"Exponential Speedometer"

Background and Explanations

In all vehicles there exists a very familiar device, the speedometer, which lets drivers know the speed at which the vehicle is moving. The speedometer is designed in such a way that it has a linear scale. That is, for the same rise in speed of the vehicle, there is a corresponding increase in the angle of the speedometer indicator needle. Depicted on a graph, the dependency between the speed of the vehicle and the indicator needle's angle swing can be indicated as a straight line. This state is shown in Fig. 1

The horizontal axis corresponds to the speed of the car, and the vertical axis corresponds to the needle's swing angle in degrees. The relationship between the speed and angle of the indicator needle looks like a straight line coming out of the point of crossing the axis, under some angle to these axes.

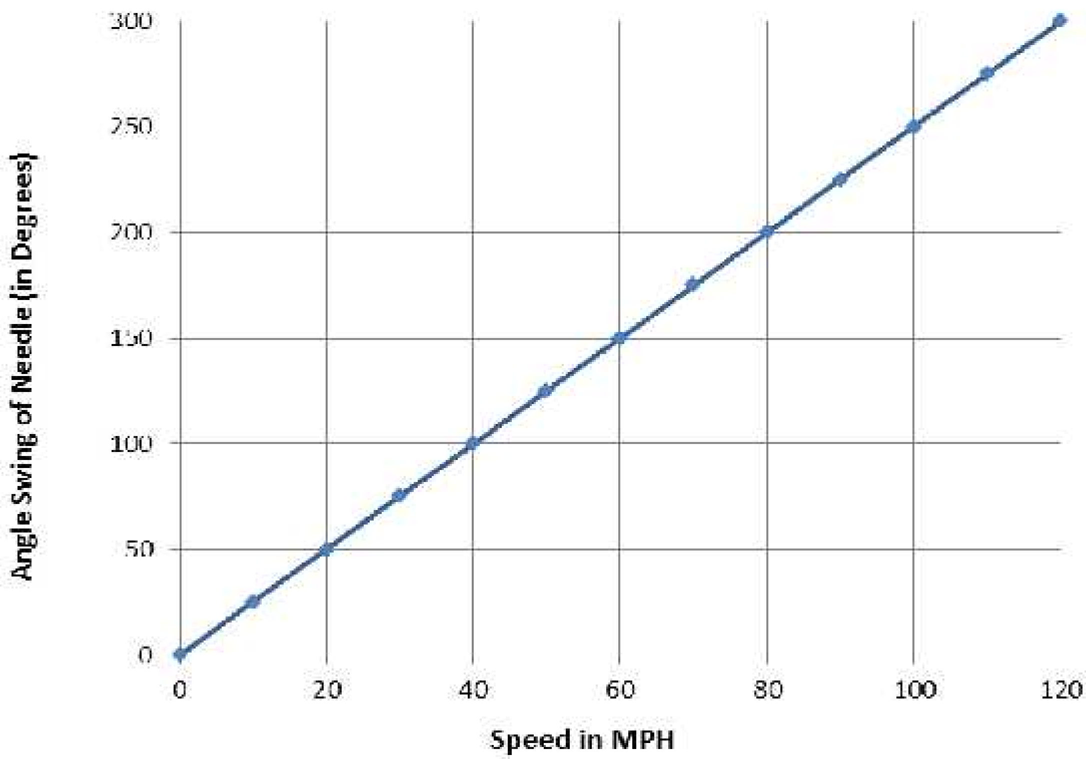

Figure 1. Angle Swing of Needle vs. Speed in Existing Speedometers

There is, however, a significant fault in the current implementation in that it does not indicate the potential risk of danger for the car and passenger(s) in case of a collision with another car or obstacle.

An important role is played by the kinetic energy of the car, which is defined as the energy possessed by a body because of its motion, equal to one half the mass of the body times the square of its speed.

Kinetic energy, along with the speed, rises exponentially in the fashion of a “square” function according to the following formula:

$$\mathbf{E=mv^2/2}$$

Where: m – mass of the car with passengers, and

v – speed of the car

As an example, assuming a mass of 1 for simplification, if the vehicle is moving at a speed of 40 MPH then its kinetic energy is equal to:

E=40x40/2 = 1600/2= 800 units of energy.

If this same car is moving with double that speed, that is 80MPH, then the kinetic energy is equal to

E=80x80/2 = 6400/2 = 3200 units of energy.

This is FOUR times greater than when the car was going half that speed.

This mathematical formula inspired and prompted me with an idea to improve or modify the speedometer, thus creating a new speed indication device.

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<u>**Description of Invention**</u>

Most drivers believe that the consequences of collision are proportional to the speed of the vehicle, when in reality the consequences of a vehicle crash rise in exponential fashion.

With the proposed speedometer implementation, the sweep of the indicator needle will increase exponentially in relation to the vehicle speed rather than in direct correlation.

That is to say, for every equal rise in the speed of the car, there will be increasingly larger swings of the needle. For larger speeds, the scale will be wider in correspondence to the increased physical danger in the event of a collision. When the driver looks at the speedometer needle and sees that it is close to reaching the end of the scale, then he or she will be more inclined to react by slowing down. The driver will be made visibly aware of the exponential danger of physical harm and potential loss of life. Colors of green, yellow, orange, and red will correspond to the rising angle swings depicting the risk levels.

With this modified speedometer, the dependency of speed from the indications on its speedometer when shown on a graph should be a curved line as shown in Figure .2.

The horizontal axis represents values of actual vehicle speed, and the vertical axis represents the values of angle swing of needle distributed according to the exponential function based on the kinetic energy formula.

The design of the new speedometer scale is shown on Page 5 - Drawing 2

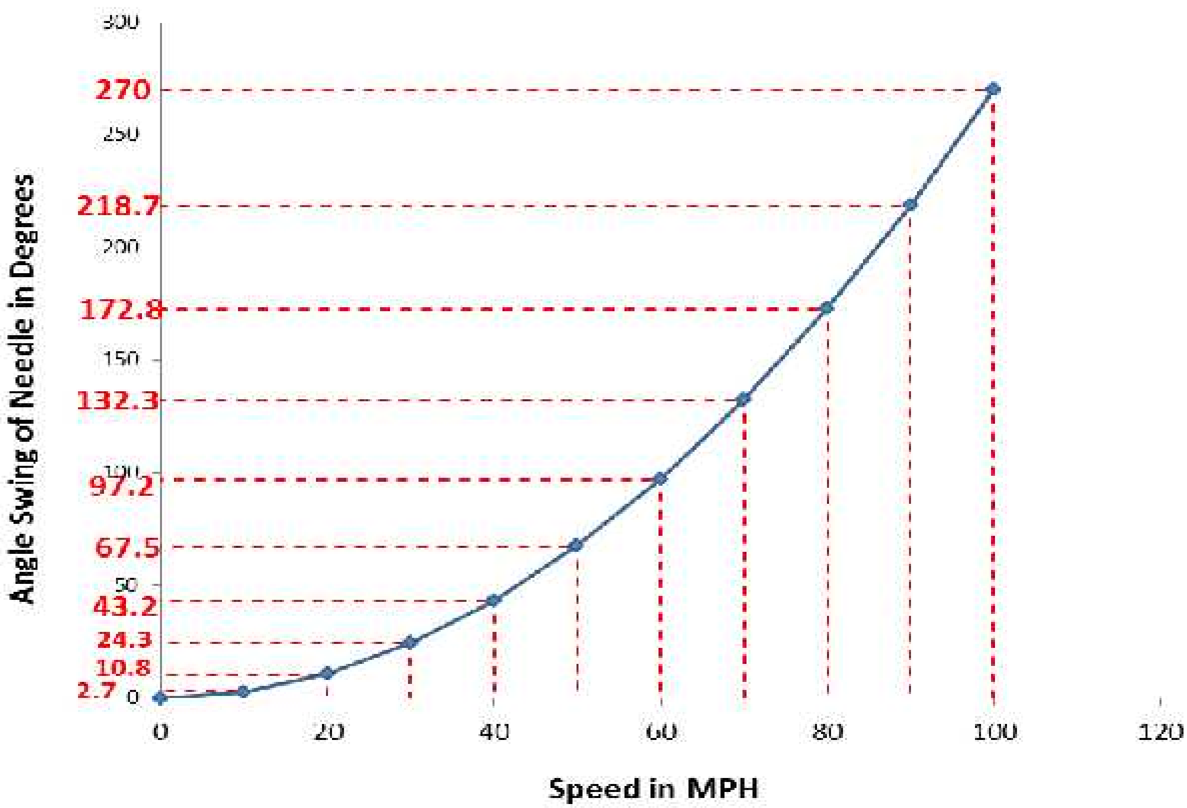

Figure 2. Angle Swing of Needle vs. Speed in New Proposed Speedometer

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In older mechanical speedometers, a change of the speedometer scale would have been difficult, but in this age of upgraded electronic speedometers the task is simple.

A question remains, however, about the scale of the gauge. If we adhere strictly to the formula for kinetic energy explained earlier, there are several issues, noted below, but none of them are insurmountable.

- Higher top speeds require larger and larger gauges to accommodate the necessary spacing.
- As a corollary to the previous point, automobile manufacturers frequently use top speed as a marketing tool and display a number that's possible only in rare circumstances.
- Due to the exponential growth of the scale, there would be crowding at low speeds.

The idea for a revised speedometer is to convey the exponential increase in risk of higher speeds.

The mathematical principles behind the kinetic energy formula allow us to use a different denominator to make the scale reasonable for all applications while still communicating the increased risk. So the scale need not be designed specifically to the formula above with the denominator of 2 and represent the actual value of kinetic energy, but rather to show the degree of risk respectively. That is, the denominator of the equation can be a different number and work in order to satisfy all applications while still showing the degree of risk.

With regards to manufacturer top speed claims, I'd propose that improving driver safety is a more valuable marketing tactic to pursue. Additionally, for all intents and purposes, the top speed displayed on current speedometers reflects an unrealistic value, one that is usually not even achievable without modifying the vehicle's on-board computer. This results in a good portion of the gauge being “wasted” for everyday driving. By limiting the top speed displayed to that which the car is electronically restricted, there should be no issue designing a gauge that can utilize the proposed scale.

As far as indicator crowding at lower speeds is concerned, I do not believe this to be a problem. Rather, the closer spacing at these speeds would reinforce that it's the safer range to be driving in. An impact at a slow rate of travel typically results in nothing more than a minor fender-bender, a fact that would be visually reflected in the smaller deviations the indicator arrow makes in this area of the gauge.

In conclusion, using a new speedometer that employs the proposed scale visually depicting the heightened risk level when driving at higher speeds will be significant in reducing the occurrence and severity of vehicular collisions.

On the next page, please see drawings of the current speedometers employed, and the new proposed speedometer.

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Drawing 1

Current speedometers in use.

Drawing 2

Invention - Exponential Speedometer