Toyota Electronic Modulated Air Suspension System for the 1986 Soarer

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Abstract—**Toyota has developed a new electronically controlled air suspension system capable of meeting mutually exclusive requirements such as soft riding and stable maneuverability on higher levels. The system uses sensors to detect vehicle speed, throttle position, steering angle, height, and other factors related to vehicle attitude. Its electronic control unit (ECU) drives the actuators to control spring rate, damping force, and height. As a result, the system reduces changes in vehicle attitude such as rolls, dives, squats, etc., and also provides stable maneuverability in high-speed cruising and improved drive characteristics on rough roads. A newly developed single-chip microcomputer is used in the ECU. The actuators for the spring rate and damping force use dc motors.**

The system not only performs optimum control automatically to meet vehicle travelling conditions, it also allows drivers to select suspension characteristics from a total of four modes according to their own preferences.

The suspension status is displayed on the MultiDisplay System CRT. This display uses all the potentials of graphic display to allow drivers to recognize information at a glance.

I. Introduction

RECENTLY THE performance of automobiles has been remarkably advanced, and consumer demands concerning suspension system have been intensified and widely varied, as well. Therefore, it is necessary to get various kinds of suspension performance at high technological levels, e.g., automatic modulation of characteristics appropriate to riding, handling, and road conditions.

The Toyota Electronic Modulated Air Suspension System, applied to the Toyota Soarer marketed in Jan. 1986, uses electronic technology to control vehicle height, spring rate, and damping force, thus achieving automatic control of suspension system characteristics.

II. System Outline

System configuration is shown in Fig. 1

The system consists of the following three control steps. First is detection of vehicle travelling conditions, second is the classification of the detected travelling conditions into one of several preset patterns, and third is to adjust vehicle height, spring rate, and damping force so that they will correspond to the characteristics designated for the pattern detected.

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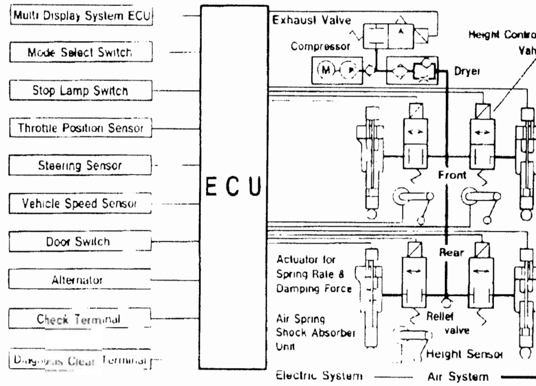

Fig. 1 System configuration

The controls performed for each pattern are outlined below

1) Braking at high speed, sharp steering and rapid starts ar detected by the vehicle speed sensor, stop lamp switch steering sensor, and throttle position sensor, and spring rat and damping force are adjusted upward when these phenomena are detected. This minimizes changes in vehicle attitude

2) During high-speed cruising, height is lowered and bot spring rate and damping force are increased to improv driving stability.

3) The presence of rough road conditions is detected b speed and height sensors, and height is increased and th spring rate and damping force are increased higher to preven bottoming.

4) Bumps on roads are detected by the speed and heigh sensors and spring rate and damping force are lowered t reduce bumps.

A compressor and height control valve are used to adjus height, and actuators driven by dc motors are used to adjus spring rate and damping force.

In addition to the sensors and actuators discussed above other major components include a system controlling ECU, suspension unit, and a mode select switch used to selec control mode.

The system is linked to the multidisplay system to displa suspension status on the CRT. Layout of system components i shown in Fig. 2.

III. Components

A. Computer

The block diagram is the ECU is shown in Fig. 3.

Its CPU is a CMOS single-chip microcomputer, speciall