Pendulum Rattler Balancer Absorber

The Sterling "Rattler" Torsional Vibration Absorber

Better Crankshaft Balance With Improved Technology

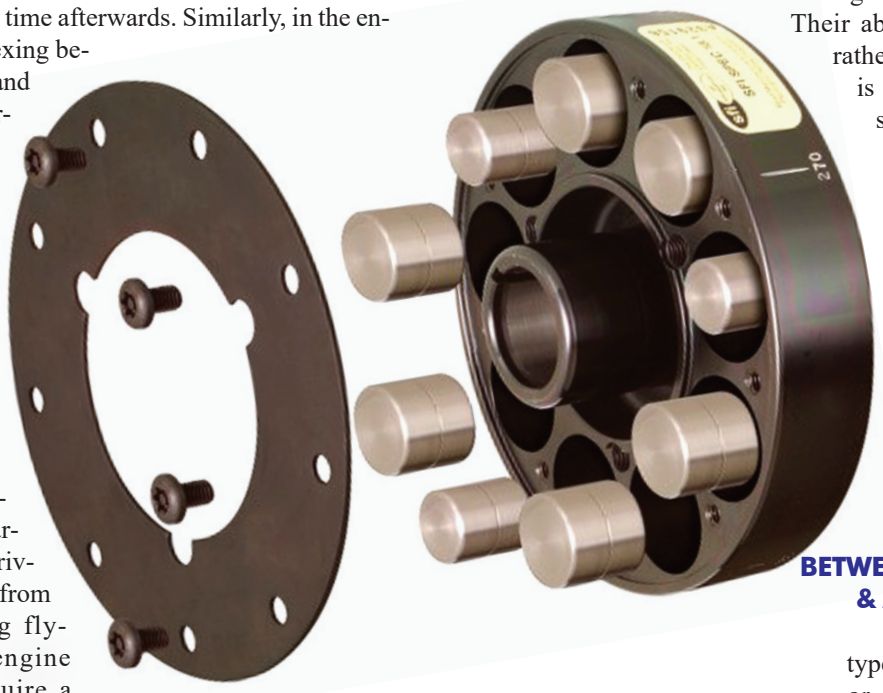
As told to the Editor by **Steve Smith**, England www.vibrationfree.co.uk

WHY GET A DAMPER!

The harmonic damper on the front of your crankshaft is/was there for a reason. Like the shock absorbers on your cars suspension, it reduces the vibration after you hit a bump in the road. Only, in the crankshaft the bump in the road is replaced by the power strokes of your engine.

If you took your shock absorbers *(dampers)* off the car, then every time you hit a bump the wheel would bounce up and down for a long time afterwards. Similarly, in the engine, the crankshaft flexing between big-end journal and the adjacent main bearing journal is damped after a power stroke with a damper. Without a damper the flexing is exaggerated and fatigue cracking ensues !!!

The trouble is that the harmonic damper is inherently heavy; it is also specifically "tuned" to the rotating masses of the particular engine and its drivetrain. Any deviation from that, e.g.; lightening flywheels, clutches, engine swaps, etc. will require a change to the inertia mass on the damper. This is hard maths and gets expensive to make it right.



Solid rollers are made in a variety of diameters and chosen to tune the balancer to the engine's requirements. This assembly is attached to the crankshaft nose or machined into a flywheel. It can incorporate a pulley and timing marks.

There are three potential problems with rubber and fluid harmonic dampers:

- They could wear out due to a combination of energy, age, and exposure to temperatures and chemicals.
- They are generally tuned to only one RPM range.
- They dampen, by wasting the energy as heat.

PENDULUM - RATTLER - BALANCER

Alternatively, the Sterling Rattler works on a totally different principle. It is generic by design to specific engine types e.g.; 4 cylinder in-line, 6 cylinder in-line, V-8's, etc.

A pendulum absorber is a balancer that is relatively new to the automotive aftermarket. This type of balancer absorbs — not just dampens — vibration through a set of counter-weights whose natural frequencies are directly proportional to the rotating speed of the crankshaft.

This alternative to the traditional damper-type balancer have now begun to trickle down from industrial and aviation environments to those of us on the street and those racing.

Pendulum absorbers *(often called "rattlers" because they make a click like sound when the clutch is first engaged as the steel cylinders find home)* have been developed to control amplitudes of vibration and angle of crankshaft twist like no other design is capable of. Their ability to absorb, rather than dampen, is the key to their success. They are effective for the entire rpm range, allow the engine to run smoothly, require virtually no maintenance and they extend crankshaft and bearing life.

DIFFERENCE BETWEEN DAMPERS & ABSORBERS?

There are fluid type and stock type or elastomer *(rubber)* dampers. Newest to the market is the Sterling Rattler absorber. The first two units have been readily available to the automotive market for many years and in fact were the only types available. The fluid type and elastomer type devices are dampers that tend to reduce vibration by using friction to dissipate energy. The Sterling Rattler, an absorber, is a device that absorbs and controls vibration by using internal rollers that automatically offsets the twisting forces that cause vibration.

DO I NEED AN ABSORBER OR DAMPER?

Simply put, to stop premature metal fatigue in your rotating assembly and to refine the noise and vibration from the engine.

The big end of each con-rod slightly increases rotational speed during power strokes and decreases during compression strokes. This is what causes twisting vibration of the crankshaft. In some instances, since the crankshaft drives >>>>

the camshaft and ignition timing, crank vibrations can also cause instability in the valve train and create spark scatter in the ignition timing. The dampers and absorbers are designed to reduce these vibrations.

WHAT IS CRANKSHAFT TORSIONAL VIBRATION?

All internal combustion engines will display crankshaft torsional vibration. This is because the accelerating torque from firing cylinders cannot be applied to crankshafts with steady pressures. It varies with the position of the crankshaft in relationship to each cylinder. As the piston rises and falls, so does cylinder pressure. The changing pressure, acting on the piston, results in forces transmitted along the connecting rod and applied to the crankshaft journal. In the operation of the crankshaft assembly, the forces reverse back and forth. The crankshaft reacts and transmits these forces that are indicative of crankshaft torsional vibration.

Each cheek of steel that joins the big end bearing journal to the main bearing journal has to carry the torque reaction between the firing cylinder and the rotating crankshaft. It cannot transfer this torque instantaneously and consequently flexes. For each forward flexing there is a reversal and this causes the crankshaft to "twist" back and forth along its length. This is the torsional vibration "a twisting action along its length as the crankshaft rotates".

HOW DOES THE STERLING RATTLER WORK?

Inside the Sterling Rattler are steel rollers that fit loosely into a specific number of cavities. By using an exact mathematical relationship, the rollers will roll forward during compression strokes and roll backward during the power stroke to keep the engine speed variations and vibration, to a minimum.

IS THIS NEW TECHNOLOGY?

The concept is not new in fact it has its origins in airplane engines as far back as the 1920's and is still being used today. What is new is that Vibration Free has applied this technology to the automotive aftermarket requirements of older and current internal combustion engines. This design concept permits the unit to be applied to front or rear mounted absorbers in the form of flywheels or pulleys and produced at a competitive price for the automotive industry.

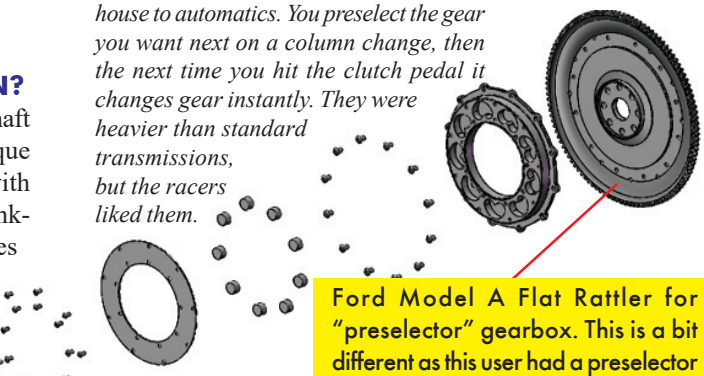
CAN AN ENGINE DYNO SHOW TORSIONAL VIBRATION TWIST?

No. To test torsional vibration twist you need expensive monitoring equipment that you will not find at your average engine builder/dyno facility. This is a very costly type of testing and very few units sold in the aftermarket have ever been exposed to this type of testing.

Vibration Free Company has likewise carried out extensive testing across many types of Sterling Rattler designs to proven results.

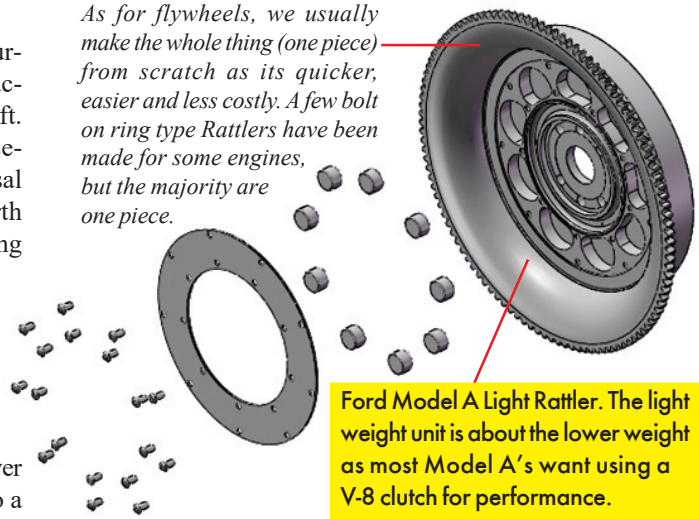
Complete New Flywheels With Rattler Machined Into Body

"Preselector" gearboxes were a half way house to automatics. You preselect the gear you want next on a column change, then the next time you hit the clutch pedal it changes gear instantly. They were heavier than standard transmissions, but the racers liked them.



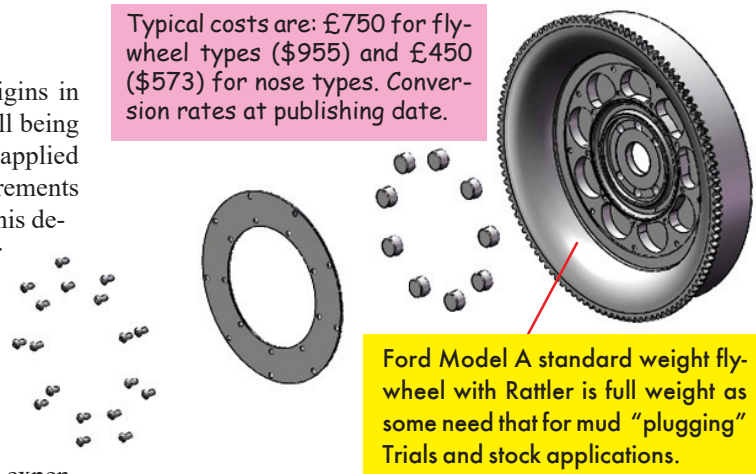
Ford Model A Flat Rattler for "preselector" gearbox. This is a bit different as this user had a preselector gearbox, but shows the Rattler as a bolted onto the flywheel.

As for flywheels, we usually make the whole thing (one piece) from scratch as its quicker, easier and less costly. A few bolt on ring type Rattlers have been made for some engines, but the majority are one piece.



Ford Model A Light Rattler. The light weight unit is about the lower weight as most Model A's want using a V-8 clutch for performance.

Typical costs are: £750 for flywheel types ($955) and £450 ($573) for nose types. Conversion rates at publishing date.



Ford Model A standard weight flywheel with Rattler is full weight as some need that for mud "plugging" Trials and stock applications.

These images show Vibration Free's modified Model A & B Ford flywheels with the rattler installed on the front face. The crankshaft nose type is shown below. All their flywheels are one piece with integral ring gear and heat treated EN24T, to make it bullet proof.

DOES IT HAVE TO MAKE NOISE TO WORK?

The only time you may hear the Sterling Rattler is when starting and stopping the engine, when you might hear the slight "click" of the rollers dropping within the cavities.

ARE SPECIAL TOOLS NEEDED?

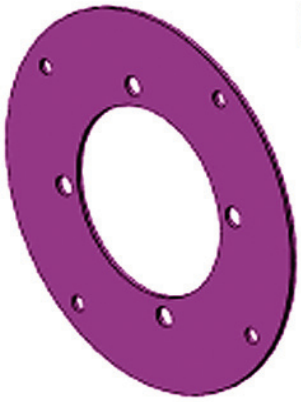
The Sterling Rattler is a positive fit onto the nose of crankshafts, so you will need to use the same drawing and pulling tools and procedure that you would when installing a normally tight pulley.

DO TIMING MARKS SLIP?

No. The timing marks are integral to the body itself and cannot move relative to the crankshaft.

WHAT ABOUT HORSEPOWER?

To date there have been many high performance engines built by astute engineers that do give a significant rise in horsepower and proven by back to back tests on the dyno.



The gains in power arrive by providing a stable and vibration free driving force for the camshaft and valve train. The Sterling Rattler has shown horsepower gains on the dyno but its primary function is extended durability due to reduced twist and fatigue.

WHAT IS RESONANCE FREQUENCY?

A bell, if struck, will "ring" at its natural frequency, just like a guitar string does. Everything has a natural frequency and a crankshaft is no different. Like the bell being struck with a hammer the firing power strokes of an engine at certain critical speeds excite the crankshaft to resonate at its natural frequency. It is not uncommon for these conditions to cause failures in crankshafts, front end accessory belts, gear train, and valve timing problems.

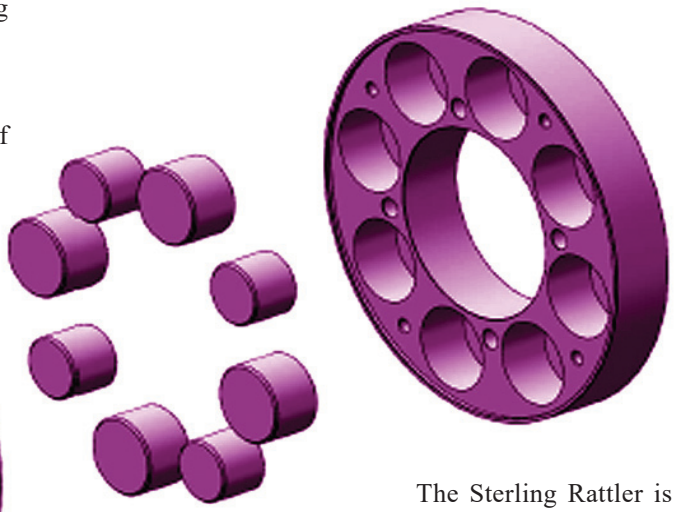
Resonance occurs when the exciting frequency is equal or close to the natural frequency of your crankshaft assembly or harmonics of it. The resonant crankshaft twisting action can be controlled by dissipating or absorbing that energy. Energy if dissipated is converted from mechanical energy into heat through friction, as is common to the elastomer and viscous type dampers. With an absorber type damper such as the Sterling Rattler, torsional control is achieved by counteracting the forces at source that would if left unchecked initiate torsional vibration.

Through research and testing, detrimental engine harmonics have been identified. The absorber is designed to eliminate those specific harmonics which can cause failure. In other words, the absorber concentrates on eliminating the cause as opposed to reducing the effect of torsional vibration.

WHAT ELSE HAS RESONANCE FREQUENCY?

No, all objects have a natural or resonant frequency. Through research and testing, we can identify where resonance frequency is most harmful to an engine. The power stroke pulses of the piston firing are by far the principle forces that cause major damage to an engine.

THE MAIN ADVANTAGE OF THE RATTLER?



The Sterling Rattler is tuned to the number of firing cylinders per revolution and is effective at all engine speeds. It can be fitted to any even fire engine at the front or back and make use of the space available. It is important to remember that maximum efficiency is achieved at all engine speeds. In order for the elastomer type to be effective, it must be carefully matched to each specific engine combination. It can be effective on stock engines since many of the OE and industry engineers spend a great deal of time tuning for a specific engine. No engine builder can do testing to match a modified engine to a damper's characteristics. Because of the design, the Sterling Rattler is tied primarily to the number of cylinders. It can easily be produced to match the specific needs of the enthusiast.

ARE THERE OTHER ADVANTAGES?

The torque capability of the Sterling Rattler to control vibration is huge. For example, the centrifugal force of one roller *(typically the Sterling Rattler has a total of 9)* at 7000 RPM creates 2407 pounds of force which is available as needed to control vibration. In other words, the rollers move as needed to control vibration. (see Q & A on next page)

CAN YOU BALANCE WITH A RATTLER INSTALLED ON THE ASSEMBLY?

Yes, the rotation of the crankshaft is sufficient to push the pucks inside the Sterling Rattler into position. One of its benefits is that it has a solid billet machined one piece concentric hub, which means the residual imbalance levels are always very low.

WHAT IS THE LIFE OF THE STERLING RATTLER?

To ensure that the Sterling Rattlers are safe to operate >>>>

at the high rpms associated with the performance industry, several measures were taken. Tests have surpassed the 100-million cycle mark with very little wear. The steel pucks inside steel cavities; roll very small amounts, not slide, in order to absorb torsional vibration. The Sterling Rattler is unaffected by temperature, whereas the heat dissipating fluid and elastomer dampers will degrade if worked too hard and do require replacement in time.

Brand new, "A", low mileage, expensive, forged billet crankshaft used without a "Rattler."Scary?

Which is more cost effective to you? Buying another crankshaft and its related installation costs or buying a Rattler Balancer once?

QUESTIONS - EDITOR TO STEVE SMITH

Steve: in the preceding article the following statement is made;

"The torque capability of the Sterling Rattler to control vibration is huge. For example, the centrifugal force of one roller (typically the Sterling Rattler has a total of 9) at 7000 RPM creates 2407 pounds of force which is available as needed to control vibration. In other words, the rollers move as needed to control vibration."

RPM RANGE FOR BANGERS

Q: Knowing that the Model A and B engine are best serviced in the 3500 maximum rpm range *(perhaps an occasional 4000 + for racing)* . . .then 7,000 rpm would not (normally) apply to Model A B Ford engines. Can you restate this with our vintage Fords in mind please?

A: Number crunching done ! One puck roller at 1000, 2000, 3000 & 4000 rpm gives; 10, 40, 90 & 161 pounds of force respectfully. Whereas there are 9 roller pucks, so collectively give; 90, 362, 815, & 1450 Ibs force for the same rpm breaks.

Think of the roller action like that of pushing a child on a swing; get the timing right and even with a small push you can enhance the swing amplitude or cancel it!

The Rattler action is designed to cancel it, once diminished the rollers are simply being carried along like passengers.

NOSE OR FLYWHEEL

Q: One question comes up often: What works best, crankshaft nose or flywheel placement for best balancer function? Of course the nose fit is most common, but then I'm a recluse (grin) and focused on old stuff..

One fellow in Texas (Ron Kelley) delivers some of his rebuilt engines with a rubber balancer on the front side of a lightened flywheel. Does it work? We really don't know. But owners feel all warm and fuzzy. Some folks simply believe "something is better than nothing." Again, we really don't know.

A: It makes no difference to the crankshaft as a "Rattler" type of Absorber can be placed anywhere on the crankshaft line.

Dampers are best placed on the nose. Unfortunately the nose of a Model A crank is not very strong and we had one break through the key area. That shows how much force and how hard the Rattler works.

A rubber based damper requires a tuned mass to *exactly* react to the natural frequency of the crankshaft line. And so, if one has been borrowed from another engine type, it will do something but it will not be as accurate or efficient as its original engine placement. Dampers (rubber and fluid) should be placed on the nose of the crank.

CORRELATION TO TIRE BALANCE BEADS

Q: There is firm named "Dyna Beads" *(and others)* that use very, very, very small ceramic balls/beads poured into tires or tubes to balance tires. They work beyond belief and get better as speed increases. I'm assuming there is some correlation between your Rattler and the beads?

A: As for Dyna Beads, we have used them too for tyre balancing, actually I worked with the British Engineer in the 1980's who designed the principle of ball bearings in a tube to balance the front loading washing machines.

However, they work on a completely different principle and only work in a softly suspended situation. Basically as your unbalance spot on the tyre gets to TDC it lifts the tyre off the ground and as it does so, the beads fall to BDC and eventually counterbalance the offset. Works well on thin tyres, doesn't work *(as well)* on wide tyres.

ARE YOU ALONE

Q: There is a company in the States that sells "Rattler" balancers. Is that you guys, a franchisee or a rip off??

A: TCI Automotive in the USA purchased the patent in 1990 for the "Rattler" design principle from its Designer and employed Him to create the designs (needed) to cater to the American range of engines, typically V8 and the odd V6 and one 4 Banger.

We met with TCI in 2005 at the PRI show and took on a European distributorship. We would take the USA Rattler and modify to suit European crankshafts.

Soon, after we were making one off versions under license and the first flywheel versions. Shortly after that TCI gave us the freedom to design and manufacture our own range and that as they say is history.