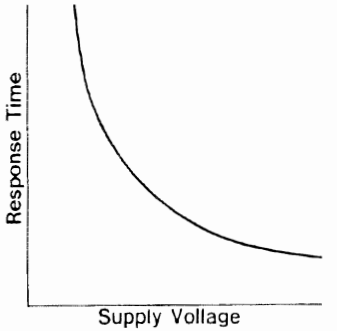

Fig. 12. Response characteristics of spring rate and damping force control actuator

modes. That is, the system provides the two control modes, NORMAL AUTO and SPORT AUTO, for spring rate and damping force, and another two control modes, NORMAL AUTO and HIGH AUTO, for vehicle height control mode.

B. Vehicle Height Control

1) Outline: The vehicle height control functions to match the actual vehicle height with the target height, which is set according to the vehicle speed and road conditions. Vehicle height is changed when the vehicle load changes due to a change of the number of passengers in the vehicle, etc., or when the target vehicle height is changed.

2) Setting Target Vehicle Height: The target vehicle height is selected from the three height levels—LOW, NORMAL, and HIGH. The target height during low-speed travelling on a flat road is taken as the basic height and height level is set according to the selected control mode: NORMAL height level is set when the control mode is in the NORMAL AUTO position and HIGH height level is selected when the control mode is in the HIGH AUTO position. The target height is changed by the travelling conditions in the following two cases:

a) During high-speed travelling, target height is lowered by one level to improve stability and aerodynamic characteristics. This change is executed at a vehicle speed higher than 90 km/h taking general travelling patterns and road conditions into consideration. After the target height has been changed, return to the basic height level occurs when vehicle speed is lowered to 60 km/h. Hysteresis of 30 km/h is provided in the control characteristics of prevent frequency occurrence of height level changes during travelling.

b) During travelling on rough roads, target height is changed one level higher when the vehicle speed exceeds a preset valve so that bottoming is reduced and driveability on rough roads is improved. The vehicle height signals from the left front wheel are used to detect rough roads. Vehicle height is changed higher when travelling on rough roads with remarkable angulation and suspension movement under such conditions is close to the natural oscillation of the sprung. Therefore, observation duration to determine whether the vehicle is travelling on rough roads is set at 0.5 s, approximately half the natural oscillation period. The target height is made higher when the following two conditions are met.

i) Variation of the vehicle height signals within the observation period has exceeded the reference value four times in succession.

ii) Vehicle speed is higher than 40 km/h

The conditions for returning to the basic vehicle height are indicated below. Returning occurs when either of these conditions is satisfied. (Hysteresis is added to the height change threshold vehicle speed.)

i) Variation of the vehicle height signals within the observation period is less than the reference value.

ii) Vehicle speed is lower than 25 km/h.

3) Vehicle Height Adjustments: The air chambers in the suspension are, under normal conditions, separated from the air lines with the height control valves provided for individual chambers closed. When there arises a need to change vehicle height, these valves open to connect the chambers with the air lines.

To increase the vehicle height, the pressure in the air lines is increased by operating the compressor with the exhaust height control valve closed. When vehicle height is to be lowered, the compressor is stopped and the exhaust valve is opened to lower the pressure in the air lines.

The air pressure inside the chambers of the individual suspensions is adjusted to bring the vehicle height to the target height.

Whether height adjustment is to occur or not is determined by the difference between the actual height and target height. Since the actual height should be adjusted to the target height as quickly as possible, such a difference in the height levels should be detected immediately. However, height disagreement caused by such a disturbance as roll while cornering, which does not require height adjustments, will continue for a relatively long period. This means that if the detection period is made too short, it will cause frequent occurrence of height adjustments or of undesirable height levels. To resolve these inconsistent requirements, two different height disagreement detection periods are provided for cases in which height disagreement easily occurs and those in which it does not.

A shorter detection period is selected right after the ignition is turned on, where variation of the number of passengers and load is anticipated, while the door is open and when the target height is changed. The detection period in such cases is set at 2.5 s, about twice the natural oscillation period of sprung to eliminate the influence of oscillation of the vehicle.

A longer detection time, set at 20 s, is applied in other cases.

There are cases in which height adjustments should not occur even when a difference between actual height and target height is detected. If the same control carried out under normal conditions is applied in abnormal states such as when the vehicle is being jacked up, the air in the chambers is extracted to contract the suspension which has been elongated due to reduced load. This causes the vehicle to be placed in an extremely undesirable attitude when the vehicle is returned to normal. To prevent such problems, the system is designed not to carry out height adjustment, if it detects abnormal vehicle height.

Height adjustment is not carried out also when the engine is