Will the Real Mountain Pulley Please Roll Forward?

Or: Should Fairmont have labeled one "Rocky Mountain Pulley" and the other "Appalachian Mountain Pulley"?

By: Richard Reiff/Rocky Mountain Division

Living in Colorado I wanted to get a narrow gauge car for some time to supplement my MT19A. However the prices of transmission based conversions lead me to obtaining a used Les King fabricated copy of an M15M. The second "M" stands for magneto, which I soon found out was barely adequate for running on the Durango & Silverton, but it did not have the ability to manually adjust spark advance, an essential need to make the 4% grade up Cumbres Pass on the C&TS. Changing out the motor for a conventional ROC with timer ignition almost did the trick, but with two riders I was still not able to maintain a satisfactory speed (at least to the EC's standards) up that severe grade, especially approaching the 10,000 foot summit. As with any run, I received a plethora of advice from experts, from getting a larger rear pulley (not possible without major frame surgery due to a shorter than standard wheelbase and interference with the idler pulley) to doing some major "hopping up" of the ROC motor by increasing compression. (I didn't like that option as doing such things tends to severely reduce the life of other internal engine components). The standard advice was "get a mountain pulley".

However, just what is a mountain pulley, and what size is it? After measuring of mine and others at various meets it turned out I had a 3.5" pulley, as measured at the outer center diameter of the pulling face. The slight crown on all ROC pulleys reduces the diameter about 1/16" on the outer edges of the pulling face.

In talking with the trackside experts, I was told that there were others who had machined or fabricated smaller "mountain pulleys". Over a 6 month period I was referred to and subsequently spoke with half a dozen 2 cycle and ROC experts. Everyone had a different opinion (actually, each claimed theirs was not an opinion, but a firm knowledge of a fact) as to what constituted a "Mountain Pulley". The jury of experts was virtually evenly split as to what a Mountain Pulley should be as far as diameter at the pulling face.

The results of the Poll: Everyone agreed the factory standard ROC pulley is 4" diameter at the center pulling face. About half of the 2-cycle experts were firm that a Fairmont Mountain Pulley is 3.5" diameter, while an equal number were firm at stating that the Fairmont standard Mountain pulley is 3.25" diameter. Each group was emphatic that the other size (3.5" or 3.25") was not a Fairmont standard, but some oddball special size. One person actually had machined a 3" pulley, but I determined that in order to fit one would also have to machine the cone on the flywheel.

As I needed just a little bit more power to get up that nasty 4% grade, I figured by replacing my 3.5" with a 3.25" should do the trick. However, no one seemed to have one for sale, so I started by making a sketch of the pulley that I wanted and bringing that to several local machine shops. All indicated they could do that, but wanted a better diagram or a real sample. As I have to remove mounting bolts and tilt my motor to remove the existing 3.5" pulley from my car (due to sidewall clearances), I borrowed a standard 4" pulley from our local 2-cycle guru (RMD president - Doug Summers).

After bringing the 4 inch pulley to some local machinists the green light was given: "sure we can do that, but if you want the pulling face smaller, what size is the inside hole?" With this encouragement I removed my 3.5" pulley to check all dimensions in detail and found an interesting (later obvious) fact: all pulleys have an inside hole diameter 0.5" smaller than the outside pulling face. (Refer to photo 3) However the 3.5"also had a bit of extra clearance against the cone/neck of the flywheel in the form of a chamfer. A 3.25" pulley (with an even smaller inside diameter) might not fit. The problem is that as the outer pulling face diameter decreases, the center hole diameter also must decrease to maintain sufficient material between the mounting flange and inside pulley wall. So, before spending lots of money to machine a 3.25" pulley I wanted to make sure it would fit against my flywheel. Fortunately one of the 2-cycle experts I was directed to (Richard Ray) not only had a 3.25" pulley, but was willing to let me borrow it to check its fit. After waiting for USPS to deliver the sample I quickly bolted it on

and made a check run, everything seemed to fit and work. So it was off to the machine shop with an authentic Fairmont Mountain Pulley (3.25" version) with the order to "make me an exact copy of one of these", but with three minor changes. I requested: 1. the fillet radius between the pulling face and mounting flange be a bit larger (factory version was about 1/32", mine is about 1/16") to reduce the stress riser factor where force is transmitted to the flange; 2. The outer flange was to be made about 1/16" thicker just for more strength; 3. The chamfer on the inside hole to mounting flange where it fits against the flywheel was made slightly larger to ensure clearance.

Figure 1 shows the borrowed factory 3.25" pulley next to my shiny new machined pulley. Note this was machined out of a solid 6 ¼ "x 6 ¼ " x 5" block of steel, the smallest stock the machine shop had on hand that would work. The mounting flange on all pulleys is 6" in diameter, thus the need for a 6"+ block of steel to start with. Included in the copy is the curved pulling face needed to keep the belt centered on the pulling face.

Figure 1 Above: Machined copy (left) next to original Fairmont 3.25" factory pulley (right). All photos by the author.

Figures 2 and 3 (page 24) show all three pulleys lined up. Left to right: 4", 3.5" and 3.25". All three look like factory made pulleys, and appear to be machined from a casting. Note that the 4" and 3.5" are very similar, with the 3.25" having a smaller diameter outer flange in relation to the pulling face diameter than the others. The differences are more apparent from the backside view (photo 3) . One advantage is I can install or remove the 3.25" pulley without the need to remove mounting bolts from my motor.

So what happened at Chama this year? The results proved to be successful. I was able to maintain 17 – 22 mph on all the 4% sections of the run up Cumbres Pass, and kept up with the other ROC cars, even those with no passengers. On one trip I even caught up to the group ahead of me and had to hold back on the few 2% segments to give them some running room. Starting torque was noticeably better, and I could pull away from a stop and get to running speed quicker, with very little need to slip the belt. Once I got moving, even on the steep grade, I did not need to slip the belt to keep the motor from stalling. As an example of speed, the first severe grade is near the start below Labotto Siding. With my former 3.5" pulley I normally would slow to 16-17 mph at this grade, with the 3.25" installed I easily kept a 20-22 mph speed. Higher up the pass, just prior to Coxo road crossing (at about 9800 feet) there is a very long 4% grade where I would either stall or get down to 5-8mph using the 3.5" pulley. With the 3.25" pulley I dropped to 16-17 mph, keeping up or catching other ROC cars on the run. No, I never approached the speed at which the AA or transmission powered cars could do, but that was not the intent.

A few downsides: My Les King built car does have some unusual compromises, one of which is a smaller wheelbase, which also translates to a shorter belt. The belt that came with the car was labeled/ stamped "M15 L12", however after several years of running was slightly stretched and worn. In the worn state it measured 69 ½", but no one seemed to have a replacement that came close. Anything longer would not work as the smaller pulley and stretched belt made the idler pulley close up free space even more. I ended up with a pinned belt ordered from Smitty, which worked well over 7 days of running on the D&S and the C&TS. The other downside is a slightly lower top speed. The smaller pulley, of course, makes the engine run faster at any given speed and my top end on the flat seemed to be about 25-26 mph, while with the larger pulley I could easily get 28 mph on the flat.

So, was it worth it? Keeping the engine and other mechanical parts standard (or at least unmodified) was a plus for me. The higher torque at a given engine speed was just enough to keep me going at speed, thus the minor issues of belt size and limited top speed were a small price to pay. Plus, I learned a lot more about pulleys than I ever wanted.

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Figure 2: Left to right: 4" Standard, 3.5" and 3.25" pulleys. Note the curved pulling face on all pulleys, needed to keep the belt centered. All photos by the author.

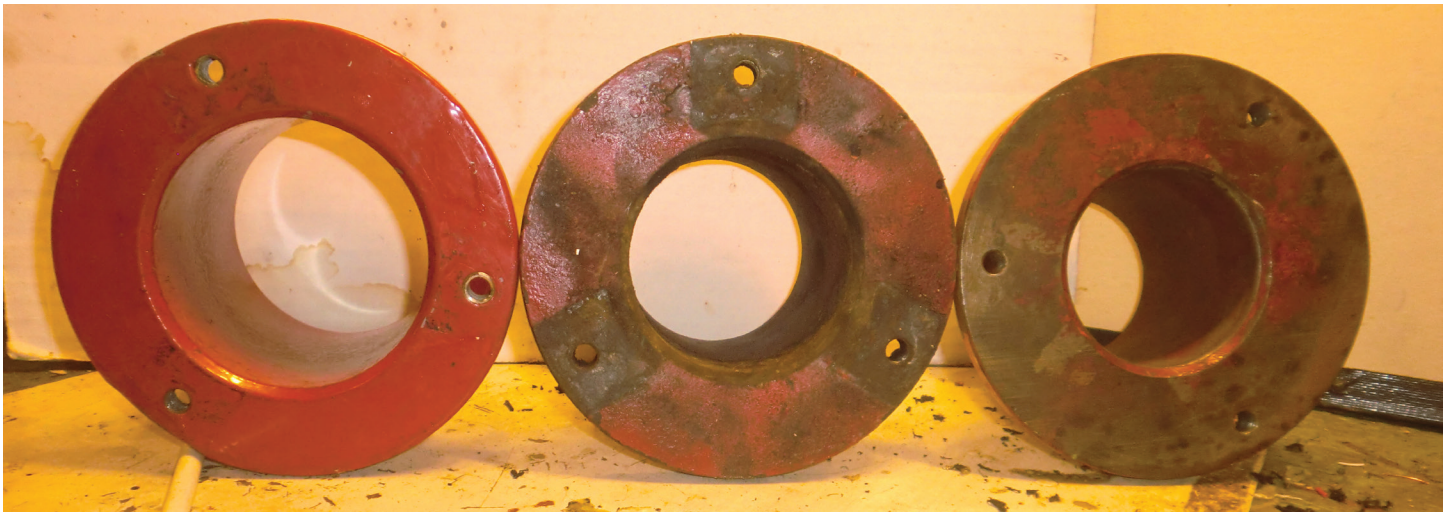

Figure 3: (ref file 6250) Back side of figure 1. 4", 3.5" and 3.25". Note the chamfer on each pulley, regardless of size.

Figure 4: Measurements showing center hole diameter is 0.5" less than outer pulling face diameter. Left pulley is standard 4" pulley (shows 3.5" inside diameter) , right is 3.5" pulley which shows a 3" inside diameter).