

# CPC COOPERATIVE PATENT CLASSIFICATION

## B PERFORMING OPERATIONS; TRANSPORTING (NOTES omitted)

### TRANSPORTING

#### B60 VEHICLES IN GENERAL (NOTE omitted)

#### B60T VEHICLE BRAKE CONTROL SYSTEMS OR PARTS THEREOF; BRAKE CONTROL SYSTEMS OR PARTS THEREOF, IN GENERAL (electrodynamic brake systems for vehicle, in general [B60L](#); brakes per se, i.e. devices where braking effect occurs, including ultimate brake actuators, [F16D](#)); ARRANGEMENT OF BRAKING ELEMENTS ON VEHICLES IN GENERAL; PORTABLE DEVICES FOR PREVENTING UNWANTED MOVEMENT OF VEHICLES; VEHICLE MODIFICATIONS TO FACILITATE COOLING OF BRAKES

##### NOTE

In this subclass, the term "brake control systems" includes brake control systems for vehicles or of general applicability

##### WARNINGS

- The following IPC groups are not in the CPC scheme. The subject matter for these IPC groups is classified in the following CPC groups:

<a href="#">B60T 8/20</a>	covered by	<a href="#">B60T 8/18</a>
<a href="#">B60T 8/22</a>	covered by	<a href="#">B60T 8/18</a>
<a href="#">B60T 8/60 - B60T 8/70</a>	covered by	<a href="#">B60T 8/17</a>
<a href="#">B60T 8/78 - B60T 8/84</a>	covered by	<a href="#">B60T 8/17</a>
<a href="#">B60T 13/122</a>	covered by	<a href="#">B60T 13/147</a> , <a href="#">B60T 13/167</a>
<a href="#">B60T 13/125</a>	covered by	<a href="#">B60T 13/141</a>
<a href="#">B60T 13/128</a>	covered by	<a href="#">B60T 13/145</a> , <a href="#">B60T 13/165</a>
<a href="#">B60T 13/13</a>	covered by	<a href="#">B60T 13/146</a> , <a href="#">B60T 13/166</a>
<a href="#">B60T 13/132</a>	covered by	<a href="#">B60T 13/143</a> , <a href="#">B60T 13/162</a>
<a href="#">B60T 13/135</a>	covered by	<a href="#">B60T 13/144</a> , <a href="#">B60T 13/163</a>
<a href="#">B60T 13/138</a>	covered by	<a href="#">B60T 13/148</a> , <a href="#">B60T 13/168</a>
<a href="#">B60T 13/60</a>	covered by	<a href="#">B60T 13/58</a>
<a href="#">B60T 15/06</a>	covered by	<a href="#">B60T 15/04</a>
<a href="#">B60T 15/08</a>	covered by	<a href="#">B60T 15/04</a>

- In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

#### 1/00 Arrangements of braking elements, i.e. of those parts where braking effect occurs {specially for vehicles}

- 1/005 . {by locking of wheel or transmission rotation}
- 1/02 . acting by retarding wheels
- 1/04 . . acting directly on tread
- 1/06 . . acting otherwise than on tread, e.g. employing rim, drum, disc, or transmission {or on double wheels}
- 1/062 . . . {acting on transmission parts}
- 1/065 . . . {employing disc ([B60T 1/062](#) takes precedence)}
- 1/067 . . . {employing drum ([B60T 1/062](#) takes precedence)}
- 1/08 . . using fluid or powdered medium
- 1/087 . . . in hydrodynamic, i.e. non-positive displacement, retarders

- 1/093 . . . in hydrostatic, i.e. positive displacement, retarders
- 1/10 . . by utilising wheel movement for accumulating energy, e.g. driving air compressors
- 1/12 . acting otherwise than by retarding wheels, e.g. jet action
- 1/14 . . directly on road (portable devices, e.g. chocks [B60T 3/00](#))
- 1/16 . . by increasing air resistance, e.g. flaps
- 3/00 Portable devices for preventing unwanted movement of vehicles, e.g. chocks
- 5/00 Vehicle modifications to facilitate cooling of brakes

#### Brake control systems or parts thereof

- 7/00 Brake-action initiating means
- 7/02 . for personal initiation
- 7/04 . . foot actuated

- 7/042 . . . {by electrical means, e.g. using travel or force sensors}
- 7/045 . . . {with locking and release means, e.g. providing parking brake application}
- 7/047 . . . . {Hand-actuated release means}
- 7/06 . . . Disposition of pedal
- 7/065 . . . . {with means to prevent injuries in case of collision (for vehicle pedals in general by moving them from an operative to an out-of-the way position [B60R 21/09](#))}
- 7/08 . . hand actuated
- 7/085 . . . {by electrical means, e.g. travel, force sensors}
- 7/10 . . . Disposition of hand control
- 7/101 . . . . {by means of a pull rod}
- 7/102 . . . . {by means of a tilting lever}
- 7/104 . . . . . {with a locking mechanism}
- 7/105 . . . . . {the lock being released by means of a push button}
- 7/107 . . . . {with electrical power assistance}
- 7/108 . . . . {with mechanisms to take up slack in the linkage to the brakes}
- 7/12 . . for automatic initiation; for initiation not subject to will of driver or passenger {(limiting speed of vehicles other than rail vehicles [B60K 31/00](#))}
- 7/122 . . {for locking of reverse movement}
- 7/124 . . {Brakes for railway vehicles coming into operation in case of accident, derailment or damage of rolling stock or superstructure (self-acting brakes in general [F16D 59/00](#))}
- 7/126 . . {Brakes for railway vehicles coming into operation in case of exceeding a predetermined speed (self-acting brakes in general [F16D 59/00](#))}
- 7/128 . . {Self-acting brakes of different types for railway vehicles ([B60T 7/12](#) takes precedence; self-acting brakes in general [F16D 59/00](#))}
- 7/14 . . operated upon collapse of driver (deadman's devices for electrically propelled vehicles [B60L 3/02](#))
- 7/16 . . operated by remote control, i.e. initiating means not mounted on vehicle
- 7/18 . . . operated by wayside apparatus
- 7/20 . . specially for trailers, e.g. in case of uncoupling of {or overrunning by} trailer (inertia-actuated overrun brakes [B60T 13/08](#))
- 7/203 . . . {with automatic brake release or reduction in case of reverse travel, e.g. by means of mechanisms mounted on the draw bar}
- 7/206 . . . . {by means of mechanisms mounted on trailer drum brakes}
- 7/22 . . initiated by contact of vehicle, e.g. bumper, with an external object, e.g. another vehicle {, or by means of contactless obstacle detectors mounted on the vehicle}
- 8/00 Arrangements for adjusting wheel-braking force to meet varying vehicular or ground-surface conditions, e.g. limiting or varying distribution of braking force (by changing number of effective brake cylinders in power brake systems [B60T 17/10](#))**
- 8/17 . . Using electrical or electronic regulation means to control braking {(detecting or indicating faulty operation [B60T 8/885](#))}
- 8/1701 . . {Braking or traction control means specially adapted for particular types of vehicles (for vehicles having more than one drive axle [B60T 8/1769](#))}
- 8/1703 . . . {for aircrafts}
- 8/1705 . . . {for rail vehicles}
- 8/1706 . . . {for single-track vehicles, e.g. motorcycles}
- 8/1708 . . . {for lorries or tractor-trailer combinations}
- 8/171 . . Detecting parameters used in the regulation; Measuring values used in the regulation
- 8/172 . . Determining control parameters used in the regulation, e.g. by calculations involving measured or detected parameters {([B60T 8/17551](#) takes precedence)}
- 8/1725 . . . {Using tyre sensors, e.g. Sidewall Torsion sensors [SWT] (for tyre pressure and temperature detection [B60C 23/00](#))}
- 8/173 . . Eliminating or reducing the effect of unwanted signals, e.g. due to vibrations or electrical noise
- 8/174 . . characterised by using special control logic, e.g. fuzzy logic {, neural computing}
- 8/175 . . Brake regulation specially adapted to prevent excessive wheel spin during vehicle acceleration, e.g. for traction control (safety devices for propulsion unit control responsive to, or preventing, skidding of wheels [B60K 28/16](#))
- 8/1755 . . Brake regulation specially adapted to control the stability of the vehicle, e.g. taking into account yaw rate or transverse acceleration in a curve (road vehicle drive control systems for control of driving stability otherwise than by controlling a particular sub-unit [B60W 30/02](#))
- 8/17551 . . . {determining control parameters related to vehicle stability used in the regulation, e.g. by calculations involving measured or detected parameters}
- 8/17552 . . . {responsive to the tyre sideslip angle or the vehicle body slip angle}
- 8/17554 . . . {specially adapted for enhancing stability around the vehicles longitudinal axle, i.e. roll-over prevention (road vehicle drive control systems for roll-over prevention otherwise than by controlling a particular sub-unit [B60W 30/04](#))}
- 8/17555 . . . {specially adapted for enhancing driver or passenger comfort, e.g. soft intervention or pre-actuation strategies}
- 8/17557 . . . {specially adapted for lane departure prevention (road vehicle drive control systems for lane keeping otherwise than by controlling a particular sub-unit [B60W 30/12](#))}
- 8/17558 . . . {specially adapted for collision avoidance or collision mitigation (road vehicle drive control systems for collision avoidance otherwise than by controlling a particular sub-unit [B60W 30/09](#))}
- 8/176 . . Brake regulation specially adapted to prevent excessive wheel slip during vehicle deceleration, e.g. ABS ([B60T 8/1755](#) takes precedence)
- 8/1761 . . . responsive to wheel or brake dynamics, e.g. wheel slip, wheel acceleration or rate of change of brake fluid pressure
- 8/17613 . . . . {based on analogue circuits or digital circuits comprised of discrete electronic elements}
- 8/17616 . . . . {Microprocessor-based systems}

- 8/1763 . . . responsive to the coefficient of friction between the wheels and the ground surface ([B60T 8/1764 takes precedence](#))
- 8/17633 . . . . {based on analogue circuits or digital circuits comprised of discrete electronic elements}
- 8/17636 . . . . {Microprocessor-based systems}
- 8/1764 . . . Regulation during travel on surface with different coefficients of friction, e.g. between left and right sides, mu-split {or between front and rear}
- 8/1766 . . . Proportioning of brake forces according to vehicle axle loads, e.g. front to rear of vehicle
- 8/1769 . . . specially adapted for vehicles having more than one driven axle, e.g. four-wheel drive vehicles
- 8/18 . . responsive to vehicle weight or load, e.g. load distribution ({using electrical circuitry on regulation means [B60T 8/17](#); } [B60T 8/30 takes precedence](#); responsive to weight and speed condition [B60T 8/58](#))
- NOTE**
- [B60T 8/1887](#) and [B60T 8/1893](#) take precedence over [B60T 8/1806](#) - [B60T 8/1881](#)
- 8/1806 . . {characterised by the calibration process or the means therefor}
- 8/1812 . . {characterised by the means for pressure reduction}
- 8/1818 . . . {Lever mechanism}
- 8/1825 . . . {Means for changing the diaphragm area submitted to pressure}
- 8/1831 . . . {pressure reducing or limiting valves}
- 8/1837 . . {characterised by the load-detecting arrangements}
- 8/1843 . . . {Arrangements for detecting air spring pressure}
- 8/185 . . . {Arrangements for detecting vehicle level}
- 8/1856 . . . {Arrangements for detecting suspension spring load ([B60T 8/1843 takes precedence](#))}
- 8/1862 . . . . {comprising sensors of the type providing a fluid output signal representing the load on the vehicle suspension}
- 8/1868 . . . . {comprising sensors of the type providing a mechanical output signal representing the load on the vehicle suspension}
- 8/1875 . . . . {comprising sensors of the type providing an electrical output signal representing the load on the vehicle suspension}
- 8/1881 . . {characterised by failure-responsive means}
- 8/1887 . . {especially adapted for tractor-trailer combinations}
- 8/1893 . . {especially adapted for railway vehicles}
- 8/24 . . responsive to vehicle inclination or change of direction, e.g. negotiating bends ({using electrical circuitry or regulation means [B60T 8/17](#)})
- 8/241 . . {Lateral vehicle inclination}
- 8/243 . . . {for roll-over protection}
- 8/245 . . {Longitudinal vehicle inclination}
- 8/246 . . {Change of direction}
- 8/248 . . {Trailer sway, e.g. for preventing jackknifing}
- 8/26 . . characterised by producing differential braking between front and rear wheels ({using electrical circuitry or regulation means [B60T 8/17](#)})
- 8/261 . . {specially adapted for use in motorcycles}
- 8/262 . . {using valves with stepped characteristics ([B60T 8/261](#), [B60T 8/266 take precedence](#))}
- 8/263 . . . {for pneumatic brake systems}
- 8/265 . . . {for hydraulic brake systems}
- 8/266 . . {using valves or actuators with external control means ([B60T 8/261 takes precedence](#))}
- 8/267 . . . {for hybrid systems with different kind of brakes on different axles}
- 8/268 . . . {using the valves of an ABS, ASR or ESP system}
- 8/28 . . responsive to deceleration ({[B60T 8/261](#), [B60T 8/262](#), [B60T 8/266 take precedence](#)})
- 8/282 . . . {using ball and ramp}
- 8/285 . . . {using horizontal moving mass}
- 8/287 . . . {using pendulums}
- 8/30 . . responsive to load ({[B60T 8/261](#), [B60T 8/262](#), [B60T 8/266 take precedence](#)})
- 8/303 . . . {using pneumatic valves}
- 8/306 . . . {using hydraulic valves}
- 8/32 . . responsive to a speed condition, e.g. acceleration or deceleration ({using electrical circuitry or regulation means [B60T 8/17](#) ; [B60T 8/28 takes precedence](#); electric devices on electrically propelled vehicles indicating the wheel slip [B60L 3/10](#); measuring linear or angular speed per se [G01P 3/00](#))}
- 8/3205 . . {acceleration ([B60T 8/34](#), [B60T 8/52](#), [B60T 8/54](#), [B60T 8/56](#), [B60T 8/58](#), [B60T 8/72](#), [B60T 8/86](#), [B60T 8/88 take precedence](#))}
- 8/321 . . {deceleration ([B60T 8/34](#), [B60T 8/52](#), [B60T 8/54](#), [B60T 8/56](#), [B60T 8/58](#), [B60T 8/72](#), [B60T 8/86](#), [B60T 8/88 take precedence](#))}
- 8/3215 . . . {Systems characterised by having means acting on components of the drive line, e.g. retarder, clutch or differential gear ([B60T 8/322 takes precedence](#))}
- 8/322 . . . {Systems specially adapted for vehicles driven by more than one axle, e.g. Four Wheel-Drive vehicles}
- 8/3225 . . . {Systems specially adapted for single-track vehicles, e.g. motorcycles ([B60T 8/3235 takes precedence](#))}
- 8/323 . . . {Systems specially adapted for tractor-trailer combinations}
- 8/3235 . . . {Systems specially adapted for rail vehicles}
- 8/324 . . . . {Speed measurement by means of centrifugal governors or the like}
- 8/3245 . . . . {responsive to the speed difference between wheels and rail, or between two wheels or two axles}
- 8/325 . . . {Systems specially adapted for aircraft}
- 8/3255 . . . {Systems in which the braking action is dependent on brake pedal data}
- 8/326 . . . . {Hydraulic systems}
- 8/3265 . . . . . {with control of the booster ([B60T 8/3275 takes precedence](#))}
- 8/327 . . . . {Pneumatic systems}
- 8/3275 . . . . {Systems with a braking assistant function, i.e. automatic full braking initiation in dependence of brake pedal velocity}
- 8/328 . . . {Systems sharing components with other fluid systems onboard the vehicle}
- 8/3285 . . . . {the other fluid systems being suspension elements}

- 8/329 . . . {Systems characterised by their speed sensor arrangements}
- 8/3295 . . . {Systems in which there is a pulsating signal superposed on the command signal}
- 8/34 . . having a fluid pressure regulator responsive to a speed condition
- 8/341 . . . {Systems characterised by their valves (B60T 8/36, B60T 8/38 take precedence)}
- 8/342 . . . . {Pneumatic systems}
- 8/343 . . . {Systems characterised by their lay-out (B60T 8/349 takes precedence)}
- 8/344 . . . . {Hydraulic systems}
- 8/345 . . . . {having more than one brake circuit per wheel}
- 8/346 . . . . . {2 Channel systems (B60T 8/345 takes precedence)}
- 8/347 . . . . . {3 Channel systems (B60T 8/345 takes precedence)}
- 8/348 . . . . . {4 Channel systems (B60T 8/345 takes precedence)}
- 8/349 . . . {Systems adapted to control a set of axles, e.g. tandem axles}
- 8/36 . . . including a pilot valve responding to an electromagnetic force
- 8/3605 . . . . {wherein the pilot valve is mounted in a circuit controlling the working fluid system}
- 8/361 . . . . {wherein the pilot valve is mounted in a circuit controlling an auxiliary fluid system}
- 8/3615 . . . . {Electromagnetic valves specially adapted for anti-lock brake and traction control systems (electromagnetic valves in general F16K 31/06)}
- 8/362 . . . . . {in pneumatic systems (B60T 8/3655, B60T 8/3675 and B60T 8/369 take precedence)}
- 8/3625 . . . . . {having at least one vacuum connection}
- 8/363 . . . . . {in hydraulic systems (B60T 8/3655, B60T 8/3675 and B60T 8/369 take precedence)}
- 8/3635 . . . . . {switching between more than two connections, e.g. 3/2-valves (B60T 8/364, B60T 8/3645 and B60T 8/365 take precedence)}
- 8/364 . . . . . {switching between a number of discrete positions as a function of the applied signal, e.g. 3/3-valves (B60T 8/3645 takes precedence)}
- 8/3645 . . . . . {having more than one electromagnetic coil inside a common housing}
- 8/365 . . . . . {combining a plurality of functions in one unit, e.g. pressure relief}
- 8/3655 . . . . . {Continuously controlled electromagnetic valves}
- 8/366 . . . . . {Valve details}
- 8/3665 . . . . . {Sliding valves}
- 8/367 . . . . . {Seat valves, e.g. poppet valves}
- 8/3675 . . . . . {integrated in modulator units}
- 8/368 . . . . . {combined with other mechanical components, e.g. pump units, master cylinders}
- 8/3685 . . . . . {characterised by the mounting of the modulator unit onto the vehicle}
- 8/369 . . . . . {Valves using piezoelectric elements (in general F16K 31/004)}
- 8/3695 . . . . {wherein the pilot valve is mounted separately from its power section (B60T 8/3605, B60T 8/361 and B60T 8/3615 take precedence)}
- 8/38 . . . including valve means of the relay or driver controlled type
- 8/40 . . . comprising an additional fluid circuit including fluid pressurising means for modifying the pressure of the braking fluid, e.g. including wheel driven pumps for detecting a speed condition, or pumps which are controlled by means independent of the braking system
- 8/4004 . . . . {Repositioning the piston(s) of the brake control means by means of a fluid pressurising means in order to reduce the brake pressure}
- 8/4009 . . . . . {the brake control means being the wheel cylinders}
- 8/4013 . . . . {Fluid pressurising means for more than one fluid circuit, e.g. separate pump units used for hydraulic booster and anti-lock braking}
- 8/4018 . . . . {Pump units characterised by their drive mechanisms (B60T 8/4095 takes precedence)}
- 8/4022 . . . . . {Pump units driven by an individual electric motor (B60T 8/4027 takes precedence)}
- 8/4027 . . . . . {Pump units driven by (parts of) the vehicle propulsion unit}
- 8/4031 . . . . {Pump units characterised by their construction or mounting (pump units in combination with valve blocks B60T 8/36)}
- 8/4036 . . . . {Pump units characterised by their failure-responsive means (B60T 8/88 takes precedence)}
- 8/404 . . . . {Control of the pump unit}
- 8/4045 . . . . . {involving ON/OFF switching}
- 8/405 . . . . . {involving the start-up phase}
- 8/4054 . . . . . {involving the delivery pressure control (B60T 8/4072 takes precedence)}
- 8/4059 . . . . . {involving the rate of delivery}
- 8/4063 . . . . . {involving the direction of fluid flow}
- 8/4068 . . . . {the additional fluid circuit comprising means for attenuating pressure pulsations}
- 8/4072 . . . . {Systems in which a driver input signal is used as a control signal for the additional fluid circuit which is normally used for braking}
- 8/4077 . . . . . {Systems in which the booster is used as an auxiliary pressure source}
- 8/4081 . . . . . {Systems with stroke simulating devices for driver input (B60T 8/4077 takes precedence)}
- 8/4086 . . . . . {the stroke simulating device being connected to, or integrated in the driver input device}
- 8/409 . . . . . {characterised by details of the stroke simulating device}
- 8/4095 . . . . {including wheel driven pumps for detecting a speed condition}
- 8/42 . . . having expanding chambers for controlling pressure {, i.e. closed systems}



- 8/4208 . . . . {Debooster systems}
- 8/4216 . . . . {having a mechanically actuated expansion unit ([B60T 8/4225](#) and [B60T 8/4266](#) take precedence)}
- 8/4225 . . . . {having a fluid actuated expansion unit}
- 8/4233 . . . . {with brake pressure relief by introducing fluid pressure into the expansion unit ([B60T 8/4241](#) takes precedence)}
- 8/4241 . . . . {pneumatically}
- 8/425 . . . . {using a vacuum}
- 8/4258 . . . . {with brake pressure relief by creating vacuum inside the expansion unit}
- 8/4266 . . . . {having an electro-mechanically actuated expansion unit, e.g. solenoid, electric motor, piezo stack}
- 8/4275 . . . . {Pump-back systems}
- 8/4283 . . . . {having a pressure sensitive inlet valve}
- 8/4291 . . . . {having means to reduce or eliminate pedal kick-back}
- 8/44 . . . co-operating with a power-assist booster means associated with a master cylinder for controlling the release and reapplication of brake pressure through an interaction with the power assist device {, i.e. open systems}
- 8/441 . . . . {using hydraulic boosters ([B60T 8/445](#), [B60T 8/446](#), [B60T 8/447](#) take precedence)}
- 8/442 . . . . {the booster being a fluid return pump, e.g. in combination with a brake pedal force booster}
- 8/443 . . . . {using compressed air ([B60T 8/445](#), [B60T 8/446](#), [B60T 8/448](#) take precedence)}
- 8/444 . . . . {using vacuum ([B60T 8/445](#), [B60T 8/446](#), [B60T 8/448](#) take precedence)}
- 8/445 . . . . {replenishing the released brake fluid volume into the brake piping}
- 8/446 . . . . {replenishing the released brake fluid volume via the master cylinder}
- 8/447 . . . . {Reducing the boost of the power-assist booster means to reduce brake pressure}
- 8/448 . . . . {the power-assist booster means being a vacuum or compressed air booster}
- 8/449 . . . . {of the multiple booster type}
- 8/46 . . . the pressure being reduced by exhausting fluid
- 8/48 . . . connecting the brake actuator to an alternative or additional source of fluid pressure {, e.g. traction control systems}
- 8/4809 . . . . {Traction control, stability control, using both the wheel brakes and other automatic braking systems}
- 8/4818 . . . . {in pneumatic brake systems}
- 8/4827 . . . . {in hydraulic brake systems}
- 8/4836 . . . . {wherein a booster output pressure is used for normal or anti lock braking ([B60T 8/4845](#), [B60T 8/4863](#), [B60T 8/489](#) take precedence)}
- 8/4845 . . . . {using a booster or a master cylinder for traction control}
- 8/4854 . . . . {pneumatic boosters}
- 8/4863 . . . . {closed systems ([B60T 8/4845](#), [B60T 8/489](#) take precedence)}
- 8/4872 . . . . {pump-back systems}
- 8/4881 . . . . {having priming means}
- 8/489 . . . . {using separate traction control modulators}
- 8/50 . . . having means for controlling the rate at which pressure is reapplied to {or released from} the brake
- 8/5006 . . . . {Pressure reapplication by pulsing of valves ([B60T 8/5012](#), [B60T 8/5018](#), [B60T 8/505](#), [B60T 8/5056](#) take precedence)}
- 8/5012 . . . . {Pressure reapplication using a plurality of valves in parallel}
- 8/5018 . . . . {Pressure reapplication using restrictions ([B60T 8/5012](#), [B60T 8/505](#) take precedence)}
- 8/5025 . . . . {in hydraulic brake systems}
- 8/5031 . . . . {open systems}
- 8/5037 . . . . {closed systems}
- 8/5043 . . . . {debooster systems}
- 8/505 . . . . {Pressure reapplication in a mu-split situation, i.e. a situation with different coefficients of friction on both sides of the vehicle}
- 8/5056 . . . . {Pressure reapplication using memory devices}
- 8/5062 . . . . {using memory chambers}
- 8/5068 . . . . {having decay means}
- 8/5075 . . . . {Pressure release by pulsing of valves ([B60T 8/5081](#), [B60T 8/5087](#) take precedence)}
- 8/5081 . . . . {Pressure release using a plurality of valves in parallel}
- 8/5087 . . . . {Pressure release using restrictions ([B60T 8/5081](#) takes precedence)}
- 8/5093 . . . . {in hydraulic brake systems}
- 8/52 . . Torque sensing, i.e. wherein the braking action is controlled by forces producing or tending to produce a twisting or rotating motion on a braked rotating member
- 8/54 . . by mechanical means
- 8/56 . . having means for changing the coefficient of friction
- 8/58 . . responsive to speed and another condition or to plural speed conditions
- NOTE**
- In this group, a single condition which is itself responsive to, or representative of, another single condition is not regarded as plural conditions
- 8/72 . . responsive to a difference between a speed condition, e.g. deceleration, and a fixed reference
- 8/74 . . . sensing a rate of change of velocity
- 8/76 . . . two or more sensing means from different wheels indicative of the same type of speed condition
- 8/86 . . wherein the brakes are automatically applied in accordance with a speed condition and having means for overriding the automatic braking device when a skid condition occurs
- 8/88 . . with failure responsive means, i.e. means for detecting and indicating faulty operation of the speed responsive control means
- 8/885 . . . {using electrical circuitry}
- 8/90 . . . using a simulated speed signal to test speed responsive control means

- 8/92 . . . automatically taking corrective action
- 8/94 . . . . on a fluid pressure regulator
- 8/96 . . . . on speed responsive control means
- 10/00 Control or regulation for continuous braking making use of fluid or powdered medium, e.g. for use when descending a long slope**
- 10/02 . with hydrodynamic brake
- 10/04 . with hydrostatic brake
- 11/00 Transmitting braking action from initiating means to ultimate brake actuator without power assistance or drive or where such assistance or drive is irrelevant (the power assistance or drive being essential [B60T 13/00](#))**
- 11/04 . transmitting mechanically
- 11/043 . . {in case of steerable wheels}
- 11/046 . . {Using cables ([B60T 11/043](#) takes precedence)}
- 11/06 . . Equalising arrangements
- 11/08 . . providing variable leverage
- 11/10 . transmitting by fluid means, e.g. hydraulic
- 11/101 . . {equalising arrangements}
- 11/102 . . {in combination with mechanical elements}
- 11/103 . . {in combination with other control devices (conjoint control of brake system and at least another sub-unit [B60W 10/188](#))}
- 11/105 . . . {with brake locking after actuation, release of the brake by a different control device, e.g. gear lever}
- 11/106 . . . . {locking and release of the brake by the clutch}
- 11/107 . . {overrun brakes with fluid means}
- 11/108 . . {to a trailer fluid system}
- 11/12 . . the transmitted force being varied therein ([B60T 11/16](#) - [B60T 11/26](#) take precedence)
- 11/14 . . the transmitted force being substantially unchanged
- 11/16 . . Master control, e.g. master cylinders (master cylinders associated with vacuum boosters [B60T 13/565](#))
- 11/165 . . . {Single master cylinders for pressurised systems}
- 11/18 . . . Connection thereof to initiating means
- 11/20 . . . Tandem, side-by-side, or other multiple master cylinder units
- 11/203 . . . . {Side-by-side configuration}
- 11/206 . . . . {with control by a force distributing lever}
- 11/21 . . . . with two pedals operating on respective circuits, pressures therein being equalised when both pedals are operated together, e.g. for steering (steering non-deflectable wheels or endless tracks by differentially driving ground-engaging elements on opposite vehicle sides using brakes as main steering effecting means [B62D 11/08](#))
- 11/22 . . . characterised by being integral with reservoir
- 11/224 . . . with pressure-varying means, e.g. with two stage operation provided by use of different piston diameters including continuous variation from one diameter to another
- 11/228 . . . Pressure-maintaining arrangements, e.g. for replenishing the master cylinder chamber with fluid from a reservoir ([B60T 11/232](#) takes precedence)
- 11/232 . . . Recuperation valves
- 11/236 . . . Piston sealing arrangements
- 11/24 . . Single initiating means operating on more than one circuit, e.g. dual circuits ([multiple master cylinder units B60T 11/20](#))
- 11/26 . . Reservoirs ([integral with master controls B60T 11/22](#))
- 11/28 . . Valves specially adapted therefor ([recuperation valves B60T 11/232](#))
- 11/30 . . . Bleed valves for hydraulic brake systems
- 11/32 . . . Automatic cut-off valves for defective pipes
- 11/323 . . . . {in hydraulic systems}
- 11/326 . . . . {in pneumatic systems}
- 11/34 . . . Pressure reducing or limiting valves {(for arrangements for adjusting wheel-braking force responsive to vehicle weight or load [B60T 8/1831](#))}
- 13/00 Transmitting braking action from initiating means to ultimate brake actuator with power assistance or drive; Brake systems incorporating such transmitting means, e.g. air-pressure brake systems (arrangements for adjusting wheel-braking force to meet varying vehicular or ground-surface conditions [B60T 8/00](#); valves incorporated in such systems [B60T 15/00](#))**
- 13/02 . with mechanical assistance or drive {(combined with fluid pressure [B60T 13/588](#))}
- 13/04 . . by spring or weight ([fluid released B60T 13/10](#))
- 13/06 . . by inertia, e.g. flywheel
- 13/065 . . . {of the propulsion system}
- 13/08 . . . Overrun brakes
- 13/10 . with fluid assistance, drive, or release
- 13/12 . . the fluid being liquid
- 13/14 . . . using accumulators or reservoirs {fed by pumps}
- 13/141 . . . . {Systems with distributor valve ([B60T 13/147](#) takes precedence)}
- 13/142 . . . . {Systems with master cylinder}
- 13/143 . . . . {Master cylinder mechanically coupled with booster}
- 13/144 . . . . . {Pilot valve provided inside booster piston}
- 13/145 . . . . . {Master cylinder integrated or hydraulically coupled with booster}
- 13/146 . . . . . {Part of the system directly actuated by booster pressure}
- 13/147 . . . . . {In combination with distributor valve}
- 13/148 . . . . {Arrangements for pressure supply}
- 13/16 . . . using pumps directly, i.e. without interposition of accumulators or reservoirs
- 13/161 . . . . {Systems with master cylinder}
- 13/162 . . . . . {Master cylinder mechanically coupled with booster}
- 13/163 . . . . . {Pilot valve provided inside booster piston}
- 13/165 . . . . . {Master cylinder integrated or hydraulically coupled with booster}
- 13/166 . . . . . {Part of the system directly actuated by booster pressure}
- 13/167 . . . . . {In combination with distributor valve}
- 13/168 . . . . {Arrangements for pressure supply}
- 13/18 . . . . with control of pump output delivery {, e.g. by distributor valves ([B60T 13/167](#) takes precedence)}

- 13/20 . . . . with control of pump driving means
- 13/22 . . . Brakes applied by springs or weights and released hydraulically
- 13/24 . . the fluid being gaseous
- 13/241 . . . {Differential pressure systems}
- 13/242 . . . . {The control valve is provided as one unit with the servomotor cylinder}
- 13/243 . . . . . {Mechanical command of the control valve, mechanical transmission to the brakes}
- 13/244 . . . . . {Mechanical command of the control valve, hydraulic transmission to the brakes}
- 13/245 . . . . . {Hydraulic command of the control valve, hydraulic transmission to the brake}
- 13/246 . . . . {The control valve is provided apart from the servomotor cylinder}
- 13/247 . . . . . {Mechanical command of the control valve, mechanical transmission to the brakes}
- 13/248 . . . . . {Mechanical command of the control valve, hydraulic transmission to the brakes}
- 13/249 . . . . . {Hydraulic command of the control valve, hydraulic transmission to the brakes}
- 13/26 . . . Compressed-air systems
- 13/261 . . . . {systems with both indirect application and application by springs or weights and released by compressed air}
- 13/263 . . . . . {specially adapted for coupling with dependent systems, e.g. tractor-trailer systems}
- 13/265 . . . . . {dependent systems, e.g. trailer systems}
- 13/266 . . . . {Systems with both direct and indirect application, e.g. in railway vehicles}
- 13/268 . . . . {using accumulators or reservoirs}
- 13/36 . . . . direct, i.e. brakes applied directly by compressed air
- 13/365 . . . . . {for railway vehicles}
- 13/38 . . . . Brakes applied by springs or weights and released by compressed air ([B60T 13/261 takes precedence](#))
- 13/385 . . . . . {Control arrangements therefor}
- 13/40 . . . . indirect, i.e. compressed air booster units {indirect systems}
- 13/403 . . . . . {specially adapted for coupling with dependent systems, e.g. tractor-trailer systems}
- 13/406 . . . . . . {specially adapted for transfer of two or more command signals, e.g. railway systems ([with electrical control B60T 13/665](#))}
- 13/44 . . . . . with two-chamber booster units
- 13/45 . . . . . with multiple booster units, e.g. tandem booster units
- 13/46 . . . Vacuum systems
- 13/465 . . . . {for railway vehicles}
- 13/48 . . . . direct, i.e. brakes applied directly by vacuum
- 13/50 . . . . Brakes applied by springs or weights and released by vacuum
- 13/52 . . . . indirect, i.e. vacuum booster units
- 13/56 . . . . . with two-chamber booster units
- 13/563 . . . . . with multiple booster units, e.g. tandem booster units
- 13/565 . . . . . characterised by being associated with master cylinders, e.g. integrally formed
- 13/567 . . . . . characterised by constructional features of the casing or by its strengthening or mounting arrangements
- 13/5675 . . . . . . {Supportstruts}
- 13/569 . . . . . characterised by piston details, e.g. construction, mounting of diaphragm
- 13/57 . . . . . characterised by constructional features of control valves
- 13/573 . . . . . characterised by reaction devices
- 13/575 . . . . . . using resilient discs or pads
- 13/577 . . . . . . using levers
- 13/58 . . Combined or convertible systems
- 13/581 . . . {both hydraulic and pneumatic}
- 13/583 . . . . {using converters}
- 13/585 . . . {comprising friction brakes and retarders}
- 13/586 . . . . {the retarders being of the electric type}
- 13/588 . . . {both fluid and mechanical assistance or drive}
- 13/62 . . . both straight and automatic
- 13/64 . . . both single and multiple, e.g. single and tandem
- 13/66 . . Electrical control in fluid-pressure brake systems
- 13/662 . . . {characterised by specified functions of the control system components}
- 13/665 . . . {the systems being specially adapted for transferring two or more command signals, e.g. railway systems ([B60T 13/662 takes precedence](#))}
- 13/667 . . . . {and combined with electro-magnetic brakes}
- 13/68 . . . by electrically-controlled valves {([B60T 13/662](#) and [B60T 13/665 take precedence](#))}
- 13/683 . . . . {in pneumatic systems or parts thereof ([in vacuum systems B60T 13/72](#))}
- 13/686 . . . . {in hydraulic systems or parts thereof}
- 13/70 . . . by fluid-controlled switches
- 13/72 . . . in vacuum systems {or vacuum booster units}
- 13/74 . . with electrical assistance or drive
- 13/741 . . {acting on an ultimate actuator}
- 13/743 . . . {with a spring accumulator}
- 13/745 . . {acting on a hydraulic system, e.g. a master cylinder}
- 13/746 . . {and mechanical transmission of the braking action}
- 13/748 . . {acting on electro-magnetic brakes ([combined with fluid-pressure brake systems B60T 13/667](#))}
- 15/00 Construction arrangement, or operation of valves incorporated in power brake systems and not covered by groups [B60T 11/00](#) or [B60T 13/00](#) (valve structures responsive to a speed condition [B60T 8/34](#); valves in general [F16K](#))**
- 15/02 . . Application and release valves
- 15/021 . . . {Railway control or brake valves}
- 15/022 . . . {with one slide valve, e.g. an emergency slide valve}
- 15/024 . . . . {with quick braking action and evacuation of air to a reservoir, to the atmosphere or to the brake cylinder}
- 15/025 . . {Electrically controlled valves}
- 15/027 . . . {in pneumatic systems}
- 15/028 . . . {in hydraulic systems}
- 15/04 . . Driver's valves

- 15/041 . . . {controlling auxiliary pressure brakes, e.g. parking or emergency brakes ([B60T 15/048 takes precedence](#))}
- 15/043 . . . {controlling service pressure brakes ([B60T 15/048 takes precedence](#))}
- 15/045 . . . {in multiple circuit systems, e.g. dual circuit systems}
- 15/046 . . . . {with valves mounted in tandem}
- 15/048 . . . {Controlling pressure brakes of railway vehicles}
- 15/10 . . . for vacuum brakes
- 15/12 . . . combined with relay valves or the like
- 15/14 . . . influencing electric control means
- 15/16 . . . Arrangements enabling systems to be controlled from two or more positions
- 15/18 . . Triple or other relay valves which allow step-wise application or release and which are actuated by brake-pipe pressure variation to connect brake cylinders or equivalent to compressed air or vacuum source or atmosphere
- 15/181 . . . {Trailer control valves ([B60T 15/20](#) and [B60T 15/243 take precedence](#))}
- 15/182 . . . {Trailer brake valves ([B60T 15/20](#) and [B60T 15/246 take precedence](#))}
- 15/184 . . . {Railway control or brake valves}
- 15/185 . . . . {with one slide valve}
- 15/187 . . . . {with a slide valve for initiation and a second slide valve for control of the braking}
- 15/188 . . . . {with a slide valve for initiation and annular valves for control of the braking}
- 15/20 . . . controlled by two fluid pressures
- 15/203 . . . . {Trailer control valves ([B60T 15/223 takes precedence](#))}
- 15/206 . . . . {Trailer brake valves ([B60T 15/226 takes precedence](#))}
- 15/22 . . . . with one or more auxiliary valves, for braking, releasing, filling reservoirs
- 15/223 . . . . . {Trailer control valves}
- 15/226 . . . . . {Trailer brake valves}
- 15/24 . . . controlled by three fluid pressures
- 15/243 . . . . {Trailer control valves}
- 15/246 . . . . {Trailer brake valves}
- 15/26 . . . . without a quick braking action
- 15/28 . . . . . and having auxiliary valves
- 15/30 . . . . with a quick braking action
- 15/302 . . . . . {Railway control or brake valves with evacuation of air to a reservoir, to the atmosphere or to the brake cylinder}
- 15/304 . . . . . {with one slide valve}
- 15/306 . . . . . {with a slide valve for initiation and a second slide valve for control of the braking}
- 15/308 . . . . . {with a slide valve for initiation and annular valves for control of the braking}
- 15/32 . . . . . and having auxiliary valves
- 15/34 . . . controlled alternatively by two or three fluid pressures
- 15/36 . . Other control devices or valves characterised by definite functions {(electrically controlled valves in fluid-pressure brake systems [B60T 15/027](#), [B60T 15/028](#))}
- 15/38 . . . for quick take-up and heavy braking, e.g. with auxiliary reservoir for taking-up slack
- 15/40 . . . . with separate take-up and applying cylinders
- 15/42 . . . with a quick braking action, i.e. with accelerating valves actuated by brake-pipe pressure variation
- 15/44 . . . . and operating independently of the main control device
- 15/46 . . . for retarding braking action to prevent rear vehicles of a vehicle train overtaking the forward ones
- 15/48 . . . for filling reservoirs
- 15/50 . . . . with means for limiting or relieving pressure in reservoirs
- 15/52 . . . for quick release of brakes, e.g. for influencing counter- pressure in triple valve or recirculating air from reservoir or brake cylinder to brake pipe
- 15/54 . . . for controlling exhaust from triple valve or from brake cylinder
- 15/56 . . . for filling reservoirs by means of a secondary supply pipe
- 15/58 . . . for supplying control impulses through a secondary air pipe
- 15/60 . . . for releasing or applying brakes when vehicles of a vehicle train are uncoupled
- 17/00 Component parts, details, or accessories of power brake systems not covered by groups [B60T 8/00](#), [B60T 13/00](#) or [B60T 15/00](#), or presenting other characteristic features (air compressors [per se](#) [F04](#))**
- 17/002 . {Air treatment devices}
- 17/004 . . {Draining and drying devices}
- 17/006 . . {Anti-frost devices}
- 17/008 . . {Silencer devices}
- 17/02 . Arrangements of pumps or compressors, or control devices therefor
- 17/04 . Arrangements of piping, valves in the piping, e.g. cut-off valves, couplings or air hoses ([traction couplings involving joints for supply lines, electric circuits, or the like \[B60D 1/62\]\(#\); couplings peculiar to railway vehicles for, or combined with, couplings or connectors for fluid conduits or electric cables \[B61G 5/06\]\(#\); pipes, cut-off valves, couplings, air hoses \[per se\]\(#\) \[F16C\]\(#\), \[F16K\]\(#\), \[F16L\]\(#\)](#))
- 17/043 . . {Brake line couplings, air hoses and stopcocks}
- 17/046 . . {Devices for pipe guiding and fixing}
- 17/06 . Applications or arrangements of reservoirs
- 17/08 . Brake cylinders other than ultimate actuators ([with built-in wear-compensating mechanisms, ultimate actuators \[F16D\]\(#\)](#))
- 17/081 . . {Single service brake actuators}
- 17/083 . . {Combination of service brake actuators with spring loaded brake actuators}
- 17/085 . . {Spring loaded brake actuators}
- 17/086 . . . {Spring loaded brake actuators with emergency release device}
- 17/088 . . {Mounting arrangements}
- 17/10 . . Two or more cylinders acting on the same brake with means for rendering them effective selectively or successively, the number of effective cylinders being variable
- 17/12 . . . according to vehicle weight
- 17/14 . . . according to vehicle speed



17/16	. . Locking of brake cylinders	2210/14	. . Rough roads, bad roads, gravel roads
17/18	. Safety devices; Monitoring	2210/16	. . Off-road driving conditions
17/20	. . Safety devices operable by passengers other than the driver {, e.g. for railway vehicles}	2210/20	. Road shapes
17/22	. . Devices for monitoring or checking brake systems; Signal devices	2210/22	. . Banked curves
17/221	. . . {Procedure or apparatus for checking or keeping in a correct functioning condition of brake systems (hydraulic pressure systems in general F15B 19/00, F15B 21/04; testing structures or apparatus G01M)}	2210/24	. . Curve radius
17/222	. . . . {by filling or bleeding of hydraulic systems}	2210/30	. Environment conditions or position therewithin
17/223	. . . . {Devices for pressurising brake systems acting on pedal}	2210/32	. . Vehicle surroundings
17/225	. . . {brake fluid level indicators (level indication in general G01F; H01H)}	2210/34	. . Blind spots
17/226	. . . {using devices being responsive to the difference between the fluid pressures in conduits of multiple braking systems}	2210/36	. . Global Positioning System [GPS]
17/227	. . . . {With additional functions, e.g. by-pass}	<b>2220/00</b>	<b>Monitoring, detecting driver behaviour; Signalling thereof; Counteracting thereof</b>
17/228	. . . {for railway vehicles}	2220/02	. Driver type; Driving style; Driver adaptive features
		2220/03	. Driver counter-steering; Avoidance of conflicts with ESP control
		2220/04	. Pedal travel sensor, stroke sensor; Sensing brake request
		2220/06	. Adjustment of accelerator pedal reaction forces
		<b>2230/00</b>	<b>Monitoring, detecting special vehicle behaviour; Counteracting thereof</b>
		2230/02	. Side slip angle, attitude angle, floating angle, drift angle
		2230/03	. Overturn, rollover
		2230/04	. Jerk, soft-stop; Anti-jerk, reduction of pitch or nose-dive when braking
		2230/06	. Tractor-trailer swaying
		2230/08	. Driving in reverse
		<b>2240/00</b>	<b>Monitoring, detecting wheel/tyre behaviour; counteracting thereof</b>
		2240/02	. Longitudinal grip
		2240/03	. Tyre sensors
		2240/04	. Tyre deformation
		2240/06	. Wheel load; Wheel lift
		2240/07	. Tyre tolerance compensation
		2240/08	. Spare wheel detection; Adjusting brake control in case of spare wheel use
		<b>2250/00</b>	<b>Monitoring, detecting, estimating vehicle conditions</b>
		2250/02	. Vehicle mass
		2250/03	. Vehicle yaw rate
		2250/04	. Vehicle reference speed; Vehicle body speed
		2250/042	. . Reference speed calculation in ASR or under wheel spinning condition
		2250/06	. Sensor zero-point adjustment; Offset compensation
		2250/062	. . losing zero-point calibration of yaw rate sensors when travelling on banked roads or in case of temperature variations
		<b>2260/00</b>	<b>Interaction of vehicle brake system with other systems</b>
		2260/02	. Active Steering, Steer-by-Wire
		2260/022	. . Rear-wheel steering; Four-wheel steering
		2260/024	. . Yawing moment compensation during mu-split braking
		2260/04	. Automatic transmission
		2260/06	. Active Suspension System
		2260/08	. Coordination of integrated systems
		2260/09	. Complex systems; Conjoint control of two or more vehicle active control systems
		<b>2270/00</b>	<b>Further aspects of brake control systems not otherwise provided for</b>
		2270/10	. ABS control systems
<b>2201/00</b>	<b>Particular use of vehicle brake systems; Special systems using also the brakes; Special software modules within the brake system controller</b>		
2201/02	. Active or adaptive cruise control system; Distance control		
2201/022	. . Collision avoidance systems		
2201/024	. . Collision mitigation systems		
2201/03	. Brake assistants		
2201/04	. Hill descent control		
2201/06	. Hill holder; Start aid systems on inclined road		
2201/08	. Lane monitoring; Lane Keeping Systems		
2201/081	. . using distance control		
2201/082	. . using alarm actuation		
2201/083	. . using active brake actuation		
2201/084	. . using suspension control		
2201/085	. . using several actuators; Coordination of the lane keeping system with other control systems		
2201/086	. . using driver related features		
2201/087	. . using active steering actuation		
2201/088	. . using transmission control		
2201/089	. . using optical detection		
2201/09	. Engine drag compensation		
2201/10	. Automatic or semi-automatic parking aid systems		
2201/12	. Pre-actuation of braking systems without significant braking effect; Optimizing brake performance by reduction of play between brake pads and brake disc		
2201/122	. . Pre-actuation in case of ESP control		
2201/124	. . Rain brake support [RBS]; Cleaning or drying brake discs, e.g. removing water or dirt		
2201/14	. Electronic locking-differential		
2201/16	. Curve braking control, e.g. turn control within ABS control algorithm		
<b>2210/00</b>	<b>Detection or estimation of road or environment conditions; Detection or estimation of road shapes</b>		
2210/10	. Detection or estimation of road conditions		
2210/12	. . Friction		
2210/122	. . . using fuzzy logic, neural computing		
2210/124	. . . Roads with different friction levels		
2210/13	. . Aquaplaning, hydroplaning		

2270/12	. . for all-wheel drive vehicles
2270/14	. . hydraulic model
2270/20	. ASR control systems
2270/202	. . for all-wheel drive vehicles
2270/203	. . hydraulic system components
2270/204	. . hydraulic model
2270/206	. . Monitoring, e.g. parameter monitoring, plausibility check
2270/208	. . adapted to friction condition
2270/211	. . Setting or adjusting start-control threshold
2270/213	. . Driving off under Mu-split conditions
2270/30	. ESP control system
2270/302	. . for all-wheel drive vehicles
2270/303	. . Stability control with active acceleration
2270/304	. . during driver brake actuation
2270/306	. . hydraulic system components
2270/308	. . hydraulic model
2270/311	. . Predefined control maps, lookup tables
2270/313	. . with less than three sensors (yaw rate, steering angle, lateral acceleration)
2270/40	. Failsafe aspects of brake control systems
2270/402	. . Back-up
2270/403	. . Brake circuit failure
2270/404	. . Brake-by-wire or X-by-wire failsafe
2270/406	. . Test-mode; Self-diagnosis
2270/408	. . Hierarchical failure detection
2270/411	. . Offset failure
2270/413	. . Plausibility monitoring, cross check, redundancy
2270/414	. . Power supply failure
2270/415	. . Short-circuit, open circuit failure
2270/416	. . Wheel speed sensor failure
2270/60	. Regenerative braking
2270/602	. . ABS features related thereto
2270/603	. . ASR features related thereto
2270/604	. . Merging friction therewith; Adjusting their repartition
2270/606	. . Axle differential or center differential features related thereto
2270/608	. . Electronic brake distribution (EBV/EBD) features related thereto
2270/611	. . Engine braking features related thereto
2270/613	. . ESP features related thereto
2270/82	. Brake-by-Wire, EHB
2270/83	. Control features of electronic wedge brake [EWB]
2270/84	. Driver circuits for actuating motor, valve and the like
2270/86	. Optimizing braking by using ESP vehicle or tyre model
2270/88	. Pressure measurement in brake systems
2270/89	. Criteria for brake release