

Diagnosis: Misfire, Part I

By Tony Rhodes, Delaware Valley Triumphs

The Patient: The engine is an original TR4a four-banger which has not been run in 15 years. The car is completely restored, but having been driven only 28,000 miles, the engine was thought to be in fine shape. When last driven no obvious problems were noticed. 20 years ago, but less than 5,000 miles ago an exhaust valve was failing to close completely due to coke build-up on the backside and burned. A new valve was installed and it was hand-lapped in place. It seemed to be fine afterward.

During the rebuild the distributor cap, ignition wires, and condenser were replaced. The carburetors and fuel pump were rebuilt (by me). Pretty much all the stuff that can wear out or routinely deteriorate with age was replaced.

The Problem: With about 5 miles on the engine since its return to life, the engine seems down on power and idles poorly. Only the most basic adjustments were made at the time of reassembly of the car, and the timing and carburetor settings are approximate. When allowed to idle, the idle speed dropped from 1000 to the point of stalling over the course of a minute or two. Once the idle dropped below 750 the tendency to stall was strong. In addition, the idle had a frequent but irregular misfire. The miss, to my ear, seemed like that of an engine that is running with an excessively rich mixture. Off idle, the engine pulled strongly, but the power and throttle response seemed weaker than expected.

The Tests: A timing light shows that the engine timing was about 7 degrees *after* TDC. So the engine was running significantly retarded.

Checking the carburetors with the air cleaners removed showed that the synchronization at idle was just about perfect. Off idle the rear carburetor drew more air than the front. Using the "lifting pins" (to lift the pistons 1/16") on the SU carburetors resulted in the engine just trying to stall. This suggested that there was a problem with the synchronization or vacuum, and that the

carburetors seemed to be running lean.

The Treatments:

Step 1) The book says that the "static" timing (i.e. with no vacuum advance or centrifugal advance) should be 4 degrees *before* TDC. The vacuum advance and the centrifugal advance both begin to act at idle, and "static" setting is supposed to be done with the engine not running. The factory never specified what the timing should be with the engine actually running at idle. I supposed that stroboscopic timing lights did not exist when the TR2 was designed, and the book was never updated. Others say that this is due to significant manufacturing variability in the distributors, and the exact amount of vacuum & centrifugal advance at idle is not able to be accurately predicted.. The book says to start with the basic setting and then incrementally advance the distributor until it begins to ping at heavy load and full throttle. At idle the vacuum advance and centrifugal advance are probably only adding a slight additional advance, maybe a couple of degrees. I would estimate that a setting of 6 degrees advance is probably a reasonable starting point when using a timing light.

The problem with using a timing light on the TR2-4a engines is that there is only a pointer mounted on the front of the engine block and a hole in the crank-mounted pulley. No advance or retard markings are present, so there is no way to accurately measure the advance with a simple timing light. An "analyzer" timing light solves this problem. It costs a little more than the plain stroboscopic timing light, but it has a knob on it which will delay the flash of the strobe. The knob is calibrated in degrees of advance.

The analyzer timing light was set to 6 degrees of advance and then the distributor mounting was loosened. With the engine running at idle the distributor was turned until the pointer on the engine and the hole in the pulley aligned. The distributor was tightened. VOILA! Six degrees of advance. The idle speed increased significantly, so the idle screws on the carburetors needed to be adjusted to bring the idle down. The misfire was somewhat improved but remained fairly frequent

and irregular.

Step 2) The carburetors were properly and fully synchronized. (The technique is quite simple with the SU kit and is the subject of a separate technical article.) Once synchronized, the pistons lifted equally, so there was no longer much concern about abnormal vacuum affecting only one carburetor. Lifting the piston of SU carburetors slightly (1/16") with the lifting pins will cause the mixture to become slightly leaner. When the mixture is correct, using the lifting pin will cause a momentary slight increase in idle speed, then a drop to a level slightly below the baseline idle speed. If it is rich the idle speed will increase and hold there. If it is lean the idle speed will just drop. Since my idle speed only dropped, the mixture seemed weak.

I turned the jet adjusting nuts downward to enrich the mixture. I heard the idle speed *drop* slightly. Typically if the mixture is lean and you are enriching toward the "ideal" mixture, then the idle speed should *increase*. Since my idle dropped, this was evidence that I was now too rich. I then lifted the pins again. Again the engine only dropped and tried to stall. I enriched it further to the point that the engine was obviously running rich. Using the lifting pins STILL only resulted in a drop on engine speed. Clearly, something was rotten in the town of Coventry.

For my TR7 I had obtained two Colortune devices. These are spark plugs with a clear crystal insulator that allows you to see the color of the burning mixture in the cylinder. The color should be "Bunsen Blue". Orangish yellow indicates a rich mixture. A whitish color indicates a lean mixture. After using these on the TR7 a few times, I found that I could be just as accurate (or more accurate) using the lifting pins on the carburetors. I put the Colortunes away and never had cause to use them again... until now.

I removed the normal spark plugs and screwed the Colortunes into the #1 and #4 cylinders. Restarting the engine showed the orangish yellow color of a rich mixture. I then turned the jet adjusting nuts upward to lean the mixture. I could lean it out to the point where it would not run, but I could not get

the blue color of a correct mixture! Coventry has something not just rotten, but putrid!

In order to get a ballpark setting of the mixture, I tuned it by ear. I started from a rich setting and adjusted the jets more lean until the idle speed started to drop. I then adjusted back in the rich direction until the idle speed came back up to the plateau. (This technique got me to within 3 to 6 flats of the adjusting nut to the "ideal" mixture. If the lifting pins were giving the expected results, I could get the mixture adjusted to within one flat or better.) Whatever the mixture was, this seemed to be reasonably close to the optimal setting.

After all this, the misfire is much reduced. The engine will idle quite comfortably at 750 rpm with an occasional miss. However the mixture is still incorrect, unable to be corrected, so there must be a basic problem with the engine.

Update: When I rebuilt the carburetors I did not rebush the bodies for the throttle shafts. The old shafts had some wear, no more than 2 thousandths, but after I fitted the carburetors I had some sticking resulting in variable idle speeds. It may have been caused by slightly too great clearances around the throttle shafts.

I had some NEW carburetors and fitted them. The problem with setting the mixture persists, and is rather annoying. I tried another alternative to tuning the mixture. Rather than progressively lean-out the mixture until the engine speed drops, then enrich it back slightly, I did the opposite. I progressively enriched the mixture until the engine speed dropped, then I leaned it back again slightly to restore the engine speed back to the plateau.

This technique made the engine very happy. Previously the engine misbehaved fairly badly when cold. Now it drives well while on choke and when warm, it seems to have good power. It still does not respond crisply to the lifting pins. I am still looking for the full solution to the tuning difficulties. I may have to get the head fixed up as the next step.