Universal Physics Journal

Question 15: Quarter mile drags + lightened flywheel = improved times. Why?

Mr. Ethan:

I have been thinking about momentum and inertia and the accepted science around these topics as well as the questions posed by your articles. Here is something I would like to see explained. Take any road car and measure its performance over a quarter mile. Remove the spare wheel or otherwise take 15 lb. out of the car and measure the performance again. It may be faster but the difference will be insignificant. Now lighten the flywheel by 15 lb. and measure the car's performance times again. The car is faster and not by the amount of weight removed from the flywheel it is measurably faster. What is at work here?

There is another situation with the light and heavy flywheel. In quarter mile drags if the same start manner is used by revving up to the limiter and dropping the clutch with the light and heavy flywheels the car with the heavy flywheel will get off the line faster but will be caught and beaten by the car with the light flywheel. Of course we assume identical cars with the same power to weight ratio. The heavy flywheel is also more likely to burn clutches and break drive train parts coming off the line. This must have something to do with the heavy flywheel at high rpm when the clutch is dropped. If inertia and momentum do not exist, then what is causing the damage?

R.M., Thornhill, South Africa

Hello R.M.:

What fun questions! While we explore this event, keep in mind that the slight performance gain from removing a 15 lb.m from the chassis is replicated in the less-massive flywheel event. In one, the 15 lb.m is removed from the chassis, while in the other the 15 lb.m is removed from the flywheel. Overall, both cars share the same 15 lb.m lighter-than-stock mass rating.

Let us begin with a car in stock condition that will accelerate from 0-50 mi/hr in 6 seconds. During this acceleration in 1st gear, the motor will increase its rate of revolution from 1000 rpm to 6000 rpm. The car's flywheel has a 33 lb.m rating and will act the same if all its matter is concentrated in a band with a 5" radius or 10" diameter with the crankshaft as the axis. Acceleration of this 33 lb.m flywheel can be considered the same as in a linear event. At 1000 rpm, the 33 lb.m flywheel band is traveling at the steady rate of 31,416in/min or 43.63 ft/sec. When revved to 6000 rpm this same 33 lb.m flywheel band is traveling at the steady rate of 218.15 ft/sec. This velocity change occurs in 6 seconds. Acceleration = (final velocity - initial velocity) / time. During this 6 second run, the flywheel's acceleration rate is a high 210.9 ft/sec/sec. Newton's formula F=ma will give the Force in absolute units required to cause this rate of acceleration for the 33 lb.m flywheel band which is 6960 Poundal / g = 216.34 lb.f.

If the flywheel band is lightened until it contains just 18 lb.m and the same rate of acceleration is performed using slightly less throttle, the Force required will be reduced to just 3796.2 Poundal /g = 118 lb.f. The difference amounts to a 98 lb.f.. Converting this linear accelerational force to a torque force standard, 98 lb.f on a 5" lever is equal to a 41 lb/ft of additional torque available to cause an increase in the car's rate of acceleration instead of being spent accelerating the 33 lb.m stock flywheel.

In the stock vehicle with the 33 lb.m flywheel, if the car accelerates from a relative zero to 50 mi/hr, which equals 73 ft/sec, in 6 seconds, the car's rate of acceleration is 12.17 ft/sec/sec. The a/A Force required to cause this relaxed rate of acceleration for the removable 15 lb.m portion of the car's chassis is 182.6 Poundal / g = 5.7 lb.f.

Thus if you remove the 15 lb.m from any portion of the car's chassis, you will make a modest 5.7 lb.f a/A force available to cause an increased rate of acceleration for the rest of the car. On the other hand, remove the 15 lb.m from the flywheel and this same 5.7 lb.f a/A force will be made available plus an increase of 41 lb/ft of available torque from the motor. Clearly this is the high-performance option.

Understanding these results is easier when you realize that once an action force causes an accelerational event, it is terminated. This means it ceases to exist and therefore is no longer available to go on to act as the cause of some other event. In our stock car with the 33 lb.m flywheel, the torque a/A force from the motor that is responsible for causing acceleration for the stock flywheel is thereby terminated. By lightening the flywheel by 15 lb.m, the torque force that is terminated accelerating the 18 lb.m flywheel is much less leaving the balance available to help force the car to a higher rate of acceleration.

When a motor with a massive flywheel is revved up before releasing the clutch, a strong a/A force is required to slow the motor. The more suddenly the revved motor is connected to the ground, the shorter the time over which the motor's revs are reduced, the greater the rate of acceleration, the greater the magnitude of a/A force required. Remember how in linear events where halving the distance inversely doubles the a/A force? Halving the time of the acceleration has the same doubling effect. Pop a really well-built clutch, metallic pucks etc, and this high a/A force challenges the strength of all driveline components. Hopefully the tires will break loose first.

Once the motor with a massive flywheel gets the jump on a competitor with an identical car but a lightened flywheel, the motor rpm is now lower as the tires hook up. Now the motor has a larger portion of its torque force being terminated while accelerating the massive flywheel to a higher rpm leaving less torque force to accelerate the car. From here on, the other car with the lightened flywheel has the advantage.

I hope that this analysis of an accelerational event focusing on the absolute nature of both force and acceleration being experienced by the object makes more sense than does an analysis that uses the relative "momentum" and relative "kinetic energy" rating systems that are not real and therefore are not being experienced by the accelerating object. Notice here, as always, Newton's imaginary "inertia" has no physical role whatsoever.

Sincerely,

Ethan Skyler