Tonka

Rishabh Shah

October 2, 2017

Bike Model: 1185

Transmission

Gear	Diameter (inch)	Number of teeth	Circular Pitch
One	5	28	0.5610
Two	7	38	0.5787
Three	9	48	0.5890

Table 1: Front gear assembly specifications

Gear	Diameter (inch)	Number of teeth	Circular Pitch
One	4	28	0.4488
Two	$3\frac{1}{2}$	24	0.4581
Three	$3\frac{1}{4}$	21	0.4862
Four	3	18	0.5236
Five	$2\frac{3}{4}$	16	0.5400
Six	$2\frac{1}{4}$	14	0.5049

Table 2: Rear gear assembly specifications

Gear	Diameter (inch)	Number of teeth	Circular Pitch
Upper	$1\frac{3}{4}$	11	0.4998
Lower	$1\frac{3}{4}$	11	0.4988

Table 3: Derailleur gear assembly specifications

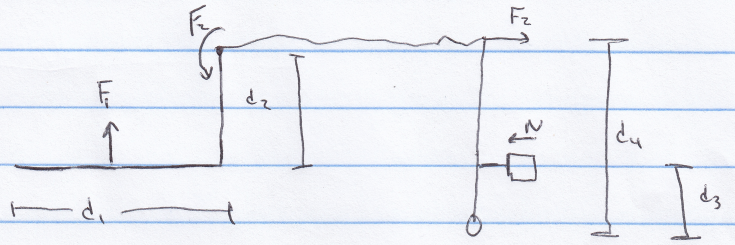
Front gear	**Rear gear**	**Gear Ratio**
One	One	1.0000:1
One	Two	1.1667:1
One	Three	1.3333:1
One	Four	1.5556:1
One	Five	1.7500:1
One	Six	2.0000:1
Two	One	1.3571:1
Two	Two	1.5833:1
Two	Three	1.8095:1
Two	Four	2.1111:1
Two	Five	2.3750:1
Two	Six	2.7143:1
Three	One	1.7143:1
Three	Two	2.0000:1
Three	Three	2.2857:1
Three	Four	2.6667:1
Three	Five	3.0000:1
Three	Six	3.4286:1

Table 4: All possible gear ratios

Linkages

Link or Joint	Length (inch)
Front brake handle (long side)	$3\frac{1}{4}$
Front brake handle (short side)	2
Rear brake handle (long side)	$3\frac{1}{4}$
Rear brake handle (short side)	2
Front brake caliper	412
Front brake joint to pad	$1\frac{1}{2}$
Rear brake caliper	412
Rear brake joint to pad	$1\frac{1}{2}$

Table 5: Brake linkage specifications



$$\sum M = 0 = \frac{F_1 d_1}{2} + F_2 d_2$$

$$F_2 = \frac{F_1 \cdot d_1 / 2}{d_2} \quad ; \quad F_f = \mu N \quad ; \quad \mu = 0.86$$

$$\sum M = 0 = F_2 d_4 + N d_3$$

$$N = \frac{F_1 \, d_1 / 2 \, d_4}{d_2 \, d_3} = \text{mechanical advantage}$$

$$\tau = F_f \, r = \mu N r = \frac{\mu r F_1 d_1 d_4}{2 d_2 d_3} = \text{relation between braking force and torque}$$

Bearings

Location	**Type**	**Function**
Front axle	Radial ball bearing	Allow the front axle to turn freely and move the wheel
Rear axle	Radial ball bearing	Allow the rear axle to turn freely and move the wheel
Brake handle	Radial ball bearing	Allow the brake handle to be pulled smoothly during braking
Brake calipers	Radial ball bearing	Allow the brake caliper to turn freely when braking
Front sprocket	Radial ball bearing	Allow the front sprocket to turn freely while pedaling
Rear sprocket	Radial ball bearing	Allow the rear gear assembly to turn freely while pedaling
Derailleur tensioner	Radial ball bearing	Allow the derailleur to move freely when tensioning the chain
Derailleur gear change	Thrust ball bearing	Allow the derailleur to be at an angle from its mounting point so gears can be changed
Derailleur sprocket	Radial ball bearing	Allow the sprockets to turn freely while pedaling
Handlebars	Radial ball bearing	Allow the fork tube to turn freely while steering
Fork tube	Radial ball bearing	Allow the fork (attached to fork tube) to turn freely while steering

Table 6: Location, type, and functions of all bearings

a. $m_m = 1.28oz$, $m_a = 0.488oz$, $V_o = 6V$

$d_c = 1.5in$, $d_a = 3in$, $V_{in} = 3V$

$f_s = 2$, $\gamma = 0.3$

$T_L = f_s F_r = 2\,(1.28(3) + 0.488(1.5)) = 9.144$

$T_s = 1.84$, $V_o = 4.5V$

$n_o = 13600$ rpm

$T_{s2} = \frac{V_2}{V_1} T_{s1} = \frac{6}{4.5}(1.84) = 2.453$

$T_r = 0.2\,\gamma\,T_{s2} = 0.2\,(0.3)(2.453) = 0.1472$

$m_r = \frac{T_L}{T_r} = \frac{9.144}{0.1472} = 62.11$ use gear ratio of 80

b. $T'_{sg} = mT_s = \gamma m T_s = 0.3(80)(2.453) = 58.872$

$n_{og} = \frac{1}{m} n_o = \frac{1}{80}(13600) = 170$

$T = T'_{sg} - k_g n$; $T = 0$; $n = 170$

$k_g = \frac{58.872}{170} = 0.3463$

$T = T'_{sg} - 0.3463 \cdot n$

$n = \frac{T'_{sg} - T}{0.3463} = \frac{58.872 - 9.144}{0.3463} =$ 143.6 rpm

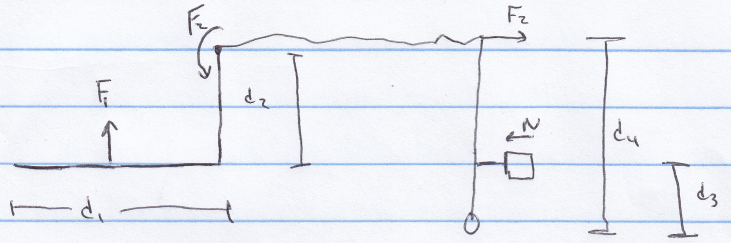
c. $m = 400$

$T'_{sg} = 294.36$

$n_{og} = \frac{1}{400}(13600) = 34$

$T = T'_{sg} - k_g n$; $T = 0$; $n = 34$

$k_g = \frac{294.36}{34} = 8.657$



$$\sum M = 0 = \frac{F_1 d_1}{2} + F_2 d_2$$

$$F_2 = \frac{F_1 \cdot d_1 / 2}{d_2} \quad ; \quad F_f = \nu N \quad ; \quad \nu = 0.86$$

$$\sum M = 0 = F_2 d_4 + N d_3$$

$$N = \frac{F_1 \, d_1/2 \, d_4}{d_2 \, d_3} = \text{mechanical advantage}$$

$$\tau = F_f \, r = \nu N r = \frac{\nu r F_1 d_1 d_4}{2 d_2 d_3} = \text{relation between braking force and torque}$$