Components for braking-force distribution

As a result of dynamic axle-load shift under braking, more braking force can be applied to the front wheels of a vehicle than to the rear wheels. Consequently, the front brakes are more generously dimensioned than the rear brakes. The reduction of the load on the rear axle is not a linear progression, however, but advances at a faster rate as deceleration increases. On vehicles with "invariable braking-force distribution", therefore, overbraking of either the front wheels of the rear wheels will occur at some point depending on the force-distribution setting.

Overbraking of the rear wheels has a negative effect on vehicle handling and can cause skidding. By adopting appropriate measures (fitting a rear-wheel pressure regulating valve), however, the handling characteristics of the vehicle can be positively influenced and the actual braking force made to approximate more closely to the ideal braking force (no wheel lock-up).

A distinction is made between

- static or dynamic pressure regulating valves, and
- pressure limiting valves.

With a pressure regulating valve, the rate of pressure increase for the rear brakes is less than that for the front brakes upwards of a specific pressure (changeover pressure or changeover point). Upwards of the changeover point, static pressure regulating valves regulate the brake pressure according to a fixed characteristic, while dynamic pressure regulating valves do so on the basis of a regulating ratio that depends on the vehicle load or the rate of deceleration.

Pressure regulating valves must be designed in such a way that under practical conditions, the braking force is distributed at a level well below the ideal level. The effect of variations in the frictional coefficient of the road surface, the engine braking torque and the tolerance limits of the pressure regulating valve must also be taken into account in order to prevent rear-wheel lock-up.

The pressure limiting valve (described at the end of this chapter) prevents the brake pressure to the rear wheels rising any further once a specific level (shut-off pressure) has been reached.

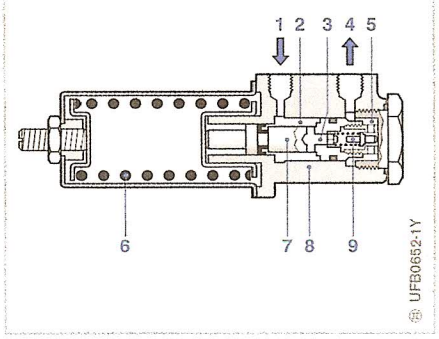
Depending on the type of vehicle and the braking system used by the manufacturer, there are essentially five versions employed:

- Fixed-setting pressure regulating valve,
- Load-dependent pressure regulating valve,
- Deceleration-dependent pressure regulating valve,
- Integral pressure regulating valve, and
- Pressure limiting valve

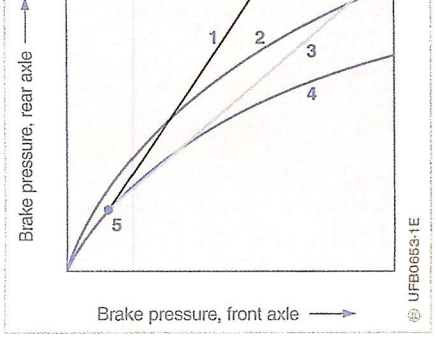
Fig. 1
1 Inlet port (from master cylinder)
2, 5 Annular chambers
3 Channel
4 Outlet port (to brakes)
6 Compression spring
7 Graduated piston
8 Valve body
9 Valve

Fig. 2
1 Unregulated pressure
2 Ideal pressure curve (laden vehicle)
3 Regulated pressure
4 Ideal pressure curve (unladen vehicle)
5 Changeover point

Fixed-setting pressure regulating valve



Fixed-setting pressure regulating valve



Fixed-setting pressure regulating valve

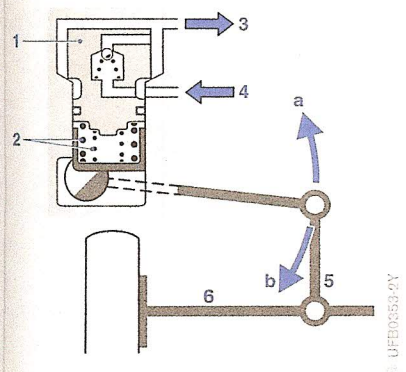
The pressure regulating valve (Figure 1) is fitted in the rear-axle brake circuit. The valve body (8) encloses a graduated piston (7) with an integral valve (9). The output pressure is reduced relative to the input pressure in proportion to the ratio of the effective areas of the annular chambers (2, 5).

When the brakes are applied, hydraulic pressure from the master cylinder passes via the inlet port (1), the annular chamber (2), the channel (3) in the graduated piston (7) and second annular chamber (5) to the outlet port (4). Shortly before the changeover pressure is reached, the pressure acting on the annular-chamber effective area (2) pushes the graduated piston to the right as far as the stop so that the valve (9) closes off the channel to the outlet port (4). As the pressure continues to increase, the graduated piston moves rapidly back and forth, opening and closing the valve (9) accordingly, thereby regulating the output pressure in proportion to the ratio of the effective areas (2, 5). Once the braking sequence ends, the pressure at the outlet port (4) pushes the graduated piston (7) against the compression spring (6) until the excess pressure in the annular chambers (2, 5) has reduced. Figure 2 shows the pressure curves.

Load-dependent pressure regulating valve

Vehicles whose payload can alter significantly from one journey to the next require so-called load-dependent pressure regulating valves (Figure 3) so that the braking forces can be adjusted according to the weight being carried. This type of pressure regulating valve is attached to the bodywork and connected to the vehicle's rear axle (6) by means of a rod linkage (5). The relative movement between suspension and body as the springs are compressed is transmitted to the graduated piston (1). The piston then compresses the control springs (2) according to the amount of suspension travel, thereby altering the changeover point. This achieves an adaptive response of the rear-axle brake pressure relative to the weight of the vehicle payload (Figure 4).

3 Load-dependent pressure regulating valve



Load-dependent pressure regulating valve

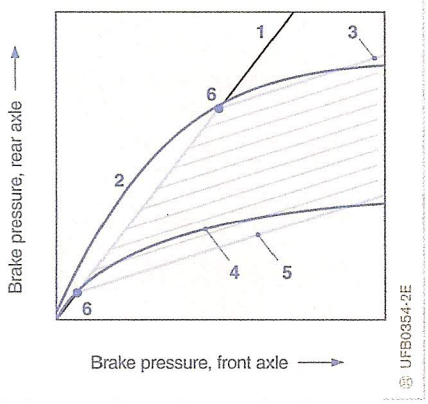


Fig. 3
a Laden vehicle
b Unladen vehicle

1 Graduated piston
2 Control springs
3 Outlet port to brakes
4 Inlet port from master cylinder
5 Linkage
6 Rear axle

Fig. 4
1 Non-reduced pressure
2 Ideal pressure curve (laden vehicle)
3 Reduced pressure (laden vehicle)
4 Ideal pressure curve (unladen vehicle)
5 Reduced pressure (unladen vehicle)
6 Changeover points