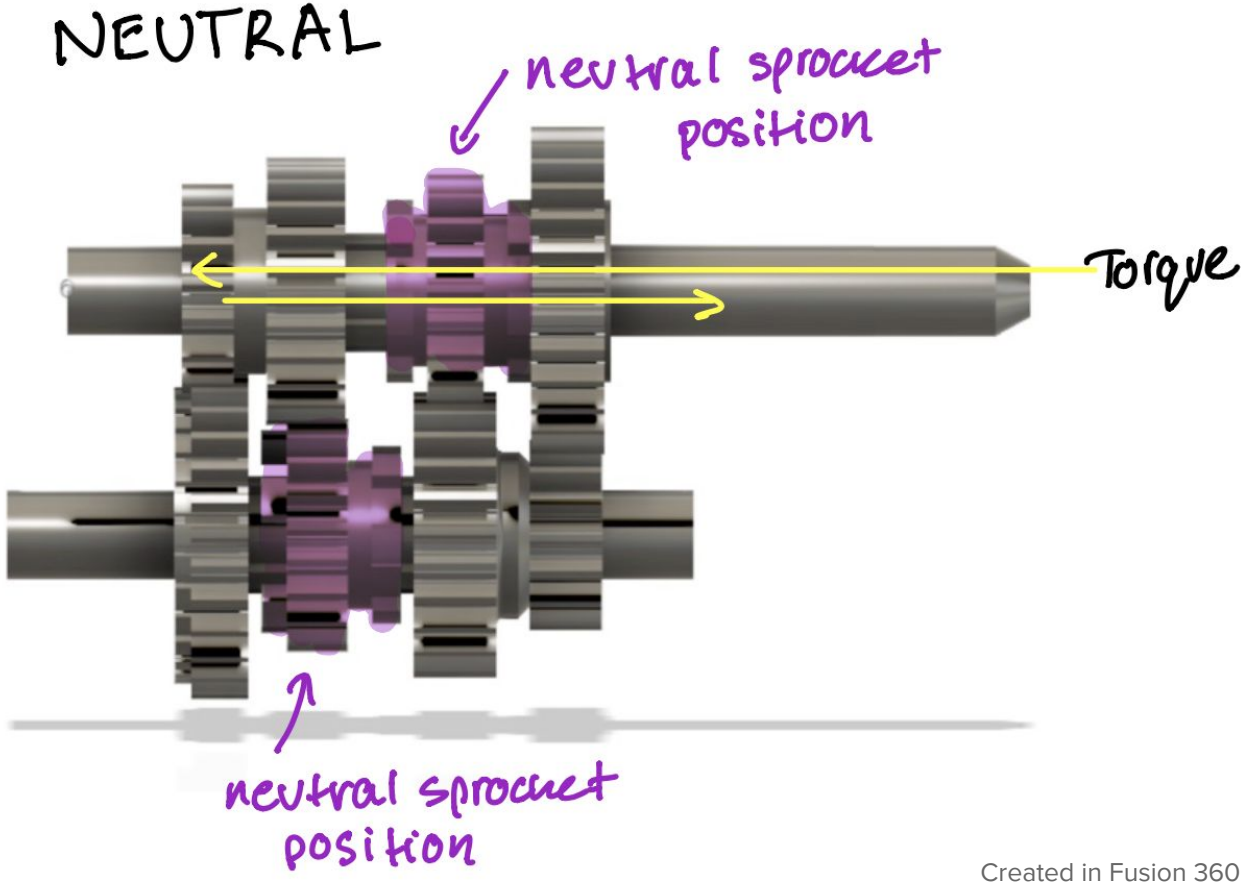
- Each color is representative of a different gear
- As the shifter plate is moved up and down the ends of the shift forks will move accordingly

Shifter Plate neutral position

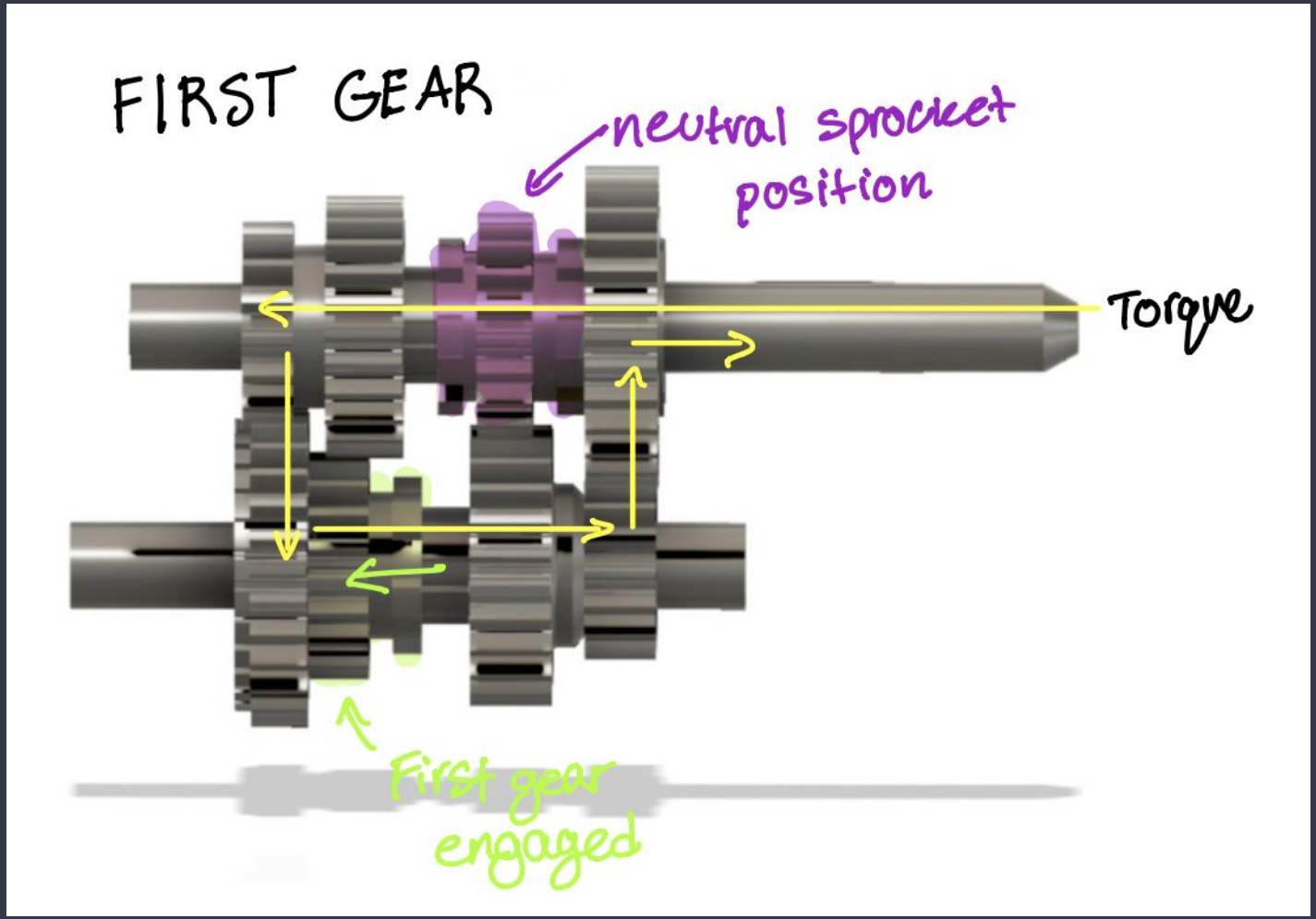


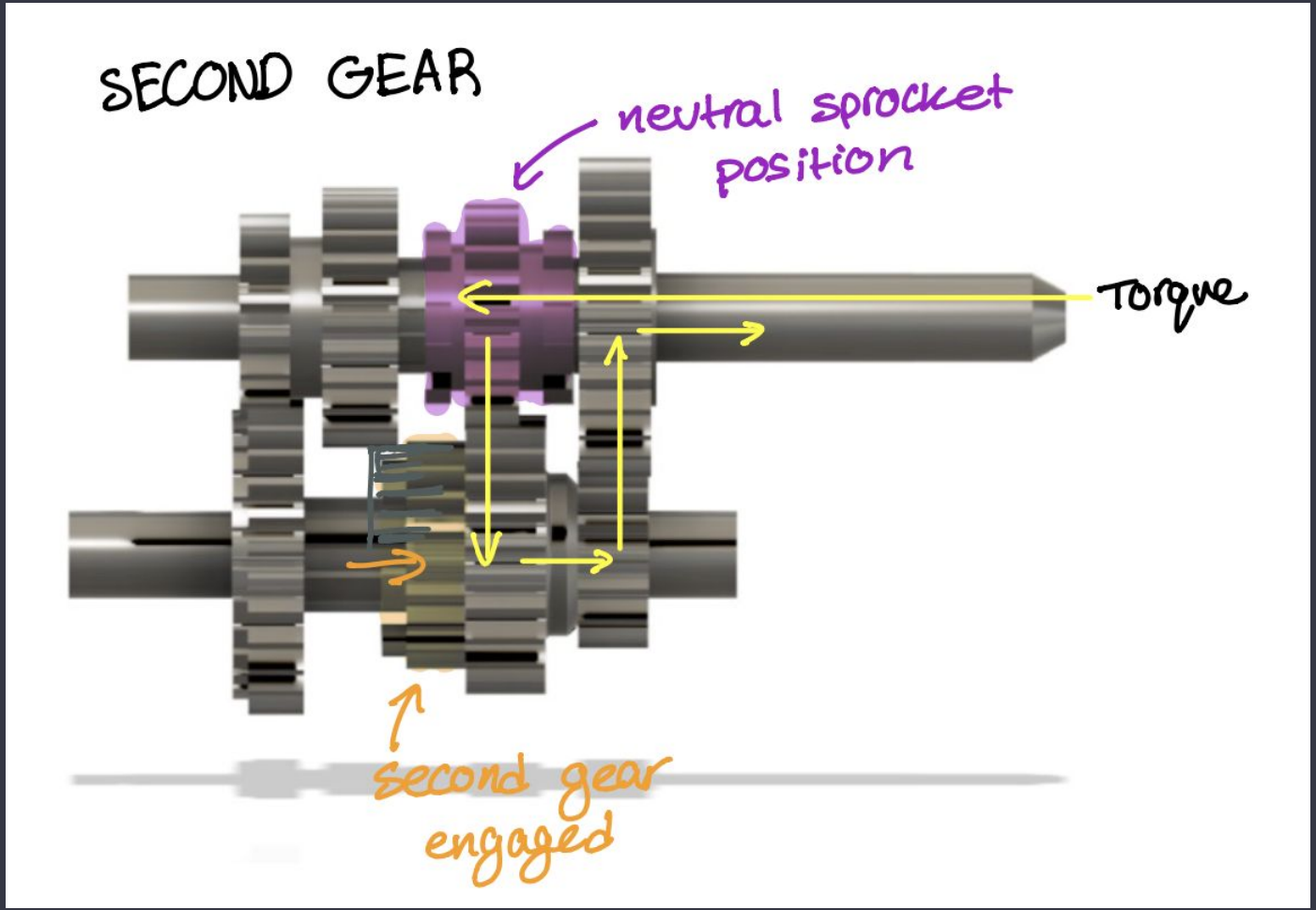
Neutral

- Neutral is in between 1st and 2nd gear mostly for the safety of the rider.
- Unlike a car, motorcycles have a shifter pedal which can cause for double shifting at times.
- In order to avoid this, when stopping at a light, neutral is placed between the two gears to make sure this is impossible,
    - This is because in order to get to first gear you must shift down to it instead of shifting up and accidentally skipping first gear.

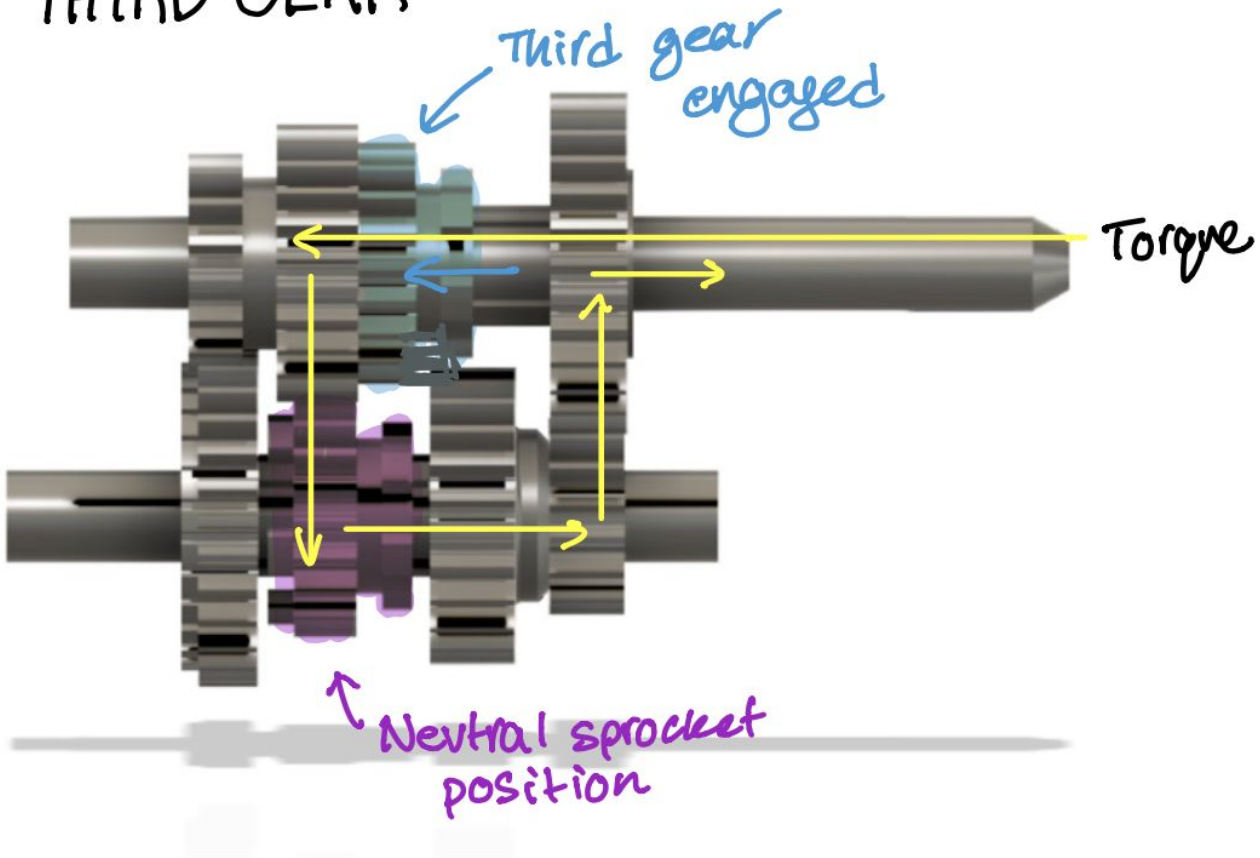


Created in Fusion 360

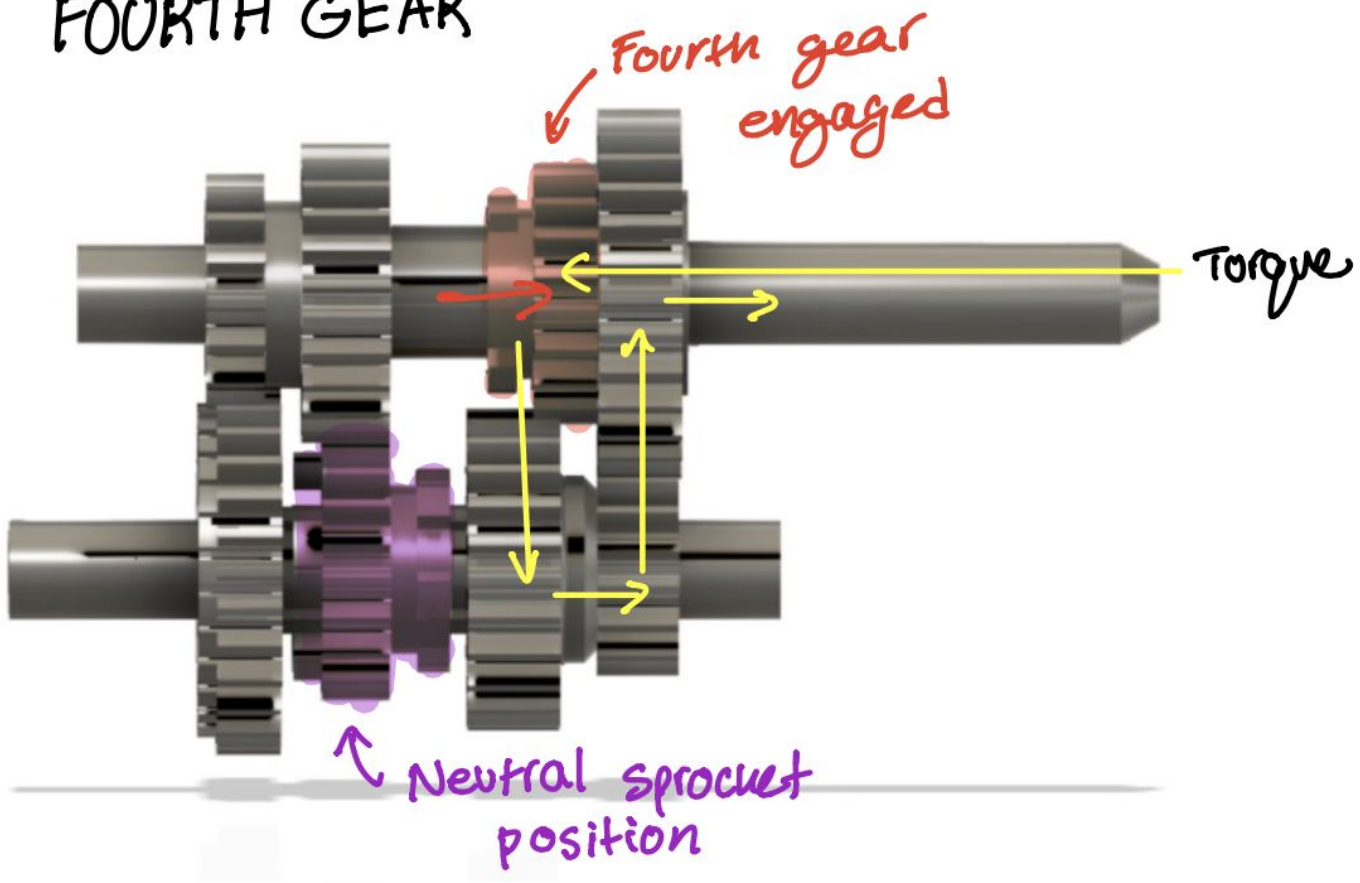

FIRST GEAR
neutral sprocket position
Torque
First gear engaged


SECOND GEAR
neutral sprocket position
Torque
second gear engaged

THIRD GEAR



FOURTH GEAR



Our Models

7 – Mainshaft Cluster (Katherine)
9 – High Gear (Sarah)
11 – Mainshaft Second Gear (Katherine)
13 – Layshaft Cluster (Alan)
14 – Layshaft Third Gear (Alan)
15 – Layshaft Low Gear (Tejas)
18 – Gearbox sprocket (Sarah)
20 – Selector Forks (Tejas)
22 – Camplate (Max)
42-46 – Kickstarter Spindle (Tejas)

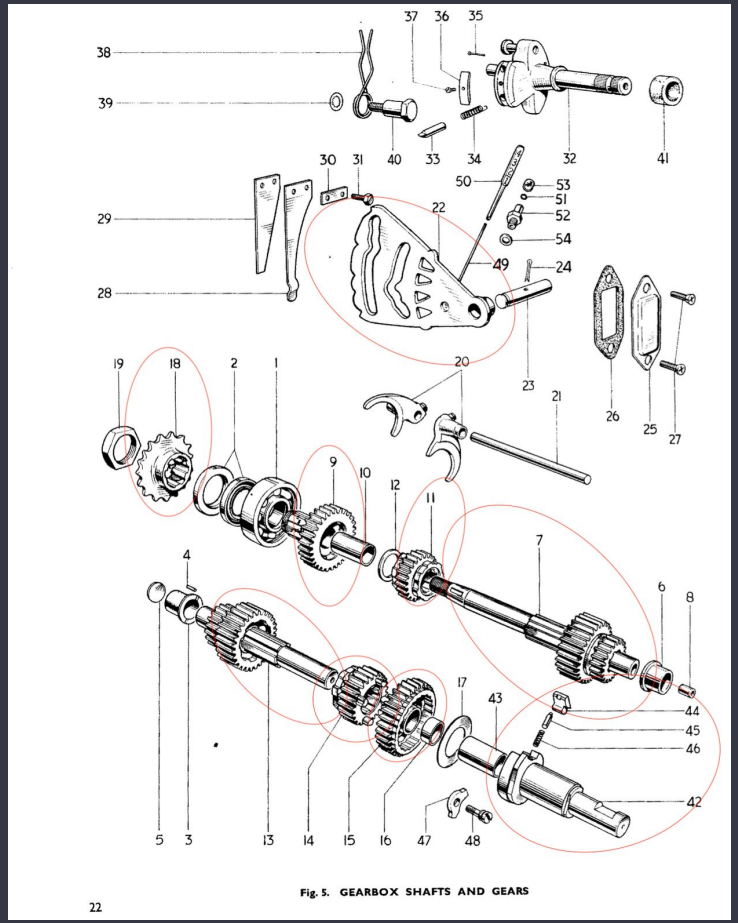


Fig. 5. GEARBOX SHAFTS AND GEARS

Fusion 360 Demonstration

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