# PROVISIONAL APPLICATION FOR PATENT

**Title:**
System and Method for Smooth, RPM-Synchronized Speed Limiting on Pre-Electronic Vehicles via Ignition Coil Primary Modulation with Rotating Cylinder Protection and Optional Driver-Specific Profiles

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## DISCLAIMER

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## FIELD OF THE INVENTION

The present invention relates to vehicle speed control systems, and more particularly to an intelligent speed limiting device and method for vehicles that lack electronic throttle control or OBD-II interfaces, such as pre-1996 carbureted or early-electronic-ignition automobiles, motorcycles, and motorhomes. The system uses GPS-derived posted speed limit data in combination with real-time engine RPM monitoring to smoothly modulate power delivery by controlling the primary circuit of the ignition coil. The system further incorporates a rotating modulation protocol to protect spark plugs and engine components, and optionally includes facial recognition for driver-specific performance profiles.

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## BACKGROUND OF THE INVENTION

Many older vehicles (pre-1996) use cable-operated throttles and conventional ignition systems with a single ignition coil whose primary winding is switched by points, an electronic module, or a simple distributor. These vehicles have no electronic throttle actuator and no OBD-II port for modern aftermarket speed-limiting devices.

Recent and proposed legislation (e.g., Illinois HB 4948 and similar laws in other states) requires repeat or serious speed offenders to install certified “Intelligent Speed Assistance” devices. Existing commercial systems are designed almost exclusively for 1996+ vehicles with electronic

throttle control and OBD-II ports. No practical, certified solution currently exists for the millions of pre-1996 vehicles still in daily use for work and family transportation.

Simple RPM-based rev limiters have existed for decades, but they do not know the posted speed limit and cannot enforce it. An earlier concept of using GPS and coil intervention on older vehicles was described in UK patent application GB2334700A (filed 1998, published 1999, later withdrawn). That disclosure described basic interruption rather than the smooth, RPM-synchronized, microcontroller-controlled modulation with rotating cylinder protection described herein.

There remains a need for a simple, retrofittable, engine-safe device that can enforce posted speed limits on pre-electronic vehicles by intelligently modulating the ignition coil primary in a smooth, RPM-synchronized manner while protecting spark plugs through rotating modulation patterns. There is also a need for such a device to optionally apply different performance profiles depending on the identity of the driver.

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## SUMMARY OF THE INVENTION

The present invention provides a compact, aftermarket intelligent speed limiting system that installs on the primary circuit of a vehicle's existing ignition coil. A microcontroller receives real-time vehicle speed and posted speed limit data from a GPS receiver and digital map database. It also monitors engine RPM directly from the ignition primary pulses. When vehicle speed exceeds the posted limit, the microcontroller smoothly reduces effective engine power by modulating (duty-cycling or selectively gating) the primary current to the coil in synchronization with the engine's RPM. This produces a gradual "loss of power" feel rather than a hard spark cut, while preventing the vehicle from exceeding the posted speed regardless of gear or overdrive.

The system includes a rotating modulation protocol that distributes reduced-energy combustion events across different cylinders over successive engine cycles. This is achieved using a simple Hall-effect sensor on a reference spark plug wire (e.g., cylinder #1) together with RPM timing calculations, thereby protecting spark plugs from localized fouling caused by repeated unburned fuel delivery.

The system further includes optional facial recognition capability that identifies the driver and applies different speed-limiting or performance profiles depending on the recognized driver (e.g., full limiting for a teen driver, minimal or no limiting for parents in the same household).

Safety features return the system to full power if GPS signal is lost. The device is designed for easy retrofit on pre-1996 cable-throttle vehicles, motorcycles, and motorhomes without requiring throttle conversion or OBD-II access.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the intelligent speed limiting system according to one embodiment of the invention.

FIG. 2 is a schematic wiring diagram showing connection of the smart switch module to the ignition coil primary on a conventional pre-1996 vehicle.

FIG. 3 is a flowchart illustrating the control algorithm that synchronizes coil modulation with measured RPM and GPS-derived speed error.

FIG. 4 shows representative timing waveforms of primary coil current with and without modulation during a speed-limiting event.

FIG. 5 is a graph showing vehicle speed versus time during a typical speed-limiting event.

FIG. 6 is a simplified block diagram of the safety and failsafe architecture.

FIG. 7 is a schematic diagram illustrating the cylinder-position reference system using a Hall-effect sensor on a reference spark plug wire to enable rotating modulation across cylinders.

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## DETAILED DESCRIPTION OF THE INVENTION

The system comprises a GPS receiver with access to a digital map database containing posted speed limits, a microcontroller, a solid-state smart switch (e.g., MOSFET or IGBT) placed in series with or across the primary winding of the ignition coil, and appropriate signal conditioning and power supply circuitry.

The microcontroller continuously:

1. Determines current vehicle speed and the posted speed limit for the vehicle's location using GPS and map data.
2. Calculates the speed error (actual speed minus posted limit).
3. Measures instantaneous engine RPM by counting ignition primary pulses over a short time window.
4. When speed error exceeds a threshold, calculates a target power reduction needed to bring vehicle speed back to (or below) the posted limit. Because the relationship

between engine power and vehicle speed depends on the current gear, the algorithm uses both vehicle speed and RPM feedback to determine the required modulation depth.
5. Generates a synchronized modulation signal (pulse-width modulation or selective pulse gating) that is phase-locked to the ignition primary pulses. This modulation reduces the average energy delivered to the coil primary on a per-cycle or multi-cycle basis, smoothly lowering effective engine torque output.
6. Applies the modulation in a controlled ramp so the driver experiences a progressive loss of power rather than an abrupt cut.
7. Continuously monitors the result via vehicle speed and RPM feedback and adjusts modulation depth in real time to maintain compliance without excessive misfire or roughness.

Because the modulation is synchronized to actual engine RPM, the system works correctly in any gear, including overdrive. The same target vehicle speed produces the appropriate RPM reduction regardless of which gear is selected.

## Safety and Engine-Protection Features

Safety and engine-protection features include:

- Immediate return to 100% duty cycle (full power) if GPS fix is lost or map data is unavailable.
- Maximum modulation depth limits to prevent excessive misfire counts that could overheat a catalytic converter (if present) or cause detonation.
- Optional knock or misfire detection input that can further reduce modulation or restore full power.
- Watchdog timer and hardware failsafe that defaults to full coil primary current if the microcontroller stops functioning.

## Rotating / Cyclic Modulation Protocol for Spark Plug and Engine Protection

In order to prevent localized fouling of spark plugs, excessive carbon buildup, and uneven wear during extended speed-limiting events, the microcontroller is further configured to apply a rotating or cyclic modulation pattern rather than modulating a fixed set of cylinders or firing positions. Because fuel continues to be delivered to all cylinders during modulation, repeated non-firing events on the same cylinders can result in raw fuel passing through to the exhaust. By rotating the modulation events across different cylinders over successive engine cycles, the system distributes the reduced-energy combustion events so that each spark plug experiences a statistically similar duty cycle of normal and modulated events.

To achieve accurate per-cylinder identification on vehicles equipped with a conventional single ignition coil and distributor (without requiring a full camshaft position sensor), the system may incorporate a simple Hall-effect sensor positioned adjacent to or clipped onto the spark plug wire of a designated reference cylinder (typically cylinder #1). The Hall sensor detects the

high-voltage pulse on the reference spark plug wire once per engine cycle. This reference pulse, combined with continuous RPM measurement derived from the ignition primary pulse train and stored knowledge of the engine's cylinder count and firing order, allows the microcontroller to determine the instantaneous cylinder position using straightforward arithmetic division and timing calculations. The modulation algorithm then advances or shifts the skip/duty-cycle pattern with each engine cycle (or group of cycles), producing a rotating distribution of modulated events.

The rotating protocol may be implemented as a fixed advancing sequence, a pseudo-random sequence seeded by RPM or elapsed time, or any other cycling method that achieves substantially even statistical distribution across all cylinders. Maximum modulation depth is still limited by the engine-protection logic described above to avoid excessive misfire counts. This rotating approach significantly reduces the risk of spark plug fouling from unburned fuel while still delivering the desired average power reduction needed to maintain compliance with the posted speed limit.

### Optional Facial Recognition and Driver-Specific Performance Profiles

In one embodiment, the system further includes an in-cabin camera with facial recognition capability. The microcontroller is configured to identify the current driver and apply different speed-limiting or performance profiles depending on the recognized individual. For example, in a family vehicle, a parent driver may be assigned a profile with minimal or no speed limiting, while a teen driver with a history of speeding violations may be assigned a profile that enforces the full intelligent speed limiting protocol described above. The facial recognition module may be integrated into the same microcontroller or may communicate with it via a wired or wireless link. This allows the same physical vehicle to provide different compliance behavior for different household members without requiring separate devices or key fobs.

The device can be packaged as a small module that splices into the coil primary wire (typically a single connection on the negative side of the coil) and receives power and ground from the vehicle's existing wiring. No modification to the throttle linkage, fuel system, or distributor is required. The same architecture applies to motorcycles (often single- or twin-cylinder) and motorhomes (frequently based on truck or van chassis with conventional ignition).

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## CLAIMS

1. A speed limiting system for a vehicle having an ignition coil with a primary winding, the system comprising:
   a GPS receiver configured to determine vehicle location and posted speed limit;
   a microcontroller in communication with the GPS receiver and configured to measure engine RPM from ignition primary pulses; and

a controllable switch coupled to the primary winding of the ignition coil, wherein the microcontroller is configured to modulate current through the primary winding in synchronization with measured RPM when vehicle speed exceeds the posted speed limit, thereby smoothly reducing engine power output.

2. The system of claim 1, wherein the modulation comprises pulse-width modulation or selective gating of primary current pulses, and the depth of modulation is determined from both vehicle speed error and current engine RPM.

3. The system of claim 1, further comprising failsafe logic that restores full primary current if GPS data is unavailable.

4. The system of claim 1, wherein the system is configured to operate on vehicles lacking electronic throttle control or OBD-II interfaces.

5. A method of limiting vehicle speed on a pre-electronic-throttle vehicle, the method comprising:
determining posted speed limit from GPS and map data;
measuring vehicle speed and engine RPM;
when vehicle speed exceeds the posted limit, calculating a modulation profile synchronized to measured RPM; and
applying the modulation profile to the primary circuit of the ignition coil to smoothly reduce engine power output.

6. The system of claim 1, further comprising a Hall-effect sensor configured to be positioned adjacent to a spark plug wire of a reference cylinder, wherein the microcontroller uses a reference pulse from the Hall-effect sensor together with measured engine RPM to determine instantaneous cylinder position and applies the modulation in a rotating or cyclic pattern across different cylinders over successive engine cycles.

7. The system of claim 1, further comprising a facial recognition camera configured to identify a current driver, wherein the microcontroller applies different speed-limiting profiles depending on the identity of the recognized driver.

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# ABSTRACT

A compact aftermarket intelligent speed limiting system for pre-1996 and other pre-electronic vehicles modulates the primary circuit of the existing ignition coil using GPS-derived posted speed limit data and real-time engine RPM feedback. The system smoothly reduces engine power through synchronized duty-cycle or pulse-gating modulation of coil primary current,

producing a progressive loss-of-power feel rather than a hard cut. A rotating modulation protocol, enabled by a simple Hall-effect sensor on a reference spark plug wire, distributes reduced-energy events across different cylinders to protect spark plugs from fouling. Optional facial recognition allows different performance profiles for different drivers in the same vehicle. The system is retrofittable with minimal wiring changes and includes robust failsafe behavior that returns full power if GPS signal is lost. The invention provides a practical compliance solution for classic cars, hot rods, motorcycles, and motorhomes that existing OBD-based systems cannot serve.

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**End of Provisional Application Draft**

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*This document contains 7 figures and 7 claims. It is ready for review and refinement by a registered patent attorney.*