Section
F
Comet

The original King Midget drive setup only works with engines having a long crankshaft. Further, variable drive transmissions have evolved to become a better and safer system than the dual clutches patented by Midget Motors. People installing larger engines generally choose a Comet variable drive transmission system.

F-1 What Do I Really Want And How Do I Get There?

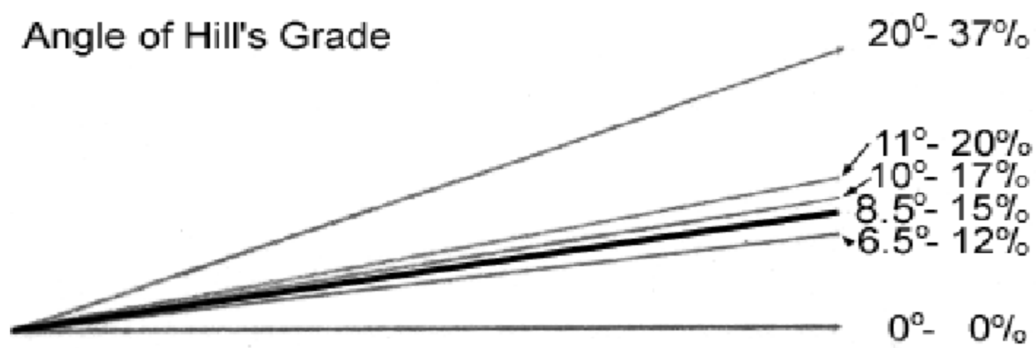
By Scot Wilson

After the 2000 Jamboree in Westport, I came home ready to put a new larger engine in my Model 3 and let her fly. After I got past the "bigger is better" idea, I started to wonder how big an engine is really needed?

The first step is to determine the performance requirements for the new setup. Since I spend most of my behind-the-windshield time going to and from work, I used the hills and speed of that trip to set the requirements. The maximum speed limit is 45 MPH with the steepest hill being seven degrees (a 12% grade). With this in mind I set the following:

Maximum speed: 50 MPH on a flat road with no head wind
Maximum grade: Eight and a half degrees (a 15% grade)

Now that I know what I want, how do I get there?



A 1951 article in Popular Science said the High Street hill is a 37% grade, and characterized a 17% hill as "steep." Comparing High Street with known hills in his area, Bob concluded the article was in error. As the diagram above shows, a 37% grade equals 20 degrees. Bob suspects that High Street is actually a 20% slope. We hope to confirm that some day [and have done so. Bob V.]

What I needed to evaluate is the horsepower of the engine and the type and ratios of the transmission. I evaluated the standard KM setup and some of the new alternatives I saw at the Jamboree.

1. Standard KM transmission setup on my `67 Model 3 which has a 12 HP Kohler, 16-tooth output sprocket and a #50 chain.
2. Standard KM transmission setup with a 12 HP Kohler, 20 tooth output sprocket and a #50 chain.
3. 12 HP Kohler with a Comet 44 clutch and #50 chain (no KM transmission).
4. 20 HP Honda with a Comet 94c clutch and #50 chain (no KM transmission).

The evaluation consisted of looking at the load; "resistance to go," versus the available push that the engine can deliver; the "go." The goal is to have more "go" than load for the performance criteria I have set above. Items that I used for calculating load (resistance to go) are:

1. Rolling resistance of the tires.
2. Wind resistance to pushing the car through the air.
3. The amount of push to get one passenger, me, and the weight of the car up the hill.

The parts that affect the "go" part are:

1. The output that the engine can produce (HP) at different RPM's.
2. The type of transmission, ratios, and efficiency of torque transfer.
3. The size of the chain, the number of teeth on the output sprocket, and the number of teeth on the driven wheel sprocket (chain drive ratio).

Since I am in the middle of doing a complete rebuild of my `67 with every part taken apart and spread all over my garage, I used the opportunity to gather all the needed information on pulley sizes, transmissions, gear ratios, and chain drive ratios. The assumptions I used are:

- The original KM transmission is 90% efficient.
- A properly aligned Comet torque converter is 90% efficient.
- A #50 chain with a 48-tooth drive ring on the drive wheel.
- The weight of the car and driver is 1000 lb. including a 680-lb. car, a 180 lb. driver (me) and a 140-lb. spouse (no kids allowed).

Take all this information, throw it into a spreadsheet on my computer, shake it a couple of times, and out comes data, lots of it. The problem is trying to figure out what all the numbers are telling me. The following output was generated:

ENGINE HP	TRANS TYPE	DRIVE GEAR	MAX SPEED ON 15% HILL	TOP SPEED ON FLAT ROAD
12	KM	16 TOOTH	12 MPH	41 MPH
12	KM	20 TOOTH	12 MPH	50 MPH
12	COMET 44	13 TOOTH	19 MPH	50 MPH
20	COMET 94	16 TOOTH	32 MPH	50 MPH

Comparing this data to my requirements show that I can meet my requirements using a 20 HP engine and a Comet Continuously Variable Transmission (CVT).

Some interesting things I found along the way are:

- A Honda 20 HP engine will develop 12% more ft-lb. torque then a Briggs and Stratton Vanguard 20 HP engine. All the 20 HP data above is based on a Honda engine.
- The difference between a #40 chain and a #50 chain is the distance between the roll pins. A #40 chain has ½" spacing and the #50 chain 5/8" spacing.
- You can order any drive sprocket from nine tooth up to 30 tooth from the Grainger catalog. You can also buy chain by the 10-foot length.
- All engines that I looked at have their highest output torque at 2500 RPM.
- The Comet clutches are actually Continuously Variable Transmissions (CVT).

This means the gear ratio changes depending on the speed of rotation. As the wheel load goes up, the engine slows down, and the pulley ratio increases to provide more torque to the wheel.

Working backwards, I then wanted to know how steep of a hill I could get up in high gear with the standard KM set-up. The Comet CVT will continuously change the gear ratio until the load equals the power available, so there is no peak torque RPM as with the standard KM transmission.

Anyway back to the question; what is the maximum hill that a standard KM set-up can handle with a 12 HP Kohler in high gear? From my notes above the engine will develop maximum torque at 2500 RPM. I'm looking for the point when the load (hill) equals the available wheel torque at 2500 RPM. In the spreadsheet I back-calculated the hill grade to determine when this happens. I found the following:

ENGINE HP	TRANS TYPE	DRIVE GEAR	MAX HILL% @2500 RPM	SPEED @2500 RPM
12	KM	16 TOOTH	8%	28 mph
12	KM	20 TOOTH	5%	35 mph

Be aware that with my `67 in small pieces all over the garage, I have no way of running real-life data points to verify my calculations. I do believe they should be on the conservative side and real-life performance should be as shown.

Where The Rubber Meets The Road!

Next I started to wonder whether the 20 HP engine can deliver all its torque to the pavement using only one drive wheel. There are two concerns:

Tire slip (light 'em up)
Torque steer.

Bob Vahsholtz provided some good data on the load at each wheel, based on him sitting in the driver's seat and no passenger. Bob weighs 170 lb. and has a 12 HP Kohler in a `64 Model III

LF=163 RF=163
LR=267 RR=330
TOTAL= 923 LB.

The amount of force that can be applied to the pavement depends on the weight applied to the drive wheel and the coefficient of friction (Cf) for rubber on pavement. Doing a little research in some handbooks and using the weights above, I found the Cf for several different surfaces. A little button pushing on the calculator gave me the following:

SURFACE	Coefficient of FRICTION (Cf)	MAX TORQUE AT WHEEL BEFORE SLIPPING
DRY PAVEMENT	.9	217 ft-lb.
WET PAVEMENT	.74	178 ft-lb.
WET GRASS	.1	24 ft-lb.

This table shows that with one drive wheel and a drive wheel load of 330 lb., the maximum torque that can be delivered to the pavement is 217 ft-lb. before it will start to spin. Looking at the maximum torque that each of the different engine set-ups can deliver at the drive wheel gives the following data:

ENGINE HP	TRANS TYPE	DRIVE GEAR	MAX TORQUE	@ RPM
12	KM	16 TOOTH	145	1500 IN LOW GEAR
12	KM	20 TOOTH	123	1500 IN LOW GEAR
12	COMET 44	13 TOOTH	163	2000
20	COMET 94	16 TOOTH	303	2000

As long as the maximum torque that the engine can deliver at the drive wheel is less than the maximum torque that will cause the wheel to break loose and slip, there is no chance for the tire to spin. Comparing the maximum torque values in the two preceding tables shows that none of the 12 HP setups should spin the tire on dry pavement. Wet pavement is close with the Comet 44 set-up. The 20 HP setup should spin the one drive wheel with no problem. This suggests that for a 20 HP and larger engine you should use a two- wheel drive differential to drive both wheels, or use a dual CVT set-up (more on this later).

Torque steer is when the car is pulled to one side during acceleration, or during stopping due to delivering the entire engine torque (or back-torque load) to just one drive wheel. The reference books I have give no information on this, but I've heard it can cause problems. I will have to either build and experience it myself, or get more information from others who have put larger engines in their cars.

What Else Can Go Wrong?

Anytime you start to modify the standard setup you most likely start pushing the components outside their normal operating envelope. Up to this point I looked at the transmission and the tire grip, but what about the drive chain? Would putting in a larger engine start breaking the drive chain? My 1959 KM Model 3 uses a #40 chain and my `67 uses a #50 chain. Turning again to some data books gave me the answer.

The maximum allowable load for a #40 chain is 810 lbs. A #50 chain can handle a maximum allowable load of 1430 lb. The 20 HP engine can develop 303 ft-lbs. at the wheel, which is a force of 761 lbs. on the chain. This is very close to the maximum rating of a 40 chain, so I recommend that for the larger engines (12 HP and above), a #50 chain should be used. From the above tire slip data, the maximum torque that can be applied to the ground before the drive wheel will spin is 217 ft-lbs., or 545 lbs. load on the chain.

I don't know why Midget Motors changed to the larger chain. Maybe they were having problems in breaking the #40 chains. The #50 chain can handle 77% more load. Robin Cole says the #40 chain "stretches like taffy" with his 14 HP engine.

You may have noticed that for the larger 20 HP engine setup, I specified a Comet 94c CVT. When picking a CVT, carefully look at the maximum HP rating. The 44 series selected for the 12 HP setup has a maximum rating of 18 HP. The 94c has a maximum rating of 30 HP.

Another thing to watch out for is the RPM at which the clutch starts to engage. A Comet CVT can be used on both 2-cycle and 4-cycle engines. Two-cycle engines develop maximum torque at a much higher RPM than the slower running 4-cycle engines. The maximum torque for the 4-cycle engine is developed at 2500 RPM, so the best choice is to have the CVT *engage* at around 2000 RPM. The engagement point is determined by the number mass of the weights used in the drive unit. To get the 2000 RPM engagement, use six weights at 53.5 grams and a pink spring. The experience of Robin Cole and Fred Perry tend to confirm these specifications.

Sources and Prices

The prices listed below are from the 2000 Comet catalog:

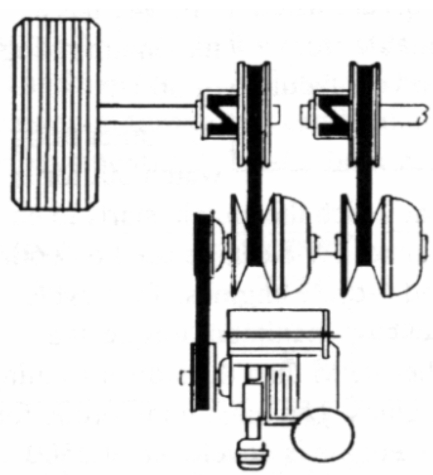
Unit	Driver	Driven	Max HP
#40	**$120**	**$120**	**18**
#94	**$175**	**$190**	**30**

A differential kit #218239A is listed for $150, and the output shafts (two req.) are listed for $50 each. These drives are available from various sources. I would recommend contacting Comet at 1-800-999-8161.

The Comet applications engineer told me that I should be able to get 90 % torque transfer (10% loss) "if properly tuned." That means the crankshaft and the driven unit shaft must be parallel to each other and the drive belt properly sized. If not, the drive belt will be pulled to one side causing erratic operation and excessive wear on the belt and clutch assembly.

So What's A Dual CVT Set-Up Anyway?

For the 20 HP and larger engines I recommend driving both rear wheels. This can be done using a true rear-end differential setup or a dual CVT arrangement (see the illustration below).



Dual torque converter to individual drive wheels — no differential required.

This enables driving both wheels without the use of a regular differential and provides a limited slip feature. Comet also offers a self-contained differential that is rated up to 500 ft-lbs. I don't have a recommendation at this point, but both should work. I did notice a Model 3 at the Jamboree last year that had a small differential like the Comet unit. I have not seen a dual CVT set-up. Both have their own challenges in installation and transferring the torque to the drive wheels.

Hey, Some Guys Look At Girls ... These Days I Look At Things That Have Engines And Smell Of Gasoline

As I travel around town I look at most anything that is driven with a gas engine. I look at go-karts at Wal-Mart, motorcycles in the parking lots, and ATV's on the back of pick-up trucks and trailers. What I seek is a cheap and simple engine/clutch set-up. One of the options I want to try in my `59 Model 3 is a small motorcycle/ATV eng-ine. I have purchased a 350cc ATV engine that will develop 27 HP. It has a six-speed transmission that should allow it to deve-lop peak torque at six different wheel RPM's. That should give it both good top end-running speed and five lower gears to handle a variety of hills and road conditions.

What I really like about the motorcycle /ATV engine idea, is it's a total integrated unit with engine, transmission, and chain drive all in one package. It weighs around 100 lbs. and should fit nicely under the back deck of my `59. I'm going to look at the Comet differential to provide dual rear wheel drive. I'll need to look at the challenges of clutch operation and shifting gears from the passenger compartment.

Since I will be removing the original KM transmission I will lose reverse. My plans are to try to connect an electric motor (starter motor) to one of the rear wheels for a slow reverse. It won't be fast, but all I need is to get out of the garage or a parking spot. Bob Vahsholtz has been working on some good ideas for reverse using an extra drive pulley off the engine drive shaft to provide reverse direction.

Something else that I have just started to look at are the new ATV's that are on the market. These new machines are quite sophisticated with some nice features that may work great in a KM. These include true integrated motor/gear-box with a drive shaft and a differential. There are several forward speeds and as a bonus, reverse. All I need to do is find an ATV that the owner used to climb trees. The way I see them ride around here, that should be easy … maybe its time for a walk in the woods.

What Do You Mean I Have To Stop Now; I Just Got It To Go!

There is a rule of hot-rodding that should never be broken and needs to apply here also. That rule is "you need to stop before you ever go." What this means is the brakes need to handle all that extra power that you put under the hood (or back deck for a KM). Before I put a bigger and heavier engine in with lots more "go" I'll need to look at the size and braking power of the standard KM brake set-up. I'll let you know what I find out.

At a later date I hope to write a follow-up to this article after I have been down that ATV engine road. I'll let you know all the ditches and potholes I find along the way, and where I finally end up.

Editor's Note: *Scot Wilson is a nuclear engineer who lives in Virginia with his wife and daughters. He posted an inquiry on the King Midget web site asking for transmission information. I sent what I could, starting a long and interesting e-mail correspondence* *that led to this article.*

Some of you have made conversions of the sort that Scot contemplates, and many others are thinking about it. As Scot notes, his work is largely theoretical at this point, and he has a lot to learn. Special thanks to Fred Perry, Robin Cole and others who have helped so far. If you have experience or ideas to toss into the hopper, let us know. Let's work together instead of each of us inventing the wheel from scratch.

Scot has promised follow-up as he proceeds with restoration of his King Midgets. ☐

Note: That was June of 2001, and we're still waiting for his follow-up! Meanwhile, Scot's article has been of considerable value to those making these modifications, and will continue to be for a long time. Bob V.

F-2 The Comet Clutch *Jon Dean*

The last newsletter asked for comments on the variable-pitch Comet clutch. I have a '69 King Midget that has a Comet clutch on it, and those in the know at several of the Jamborees that I have attended said that it is possible that mine might have come from the factory with the Comet clutch. I was told that, at some point, Midget Motors was experimenting with the Comet clutch, and it was thought that mine might have been one of those.

My car also has oversize wide rear wheels and tires. Both the Comet clutch and wide rear wheels appear to be original factory equipment. How do any of us know what is factory, and what isn't, especially since it seems that every car is a little different from the next one, even if it was built on the same day?

Getting back to the performance of the Comet clutch. First of all, in 1966, I had a new '66 King Midget with a 12 hp. Kohler engine using the normal 2-speed clutch. I will be comparing the performance of the new '66, as I remember it, against my old and tired '69 with the Comet clutch.

The '66 had a good low range, but not as good as the '69. The shift from the low range to the high range, in the '66, always came with an obvious surge when the high-speed clutch took over. This does not take place with the Comet, since it is constantly changing its torque with the variance of both engine speed and road speed. The Comet clutch has a stronger feel, and a much smoother feel of operation.

I have no idea why any of the drive ratios are in either the lower speeds or the top end using the Comet clutch since it is constantly changing. I can tell you that my wife and I went up the High Street hill in Athens with no trouble at all, and that was with a two-person payload of over 400 pounds. My '69 engine is the original, and is very tired, but what power it does put out, the Comet clutch uses to its maximum efficiency. In the over ten years that I have owned and driven my '69, 1 have had no drive problems, nor have I had to adjust anything on the Comet clutch. ☐

F-3 Notes on Comet Clutches

On the Yahoo Group, there were questions about Comet drives and which was best for King Midgets. Lee Seats answered:

"I have used the 44 magnum with an 18 hp Onan opposed and at 40 mph, if I pushed the pedal to the floor, it would smoke the belt.

The 40 Series requires more cleaning to operate correctly. The 44 does not require much at all. The 7\8" belts on the 44 would last about a thousand miles so I went to a 94C. Same principle as the 44; it works with nine pucks that spin outward with more rpm's to move the sheave.

The 94C is good for 60 hp and it uses a 1 1\8" belt. I've never had a belt fail and I have had it on my King for five years. Now I'm running a 25 hp with the same clutch and have never had a problem.

The only thing I did when I got it was coat the puck-ways with Neverseize.

The size can be tailored to the shaft size of your engine. If you are under 16 hp, a 94 C may be overkill and you might want to use the 44 with a 40 driven. But 94 C is trouble free."

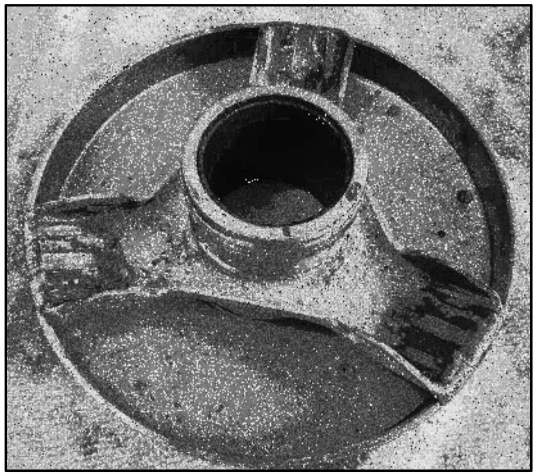
A lot of information on Comet systems and how they work can be found at www.gokartsupply.com. ◻

F-4 The Comet 40; Challenges and Patches *By Bob V.*

THE COMET 40 SEEMS THE RIGHT CLUTCH for a KM repowered with 16 hp or less. Gert Gehlhaar and I both have King Midgets with that clutch and "Chonda" engines of about 14 hp. Nice.

But we've had problems with them wanting to "seize up" when changing speed. Both are nearly new. Comet instructions say to lube every 50 hours—maybe a thousand miles, and neither has gone nearly that far. Gert got a dose of the specified molybdenum lubricant and we slicked 'em both up in my barn. They both worked fine … for a while. I've put about 50 miles on mine since and it has been, sort of, OK, but sticky at low speed. Gert uses his KM a lot, and had to lube it again after less than 50 *miles.*

Here's how the system works. Above are three steel rollers, attached to each other by springs. They fit in the "tracks" shown below



They roll up the little ramps under centrifugal force, pressing an opposing cone against the drive belt. You can see how the rollers have already worn grooves into the surfaces.

The assembly is shown in this photo. Steel on steel. What to do? Gert suggested waiting until we were sure his clutch was defective or a poor design. He had a new 40 and was reluctant to install it, fearing it would also prove troublesome.

The last time (the *fourth* time) he took it apart it still had plenty of lube, but given the wear shown, he was concerned. He cleaned and lubed it again and it worked well for our June KMW meet, but soon after was starting to hang up again.

We talked to Randy Chesnutt. He and Ted Richardson both have trouble free Comet 44s so Gert decided to replace his 40 with a 44.

Randy said he's not expert on the 40 design, but it requires the metal (pivotal point) roller cams to move the pulley's sheaves.

The 44, a completely different design, uses non metal pucks to move the sheaves. The lubrication of choice is a dry lube called molybdenum disulphide and the second choice is a dry graphite. Graphite is typically used since it's cheaper and easier to find. The reason for the dry lube is resistance to dirt and other contaminates. If you want to use both moly and graphite, Loctite sells a can with the two combined. It's not cheap.

Randy suspects the metal-to-metal cam roller surface on the 40 is easily damaged and once this happens it's a downward spiral to increased maintenance. Such wear spots will capture contaminates and create more scarring of the metal surface. Cleaning or shining it probably won't fix the damage. It will still have damaged roller cams and carriers. Contaminated dry lube is resistant to water but can be washed away with a petroleum product such as WD 40. Doing so and then re-lubing with the proper dry lubricant might be the best that can be done. The pucks in the 44 don't seem to cause the same problems.

We consulted other experts.

John White has heard of a 40 driver that would hang up and recalls the owner boiled it in oil. Did that work? He doesn't know. He's also noticed the ramps on a 44 series driven clutch showing early signs of wear, which doesn't necessarily hurt anything—they're made from aluminum alloy.

Lee Seats had a Comet 40 on a Cushman scooter and believes the design is terrible. The moving rollers encounter resistance from the outer cover, causing fragments of dirt and junk to accumulate in the cone area. The dust gets in the holes in the rollers, which are metal on metal. That causes binding of the clip that holds the springs between the rollers. Eventually there is too much resistance and the clutch quits moving smoothly and causes the lockup problems Gert and I have experienced.

Lee experimented with the clips, mashing them so that the rollers wouldn't have any resistance on the clip, which prolonged the need to clean. Denny Jasper's Model 2 had a 40 which he pulled and cleaned every two months or so because it would get chattery and hang up. Denny did the trick Lee mentioned with the clips in the rollers and prolonged maintenance. Now Jody Jasper has that M2, and has some of the same trouble.

Gert talked to Go Kart Supply and discussed the problems we are having with the type 40 Comet clutches and asked if he could exchange his new 40 for a 44. They agreed to the exchange as long as the 40 had not been used and was still in the original box, not including shipping costs, and Gert accepted. He now has about 80 miles on the 44 and it's as smooth as silk. "It will sit at a light and the engine idles just fine—no more killing the engine or jerking around."

What's still not entirely certain is if Gert's Comet 40 clutch was defective or inherently bad design. I have my fingers crossed that mine will do better! Perhaps the design is simply touchy—if anything goes amiss, it could disturb the wear pattern and cause the hang-ups.

At the WV Jam, I looked for cars with 40s to see if I could learn anything from their owners. Some say their 40s have worked perfectly for years, with no lubrication. The consensus seems to be that the 40 can be OK, the 44 is much better, and the 94 is a real winner.

If you have any additional tips on Comet 40 design and maintenance, please let us know. ☐