This is an interesting discussion. I find the Porsche patent very concise and easy to understand compared to most. As a Mechanical Design Engineer (~35 years) who works in a field where vibration control and isolation is always a major contributor to design, perhaps I can shed some light on what I understand the problem is and Porsche's solution. Full disclosure: I have no physical experience with the TT, other than checking/torqueing the driveshaft clamps, crank end play, etc. I'm currently researching my own TT rebuilt project, which is one reason this thread has caught my interest.

According to the patent, TT bending is the concern. The TT, like all physical items has a natural frequency (Fn) at which it will naturally vibrate (in bending) when excited at/near this frequency – it also has a natural frequency in torsion, where it will naturally twist, not part of this discussion. The Fn is a function of the stiffness (K – sometimes referred to as spring rate) and mass (M) of the system - **Fn = square root of (K/M)**. The K for the TT is based on its physical size/shape, material properties (specifically E – modulus of elasticity) and mounting conditions (fixed, simply supported, etc.). The M is based on the TT weight, and that of items it supports – for example, internal bearings, and part of the driveshaft weight (some of the driveshaft weight can be considered supported by the engine and transmission). The Fn of the TT can be manipulated via design by changing K, M or both, but overall size, weight, strength and cost constraints will limit the range in which the Fn will occur. Considering its physical size, I'd say it's a low frequency system, and based on my own drivetrain resonance I'm currently experiencing @~3000 RPM, I'll call it 50 Hz (Hertz - cycles/sec). It could be even lower, perhaps 25 Hz (50 Hz would be a 2X harmonic of 25 hz). So, when the TT gets excited by something at or near its Fn, it is going to resonate (vibrate) like a guitar string. The amount of travel (displacement) that occurs as it resonates is related to the Fn – the lower the Fn the higher the displacement – the higher the displacement, the greater the bending stress in the TT. Thus raising the Fn, which can be done by increasing K or lowering M, or both, is normally a good thing - perhaps not practical in this application.

Introduce Damping, which is a property or process by which vibration energy is removed (dissipated – converted to heat), thus reducing the amount of displacement that occurs at Fn. Without damping, the system would continue to oscillate with greater and greater displacement until it failed. For example – a singer causing a glass to shatter, when exposing it to sound frequency at the glasses Fn; the glass in air does not have enough damping so the glass oscillates until failure. The TT material itself (steel, I presume) generally has some, but not a lot of internal damping (think Lead, which has a lot of internal damping); however, the surrounding air and other components (bearings, driveshaft, etc.) also act to add damping to the system (they help dissipate vibratory energy through friction/heat). When excited with an input force at/near its Fn, the TT is always going to oscillate (resonate at Fn) – the less the available damping the greater the displacement of the TT. Adding damping will reduce the displacement of the oscillations at Fn, which reduces stress – it won't necessarily change the Fn, however. Apparently, Porsche had a problem with TT oscillation causing problems, whether NVH, or mechanical failure or both.

To solve the problem, Porsche set up a secondary spring/mass/damper system inside the TT, most likely tuned to the same Fn as the TT (patent refers to "dynamic coupling"), positioned at the location of greatest displacement, which increased the effective damping of the TT. Instead of all the vibration energy being applied to the TT itself, a good deal of it is transferred through the TT to the internal damper mass via the elastomeric mount. The mount, being an elastomer, acts as both a spring and damper, and enables dissipation (conversion to heat) of some of the vibration energy. The TT is still vibrating at its Fn, it is just not displacing as much because some of the energy is redirected into the damper mass. What I'm not certain of, but believe occurs, is the internal damper mass actually moves out of phase with the TT, at the same Fn (or a harmonic). Meaning, when the TT deflects upward, the damper mass is moving downward, and visa-versa. The elastomeric mount in between the two is absorbing a lot of the energy (converting it to heat, which is ultimately transferred to the TT and then the ambient).

What is causing the TT to get excited in the first place? Normally, the TT is going about doing its business. However, once subjected to an cyclic input force (forcing function) applied at or near its Fn (or a harmonic (multiple) thereof), it will start to vibrate (resonate) at its Fn. It's the engine/driveshaft rotating which is exciting the TT. Any imbalance in the rotating system will serve to further increase the input to the TT. The engine/driveshaft speed ranges from let's say 600 to 6600 RPM, or 10 to 110 Hz. Since the TT Fn is most likely within this frequency range, the engine/driveshaft spinning within or in contact with the TT will excite the TT during normal operation. There is no way around it. The practical solution is the increase the damping to reduce (attenuate) the displacement that will occur – which is what Porsche did. A more classic, but less practical approach would be to change the TT design to increase the Fn, preferable above 110 Hz, such that the TT will never couple with the engine/driveshaft in the first place. Not in the cards for something this massive.

In summary: During normal operation, as the engine passes through its RPM range, the engine/driveshaft continuously imparts vibratory (cyclic) forces on the TT; at a specific RPM (or RPMs), these cyclic forces couple with the TT causing it to resonate at its Fn. Due to the lack of natural damping in the system, the displacement that occurs generates high levels of NVH, increased stress in the TT and possibly increased stress in the driveshaft. Why the driveshaft? It is connected to the TT via bearings – as the TT resonates at its Fn, it carries the driveshaft with it (bending it "up and down") as the driveshaft rotates, causing an additional reversing bending stresses, which increases fatigue. To resolve the problem, Porsche incorporated a secondary spring-mass-damper assembly to attenuate engine/driveshaft induced vibration in the TT to reduce NVH and stress.