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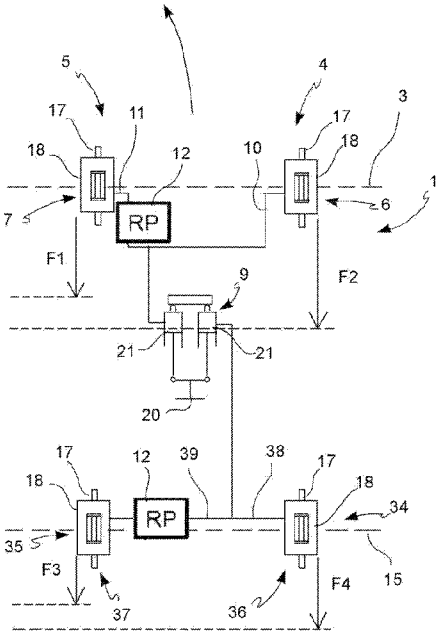

FIG. 2

(57) Abstract: The object of the present invention is a dissymmetric braking system (1) for vehicle (2), in which said vehicle comprises at least one first vehicle axle (3 or 15) supported by at least one right axle wheel (4 or 36) and at least one left axle wheel (5 or 37) of the vehicle; in which said braking system (1) comprises: - at least one right wheel braking device (6 or 34); - at least one left wheel braking device (7 or 35); - at least one device to apply a braking action by the driver (8); - at least one actuating device (9) to transform the braking action into a braking pressure command or first pressure or input pressure (PI); - at least one right wheel connection (10 or 38) between said at least one actuating device (9) and said first axle right wheel braking device (6 or 34); at least one left wheel connection (11 or 39) between said at least one actuating device (9) and said first axle left wheel braking device (7 or 35); at least one pressure reducing device (12) is provided in one of said connections (10, 11 or 38, 39); said pressure reducing device (12) comprises at least one transfer device (13) which receives said first pressure (PI); and in which said at least one transfer device (13) transforms said first pressure (PI) into a reduced braking pressure or second pressure or output pressure (P2), whereby avoiding, during the braking action, a fluidic connection between a fluid which has said first pressure (PI) and a fluid which has said second pressure (P2); so as to determine, during the braking action, a relationship between said first pressure (PI) and said second pressure (P2) with linear, or proportional, trend without variation of linearity or proportionality throughout the operating field of the pressure reducing device (12); and so that the braking action of one of said at least one right wheel braking device (6 or 34) and at least one left wheel braking device (7 or 35) is lower than the other.

[Continued on next page]

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[0001]. Field of the invention

[0002]. The object of the present invention is a dissymmetric braking system for a vehicle.

[0003]. The present invention in particular relates to a braking system which comprises a device to apply a braking action by the driver, such as e.g. a pedal, an actuating device to transform the braking action into a braking pressure command, or input pressure, such as e.g. a brake cylinder, a right wheel connection conduit between said actuating device and a first axle right wheel braking device, e.g. a right wheel disc brake, a left wheel connection conduit between said actuating device and a first axle left wheel braking device, e.g. a left wheel disc brake, and also a pressure reducing device provided in one of said connection conduits.

[0004]. Background art

[0005]. In vehicles, and in sports vehicles in particular, it is particularly important to maximize the braking action and allow a safe control of the vehicle by the driver, in order to have a balanced braking action.

[0006]. For this reason, two brake cylinders (two master cylinders) operated with a single pedal by the driver of the vehicle are often used so as to send a separate but similar (hydraulic)

signal to the front and rear brakes or in a crossed manner to the front right and rear left wheel and front left and rear right wheel (or vice versa).

[0007]. Again for the same reason, it is known to differentiate the braking action between axle and axle in order to avoid locking the wheels of less loaded axles.

[0008]. To solve this known problem, it is known to provide brake circuits with pressure reducers which transmit a different pressure signal between the front vehicle axle and the rear vehicle axle.

[0009]. It is known in particular, by means of reducing pressure valves, to transform an input pressure or Pin into a different and reduced output pressure or Pout in a single fluid conduit for feeding the brakes of a whole axle of the vehicle. Solutions of this type are known for example, from **US4113317, US5433514, US2017153653A1, US2016138726A1** and **US2003094202A1.**

[0010]. These known solutions put the valve input fluidically in communication with the output thereof to have a fluid flow which reduces the pressure thereof and is sent as control to the disc brake.

[0011]. However, the need is strongly felt in the prior art to have a response to the less loaded axle of the vehicle, typically the rear one, which simultaneously starts and with the same intensity as the front axle to then only successively decrease the action thereof when the weight of the braked vehicle moves in particular manner on the front axle, also due to the braking. Therefore, there is a strong desire in the prior art to reduce the

pressure at the rear brakes only after a predetermined braking intensity threshold, typically of control pressure or input pressure Pin, as depicted in figure 3.

[0012]. For this reason, it is known to insert a proportional valve in the braking system, between the brake cylinder and the brake discs of the rear axle, which due to low pressure values, allows an input pressure or Pin to be obtained which is identical to the output pressure or Pout to then reduce the output pressure or Pout with respect to the value of the input pressure or Pin at a predetermined threshold value. Solutions of this type are known from **US3837713A, US4205883, US4702529, US4986609, US5147113, US2924306, US3245221, US4544210, US4707036.**

[0013]. Furthermore, the vehicle is adjusted in the case of sports vehicles, and in particular of vehicles which race on oval tracks with outwardly superelevated curves in order to have an inclined road surface (track banking - see figure 13), for example with toe-in and camber, which point the vehicle towards the inner curve so as to facilitate traveling the oval track (see figure 14).

[0014]. However, if the braking system is operated here, the same braking action on the front inner curve wheel and on the outer curve wheel bring about an accentuation of the tendency of the vehicle to close out the curve, making the drivability of the vehicle even more complex.

[0015]. To solve this problem, it is known to insert a proportioning valve on one conduit alone which feeds the brake fluid to the disc brake of a front wheel so that after an initial

identical braking command on both wheels, one of them decreases the braking intensity thereof. This solution is known for example from Tilton Engineering (http://tiltonracing.com/wp-content/uploads/98-1261-Brake-Proportioning-Valve_.pdf).

[0016]. By initially determining a same input Pin and output Pout pressure up to reaching a limit, past which the output pressure is reduced with respect to the input pressure, all of these known solutions keep from meeting the strongly felt need to avoid the vehicle, for example in a curve of an oval track, from emphasizing its oversteering right from the start, thus closing out the curve in a manner which is complex to manage by the driver. Indeed, at the beginning of the braking, due to the identical pressure signal imparted to the disc brakes of both inner and outer curve wheels, the vehicle immediately starts closing out the curve, thus determining a trajectory setup which then becomes complex to correct also if the braking action of the inner curve wheel successively decreases.

[0017]. Thus, these known solutions do not allow solving all the strongly felt needs of:

[0018]. - in addition to desiring the differentiation of the braking action on the wheels of the same axle (inner curve wheel and outer curve wheel), compensate the tendency of the vehicle to go towards in the inside of the curve from the start, then reducing the braking action of the wheel(s) on the inner curve side from the start;

[0019]. - keeping the braking action on the inner curve wheel

proportional to the outer curve wheel and throughout the field of pressures applied to the braking system, thus making the vehicle much more comprehensible for the driver to manage;

[0020]. - allowing an immediate differentiation of the braking action between the wheels of the same axle and above all, the strongly felt need to be met to allow an adjustment of the braking system according to the track, the road surface and the adjustment or malfunctioning of the vehicle, albeit while reducing the pressure on the inner curve side of the vehicle with respect to the outer side of the vehicle (or vice versa if required by the performance for example, for an incorrect setting of the vehicle or a different road surface from the one described above).

[0021]. Solution

[0022]. These and other objects are achieved with a braking system according to claim **1**, a pressure reducing device according to claim **8**, an assembly of a pressure reducing device and a multiplicity of elastic elements according to claim **10**, a vehicle according to claim **11**, and also a method for reducing the braking pressure according to claim **12**.

[0023]. Certain advantageous embodiments are the object of the dependent claims.

[0024]. An analysis of this solution has shown how the solution proposed allows a pressure reducing system to be obtained which meets the above-described felt and continuing needs due to solutions of the prior art which are misguided for a person skilled in the art.

[0025]. Drawings

[0026]. Further features and advantages of the invention will be apparent from the description provided below of preferred embodiments thereof, given by way of non-limiting examples, with reference to the accompanying drawings, in which:

[0027]. - figure 1 depicts a diagrammatic view of a braking system according to the prior art, in which the braking action is positively synchronized between the front and rear axle but there are identical or similar braking actions on the wheels of the same axle;

[0028]. - figure 2 shows a braking system according to the present invention, in which there is inserted a braking pressure reducing device made according to the present invention in the branches of the system directed at controlling the braking action of one side of the vehicle, here the left side of the vehicle with respect to the direction of travel indicated in the drawing which also shows the direction and path of travel for example, of an oval track with superelevated curves towards the left with respect to the driver; in this drawing the braking actions F1, F3 of the left side of the vehicle, or inner curve side, are smaller than the braking actions F4, F5 of the right side of the vehicle, or outer curve side;

[0029]. - figure 3 depicts a proportional relationship diagram between the control pressure or pressure input into a pressure reducing device made according to the prior art, in which the output pressure of the device is variable according to the adjustment of the device; as is shown, the output pressure in a first stretch of

the relationship which is always present, is of identical entity to the input pressure, to then be reduced as an adjustable threshold is reached;

[0030]. - figure 4 depicts a relationship diagram between the control pressure or pressure input P1 or Pin to a pressure reducing device according to the invention and the output pressure P2 or Pout of the device which is variable according to the adjustment of the device; as is shown, the dotted line indicates the relationship of the prior art, the solid line shows the various relationships obtained by adjusting the device of the invention by changing the elastic constant K1 of the first elastic element 14 (in which the linear trend has an inclination with respect to the axles Pin and Pout proportional to K1, …Ki,Ki+1, … Kn,);

[0031]. - figure 5 depicts a relationship diagram between the control pressure or pressure input P1 or Pin to a pressure reducing device according to the invention, and the output pressure P2 or Pout of the device which is variable according to the adjustment of the device; as is shown, the dotted line indicates the relationship of the prior art, the solid line shows the various relationships obtained by adjusting the device of the invention by changing the preload of the first elastic element 14 (in which the linear trend has an inclination with respect to the axles Pin and Pout again proportional to K1);

[0032]. - figure 6 shows a longitudinal sectional view of a pressure adjusting device according to the invention, according to a first elastic constant and preload setting;

[0033]. - figure 7 shows a longitudinal sectional view of a pressure adjusting device according to the invention, according to a second elastic constant setting, lower than the one of the adjustment in figure 6, and similar preload;

[0034]. - figure 8 shows a longitudinal sectional view of a pressure adjusting device according to the invention, according to a second elastic constant setting, similar to the one of the adjustment in figure 6, and a greater preload with respect to the one in figure 6;

[0035]. - figures 9 to 11 show a multiplicity of first elastic elements 14 which can be used for example, in an assembly, or kit, according to the invention in conjunction with a pressure adjusting device, as depicted in figure 6;

[0036]. - figure 12 shows a variant of the braking system according to the invention, in which there is provided a by-pass conduit 68 which, according to the adjustment selected by the driver of the vehicle, allows controlling a braking device, whereby avoiding or involving a braking adjustment device;

[0037]. - figure 13 depicts a vehicle, in cross section transverse to the drawing, in a step of traveling a superelevated curve of an oval track, for example, as known in the NASCAR races;

[0038]. - figure 14 diagrammatically shows a vehicle and the camber adjustment thereof of the two wheels on the same axle to facilitate the travelling of a superelevated curve of an oval track with anticlockwise direction of travel.

[0039]. Description of some preferred embodiments

[0040]. According to a general embodiment, is provided a dissymmetric braking system 1 for a vehicle 2.

[0041]. Said vehicle comprises at least one first vehicle axle 3 or 15 supported by at least one right axle wheel 4 or 36 and at least one left axle wheel 5 or 37 of the vehicle.

[0042]. Said braking system 1 comprises at least one right wheel braking device 6 or 34; at least one left wheel braking device 7 or 35; at least one device to apply a braking action by the driver 8; at least one actuating device 9 to transform the braking action into a braking pressure command or first pressure or input pressure P1.

[0043]. Said braking system 1 further comprises at least one right wheel connection 10 or 38 between said at least one actuating device 9 and said first axle right wheel braking device 6 or 34; at least one left wheel connection 11 or 39 between said at least one actuating device 9 and said first axle left wheel braking device 7 or 35.

[0044]. Advantageously, at least one pressure reducing device 12 is provided in one of said connections 10, 11 or 38, 39.

[0045]. Said pressure reducing device 12 comprises at least one transfer device 13 which receives said first pressure P1.

[0046]. As a further advantage, said at least one transfer device 13 transforms said first pressure P1 into a reduced braking pressure or second pressure or output pressure P2 whereby avoiding, during the braking action, a fluidic connection between a fluid which has said first pressure P1 and a fluid which has said second pressure P2 so as to determine, during the braking action, a relationship

between said first pressure P1 and said second pressure P2 with linear, or proportional, trend without variation of linearity or proportionality throughout the operating field of the pressure reducing device 12, and so that the braking action of one of said at least one right wheel braking device 6 or 34 and at least one left wheel braking device 7 or 35 is lower than the other.

[0047]. According to one embodiment, said pressure reducing device 12 comprises at least one first elastic element 14 which has a first elastic constant K1 of predetermined entity. Said at least one first elastic element 14 constantly biases said at least one transfer device 13 acting in opposition to the bias of said first pressure P1.

[0048]. According to one embodiment, said device to apply a braking action by the driver 8 is at least one brake pedal 20.

[0049]. Said actuating device 9 is a brake cylinder or master cylinder 21 controlled by said brake pedal 20.

[0050]. Said at least one right wheel connection 10 or 38 is a feeding fluid conduit which fluidically connects said brake cylinder 21 to said right wheel braking device 6 or 34.

[0051]. Said at least one left wheel connection 11 or 39 is a feeding fluid conduit which fluidically connects said brake cylinder 21 to said left wheel braking device 7 or 35.

[0052]. According to one embodiment, said vehicle 2 comprises at least two axles, a first front axle 3 and a second rear axle 15.

[0053]. According to one embodiment, each axle 3, 15 comprises a right wheel disc brake 16 comprising a brake disc 17 and a brake

caliper 18 located astride the disc brake.

[0054]. According to one embodiment, each axle 3, 15 comprises a left wheel disc brake 19 comprising a brake disc 17 and a brake caliper 18 located astride the disc brake.

[0055]. According to one embodiment, said device to apply a braking action by the driver 8 is a brake pedal 20 or a brake lever.

[0056]. According to one embodiment, said actuating device 9 is two brake cylinders or a dual master cylinder 21, arranged mutually in parallel and controlled simultaneously by said brake pedal 20 or brake lever.

[0057]. A first brake cylinder 21 is intended for the front braking action and a second brake cylinder 21 is intended for the rear braking action or for crossed braking actions between front right or left wheels and rear left or right wheels.

[0058]. According to one embodiment, said connection in which said pressure reducing device 12 is provided is a front right wheel connection 10.

[0059]. According to one embodiment, said connection in which said pressure reducing device 12 is provided is a rear right wheel connection 38.

[0060]. According to one embodiment, said connection in which said pressure reducing device 12 is provided is a front left wheel connection 11.

[0061]. According to one embodiment, said connection in which said pressure reducing device 12 is provided is a rear left wheel connection 39.

[0062]. According to one embodiment, said pressure reducing device 12 is provided in only one of said right or left wheel connections 10 or 11 or 38 or 39.

[0063]. According to one embodiment, said pressure reducing device 12 is provided for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle.

[0064]. According to one embodiment, said pressure reducing device 12 is provided in both the front and rear right wheel connections 10 and 38.

[0065]. According to one embodiment, said pressure reducing device 12 is provided in both the front and rear left wheel connections 11 and 39.

[0066]. According to one embodiment, said fluid is a brake fluid.

[0067]. According to one embodiment, said system 1 is a hydraulic system.

[0068]. According to one embodiment, said system 1 is an electro-hydraulic system in which some components are electrically actuated.

[0069]. According to one embodiment, said system 1 is a brake-by-wire system in which all components are electrically actuated.

[0070]. According to one embodiment, said system 1 also provides a further symmetric pressure reducing device 33 to reduce the pressure directed to both braking devices 34, 35 of the rear axle 15 to differentiate the braking between the front vehicle axle or first vehicle axle 3 and the rear vehicle axle or second vehicle axle 15.

[0071]. According to one embodiment, said further symmetric pressure reducing device 33 is arranged upstream, closer to the

actuating device master cylinder 9, with respect to the pressure reducing device 12.

[0072]. According to one embodiment, said further symmetric pressure reducing device 33 is arranged downstream, further from the actuating device master cylinder 9, with respect to the pressure reducing device 12.

[0073]. According to one embodiment, said at least one transfer device 13 transforms said first pressure or input pressure P1 into a reduced braking pressure or second pressure or output pressure P2, whereby avoiding, during the braking action, a fluidic connection between a fluid which has said first pressure P1 and a fluid which has said second pressure P2 and avoiding the creation of a fluid flow between the receiver of said first pressure P1 and said second pressure P2.

[0074]. According to one embodiment, said pressure reducing device 12 comprises a pressure reducing device body 22.

[0075]. Said pressure reducing device body 22 comprises:

[0076]. A first pressure reducing device chamber or input chamber 23, in which said first pressure P1 is provided;

[0077]. a second pressure reducing device chamber or output chamber 24, in which said second pressure P2 is provided.

[0078]. According to one embodiment, said input chamber 23 provides an input chamber dimension A1 which is transverse to a sliding direction of said transfer device 13. Said output chamber 24 provides an output chamber dimension A2 which is transverse to a sliding direction of said transfer device 13, and said input chamber

dimension A1 is smaller than said output chamber dimension A2.

[0079]. According to one embodiment, said pressure reducing device body 22 comprises a third chamber 29, and in which said at least one first elastic element 14 is accommodated in said third chamber 29.

[0080]. According to one embodiment, said pressure reducing device body 22 comprises a fourth chamber 40 arranged between said first chamber 23 and said second chamber 24 and separated from said first and second chamber 23, 24 in fluid-tight manner by means of one-way seals 30, 31.

[0081]. According to one embodiment, said second chamber 24 is closed on a side thereof opposite to said first chamber 23 by a separating wall 43 of the pressure reducing device body 22.

[0082]. According to one embodiment, said separating wall 43 comprises a rod through-housing 44 adapted to accommodate said transfer device 13, e.g. a floating rod 25, in fluid-tight and sliding manner.

[0083]. According to one embodiment, said rod through-housing 44 is arranged between said second chamber 24 and said third chamber 29.

[0084]. According to one embodiment, said rod through-housing 44 comprises a third one-way fluid-tight seal 41 which confines the fluid in said second chamber.

[0085]. According to one embodiment, said rod through-housing 44 comprises a scraper seal between body and rod 42 which acts on the outer skirt of said floating rod 25.

[0086]. According to one embodiment, said first chamber or input

chamber 23 comprises an input opening 45 adapted to connect said first chamber 23 to said connection 10 or 11 or 38 or 39 in fluid-tight manner in order to connect said pressure reducing device 12 to said actuating device 9.

[0087]. According to one embodiment, said second chamber or output chamber 24 comprises an output opening 46 adapted to connect said second chamber 24 to said connection 10 or 11 or 38 or 39 in fluid-tight manner in order to connect said pressure reducing device 12 to said braking device 6 or 7 or 34 or 35.

[0088]. According to one embodiment, said first chamber or input chamber 23 comprises a bleeding opening 47 adapted to connect said first chamber 23 to a bleeding device 49 in fluid-tight manner.

[0089]. According to one embodiment, said pressure reducing device body 22 comprises a tank opening 48 adapted to connect said connection 10 or 11 or 38 or 39 to a fluid tank 28 for accommodating a braking system fluid reserve.

[0090]. According to one embodiment, said tank opening 48 is provided in said fourth chamber 40.

[0091]. According to one embodiment, said fluid tank 28 is connectable to said second chamber 24, allowing the feeding of fluid during the return stroke of the second plate 27 for recalling by vacuum the fluid into the second chamber by means of said second one-way seal 31 which allows the passage of fluid from the outside, e.g. from the fourth chamber 40 into the second chamber 24, e.g. if the brake pads in a brake caliper 18 are worn.

[0092]. According to one embodiment, said fluid tank 28 is

connectable to said first chamber 23, allowing the feeding of fluid during the return stroke of the first plate 26 for recalling by vacuum the fluid into the first chamber 23 by means of said first one-way seal 30 which allows the passage of fluid from the outside, e.g. from the fourth chamber 40 into the first chamber 23.

[0093]. According to one embodiment, said pressure reducing device body 22 comprises a third chamber or elastic device chamber 29.

[0094]. According to one embodiment, said third chamber 29 receives said first elastic element 14.

[0095]. According to one embodiment, said third chamber 29 receives an active rod end 50 which is at least partially accommodated in said third chamber 29, whereby cooperating with said first elastic element 14.

[0096]. According to one embodiment, said transfer device 13 is a floating rod 25 which comprises at least two thrust plates 26, 27, an input chamber first thrust plate 26 and an output chamber second thrust plate 27.

[0097]. According to one embodiment, said first and second plate 26, 27 are mechanically connected to one another and are integral with the floating rod 25 itself at a mutually predetermined distance so that said input chamber first thrust plate 26 is arranged in floating and fluid-tight manner in said first chamber or input chamber 23 and said output chamber second thrust plate 27 is arranged in floating and fluid-tight manner in said second chamber or output chamber 24.

[0098]. According to one embodiment, said first plate 26 comprises

a predetermined first plate action area A1 of predetermined dimensions transverse to the movement direction of said floating rod 25.

[0099]. According to one embodiment, said second plate 27 comprises a predetermined second plate action area A2 of predetermined dimensions transverse to the movement direction of said floating rod 25.

[00100]. According to one embodiment, said first plate action area A1 of said first plate 26 is smaller than the second plate action area A2 of said second plate 27.

[00101]. According to one embodiment, said floating rod 25 is in one piece with said first plate 26 and with said second plate 27.

[00102]. According to one embodiment, a first one-way seal 30 is associated with said first plate 26 which makes it possible to form a seal in said first chamber or input chamber 23 so as to prevent fluid passage between said first chamber 23 and said second chamber 24 and/or between said first chamber 23 and said fourth chamber 40.

[00103]. According to one embodiment, a second one-way seal 31 is associated with said second plate 27 which makes it possible to form a seal in said second chamber or output chamber 24 between said second chamber 24 and said first chamber 23 and/or between said second chamber 24 and said fourth chamber 40.

[00104]. According to one embodiment, said second plate 27 comprises second plate connecting through holes 51 for the passage of fluid, said second plate connecting through holes 51 being selectively closed by a second one-way seal 31 during the braking

action.

[00105]. According to one embodiment, said floating rod 25 between said first plate 26 and said second plate 27 comprises a spacer rod portion 32 which separates the two plates 26, 27.

[00106]. According to one embodiment, said floating rod 25 is in one piece with an active rod end 50 which is at least partially accommodated in a third chamber 29, whereby cooperating with said first elastic element 14 which is accommodated in said third chamber 29.

[00107]. According to one embodiment, said floating rod 25 enters into said first chamber 23, said floating rod 25 crosses said fourth chamber 40, said floating rod 25 crosses said second chamber 24 and said floating rod 25 enters into said third chamber 29.

[00108]. According to one embodiment, said at least one first elastic element 14 is interchangeable by selecting predetermined and mutually different elastic constants K1, Ki, …. Kn.

[00109]. According to one embodiment, said transfer device 13 comprises an active rod end 50 which is constantly biased by said at least one first elastic element 14.

[00110]. According to one embodiment, said first elastic element 14 is accommodated, with a first elastic element end 52 thereof, in a supporting and guiding cup 53 for said first elastic element end.

[00111]. According to one embodiment, said supporting and guiding cup 53 rests, constantly biasing said active rod end 50.

[00112]. According to one embodiment, said supporting and guiding cup 53 comprises a rod end-housing 54 which accommodates said active

rod end 50.

[00113]. According to one embodiment, said at least one first elastic element 14 acts between at least one transfer device 13 and a first elastic element support 55.

[00114]. According to one embodiment, said first elastic element support 55 comprises a bottom 56 and an elastic element guide 57 adapted to cooperate with a second elastic element end 58 so that the second elastic element end 58 rests and is guided during its constant elastic bias.

[00115]. According to one embodiment, said first elastic element support 55 is adjustable in its position relative to said second chamber 24 so as to modify the preload of said at least one first elastic element 14 in controlled manner.

[00116]. According to one embodiment, said first elastic element support 55 comprises a safety nut 59 for locking the first elastic element support 55 in a predetermined position.

[00117]. According to one embodiment, said first elastic element 14 is accommodated in a third chamber 29 formed in a pressure reducing device body 22.

[00118]. According to one embodiment, said third chamber 29 comprises an elastic element opening 60 which allows the insertion of said first elastic element 14 in said chamber.

[00119]. According to one embodiment, said elastic element opening 60 is delimited by a threaded wall adapted to receive a bottom 56 having a threading adapted to cooperate with said threading of the elastic element opening 60 to adjust the position of bottom 56.

[00120]. According to one embodiment, a safety nut 59 comprises an external threading with reverse helix with respect to the threading of bottom 56 so as to be screwed into said elastic element opening 60 and lock said bottom 56 in position.

[00121]. According to one embodiment, said pressure reducing device 12 comprises at least one second elastic device 61.

[00122]. According to one embodiment, said at least one second elastic device 61 constantly biases said transfer device 13 in opposition to the bias of said first pressure P1.

[00123]. According to one embodiment, said at least one second elastic device 61 is arranged between said second plate 27 and said pressure reducing device body 22.

[00124]. According to one embodiment, said at least one second elastic device 61 is arranged in said second chamber 24.

[00125]. According to one embodiment, said at least one first elastic element 14 is a helical spring.

[00126]. According to one embodiment, said at least one second elastic element 61 is a helical spring of predetermined elastic constant K2.

[00127]. According to one embodiment, said pressure reducing device 12 comprises a pressure reducing device body 22.

[00128]. According to one embodiment, said pressure reducing device body 22 comprises at least two half-bodies, a first half-body 62 and a second half-body 63.

[00129]. According to one embodiment, said first half-body 62 delimits said first chamber 23.

[00130]. According to one embodiment, said first half-body 62 delimits said second chamber 24.

[00131]. According to one embodiment, said first half-body 62 delimits said fourth chamber 40.

[00132]. According to one embodiment, said first half-body 62 comprises a half-body coupling end 64 for connecting to said second half-body 63.

[00133]. According to one embodiment, said half-body coupling end 64 comprises a mounting opening 65 closed by said second half-body 63.

[00134]. According to one embodiment, said transfer device 13 is inserted through said mounting opening 65 having previously separated said second half-body 63.

[00135]. According to one embodiment, said first half-body 62 and said second half-body 63 are connected to each other in fluid-tight manner.

[00136]. According to one embodiment, said second half-body 63 comprises a half-body extension 66 which is inserted in fluid-tight manner in said mounting opening 65.

[00137]. According to one embodiment, said second half-body 63 delimits said third chamber 29.

[00138]. According to one embodiment, said second half-body 63 comprises lightening side windows 67.

[00139]. According to one embodiment, at least one transfer device 13 receives a first pressure P1 or input pressure or control pressure.

[00140]. According to one embodiment, said at least one transfer device 13 transforms said first pressure P1 into a reduced braking pressure or second pressure P2, whereby avoiding, during the braking action, a fluidic connection between the fluid which has said first pressure P1 and the fluid which has said second pressure P2.

[00141]. According to one embodiment, at least one first elastic element 14 has an elastic constant K1 of predetermined entity.

[00142]. According to one embodiment, said at least one first elastic element 14 constantly biases said at least one transfer device 13 in opposition to the bias applied by said first pressure P1, so as to determine a relationship between said first pressure P1 and said second pressure P2 with linear, or proportional, trend, without variation of linearity or proportionality throughout the operating field of the pressure reducing device 12.

[00143]. According to a general embodiment, a device 12 comprises one or more of the features listed in any one of the embodiments described above.

[00144]. According to a general embodiment, an assembly or kit comprises a device 12 as described in any one of the embodiments described above and a plurality of first mutually interchangeable elastic elements 14 having mutually different elastic constants K1, ... Kn to determine different linear relationships between said first pressure P1 and said second pressure P2.

[00145]. According to a general embodiment, a vehicle 2 comprises a braking system 1 as described in any one of the embodiments indicated above.

[00146]. A braking pressure reducing method is described below.

[00147]. Said method comprises the steps of:

[00148]. - applying a first pressure P1 to a first means or fluid;

[00149]. - with said first pressure P1, moving a transfer device 13, whereby transferring the force generated by said first pressure P1 to a second means or fluid, avoiding a fluidic connection between said first and second means or fluid during the transfer of the force;

[00150]. - equal force being transmitted, reducing the pressure into a second pressure P2;

[00151]. - elastically and constantly biasing said transfer device 13 with a first elastic element 14 of predetermined elastic constant K1;

[00152]. - so as to have a linear or proportional relationship between said first pressure P1 and said second pressure P2 without variation of linearity or proportionality throughout the operating field of the method.

[00153]. According to further criteria for carrying out this method, the further step is provided:

[00154]. - adjusting the proportional relationship law between said first pressure P1 and second pressure P2 by modifying the elastic constant K1 of the elastic element 14.

[00155]. According to a further criteria for carrying out this method, the further step is provided:

[00156]. - adjusting the preload of the elastic element 14 so as to achieve a delay in the response of the second pressure P2 as the

first pressure P1 varies.

[00157]. According to a further criteria for carrying out this method, the further step is provided of:

[00158]. - applying a force with a pedal 20 or lever;

[00159]. - transforming said force into a first control pressure or input pressure or first pressure P1;

[00160]. - obtaining said first pressure P1 in a first chamber 23 of a pressure reducing device 12, in which said first chamber has a predetermined first thrust section A1;

[00161]. - transferring the force generated by the first pressure P1 on said first thrust section A1 to a second chamber 24 of said pressure reducing device 12 in which said second chamber 24 has a predetermined second thrust section A2 so as to generate a reduced second pressure P2 in said second chamber 24;

[00162]. - avoiding, during the braking action, a fluidic connection between said first chamber 23 and said second chamber 24;

[00163]. - elastically and constantly biasing said second thrust section A2 of said second chamber 24 with a first elastic element 14 of predetermined elastic constant K1 in a direction opposite to said first pressure P1;

[00164]. - conveying said second pressure P2 to a braking device 6 or 7 or 34 or 35.

[00165]. According to one embodiment, the second chamber has an actual section A2 which is greater than the actual section A1 of the first chamber. In other words, the first plate has a first area of action A1 which is smaller than the area of action A2 of the second

plate.

[00166]. Therefore, the force applied on the pedal of brake F1 being equal, the second pressure P2 obtained in the second chamber with greater area of action is less with respect to the first pressure P1 in the first chamber with smaller area of action, with a proportionality given by A1/A2.

[00167]. Assuming a stroke of the floating rod having an entity equal to x, a preload of the first elastic element equal to PR1 and a preload of the second elastic element equal to PR2, the following would result at each braking instant:

[00168]. $F1 = P1*A1 = P2*A2 + PR2 + PR1 + (K2x + K1x)$

[00169]. Thus, the most important pressure reduction is given by the ratio A1/A2 and there is no second pressure P2 until F1 reaches a value proportional to PR1+PR2; when the preload is exceeded, the second pressure P2 increases linearly proportionately to (K1+K2).

[00170]. Due to the embodiments described, in addition to differentiating the braking action on the wheels of the same axle (inner curve wheel and outer curve wheel), the tendency of the vehicle to go towards the inside of the curve may be compensated for from the first instants of the braking start, therefore reducing the braking action from the start, the braking action of the wheel(s) on the inner curve side.

[00171]. Moreover due to the solutions proposed, the braking action on the inner curve wheel may be kept proportional to the outer curve wheel and throughout the field of pressures applied to the braking system, thus making the vehicle much more comprehensible for the

driver, and therefore simpler to manage.

[00172]. Furthermore due to the solutions proposed, albeit while reducing the pressure on the inner curve side of the vehicle with respect to the outer side of the vehicle (or vice versa if required by the performance for example, for an incorrect setting of the vehicle or a different road surface different from the one described above), an immediate differentiation of the braking action may be obtained between the wheels of the same axle and above all, the strongly felt need to allow an adjustment of the braking system according to the track, the road surface and the adjustment or malfunctioning of the vehicle may be met, for example by modifying the preload of the elastic element or replacing the elastic element with one having different elastic features.

[00173]. Those skilled in the art may make many changes and adaptations to the embodiments described above or can replace elements with others which are functionally equivalent in order to meet contingent needs without however departing from the scope of the appended claims.

[00174]. According to one embodiment, there is only one connection in which said pressure reducing device 12 is provided and it is a front right wheel connection 10.

[00175]. According to one embodiment, there is only one connection in which said pressure reducing device 12 is provided and it is a rear right wheel connection 38.

[00176]. According to one embodiment, there is only one connection in which said pressure reducing device 12 is provided and it is a

front left wheel connection 11.

[00177]. According to one embodiment, there is only one connection in which said pressure reducing device 12 is provided and it is a rear left wheel connection 39.

[00178]. According to one embodiment, said system 1 only provides said pressure reducing device 12 for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle. Said system 1 also provides a further symmetric pressure reducing device 33 to reduce the pressure directed to both braking devices 34, 35 of the rear axle 15 to differentiate the braking between the front vehicle axle or first vehicle axle 3 and the rear vehicle axle or second vehicle axle 15.

[00179]. According to one embodiment, said pressure reducing device 12 is provided for one alone or for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle.

[00180]. According to one embodiment, said pressure reducing device 12 is provided for one alone or for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle and in which said system 1 also provides a further symmetric pressure reducing device 33 to reduce the pressure directed to both braking devices 34, 35 of the rear axle 15 to differentiate the braking between the front vehicle axle or first vehicle axle 3 and the rear vehicle axle or second vehicle axle 15.

LIST OF REFERENCES

1	braking system
2	vehicle
3	first or front vehicle axle
15	second or rear vehicle axle
4	right wheel of first axle
5	left wheel of first axle
36	right wheel of second axle
37	left wheel of second axle
6	front right wheel braking device
7	front left wheel braking device
34	rear right wheel braking device
35	rear left wheel braking device
8	device for applying a braking action by the driver
20	brake pedal or brake lever
9	actuating device (master cylinder)
10	right wheel connection or front right connection
11	left wheel connection or front left connection
38	rear right connection
39	rear left connection
16	right wheel disc brake
19	left wheel disc brake
17	brake disc
18	brake caliper
21	brake cylinder or master cylinder

12 pressure reducing device

22 pressure reducing device body

23 first pressure reducing device chamber or input chamber

24 second pressure reducing device chamber or output chamber

29 elastic device chamber or third chamber

40 fourth separating chamber between first and second chamber

13 transfer device - floating rod

25 floating rod

32 spacer rod portion

50 active rod end

26 input chamber first thrust plate

27 output chamber second thrust plate

51 second plate connecting through holes

28 fluid tank

30 first one-way seal

31 second one-way seal

41 third one-way fluid-tight seal - sealingly arranged between pressure reducing device body and floating rod

42 scraper seal between body and rod

33 symmetric pressure reducing device

43 separating wall of the pressure reducing device body

44 rod through-housing

45 input opening

46 output opening

47 bleeding opening

48 tank opening

49 bleeding device

60 elastic element opening

14 first elastic element

52 first elastic element end

58 second elastic element end

53 supporting and guiding cup

54 rod end-housing

55 first elastic element support

56 bottom

57 elastic element guide

59 safety nut

61 second elastic device

62 first half-body

63 second half-body

64 half-body coupling end

65 mounting opening

66 half-body extension

67 lightening side windows

P1 first pressure or braking pressure command or input pressure

P2 second pressure or reduced braking pressure or output pressure

K1 predetermined first elastic constant

K2 predetermined elastic constant of the second elastic element

A1 input chamber dimension

A2 output chamber dimension

A1 predetermined first plate action area

A2 predetermined second plate action area

F1 front inner curve braking action of the vehicle

F2 front outer curve braking action of the vehicle

F3 rear inner curve braking action of the vehicle

F4 rear outer curve braking action of the vehicle

CLAIMS

1. A dissymmetric braking system (1) for vehicle (2), wherein

- said vehicle comprises at least one first vehicle axle (3 or 15) supported by at least one right axle wheel (4 or 36) and at least one left axle wheel (5 or 37) of the vehicle;

wherein said braking system (1) comprises:

- at least one right wheel braking device (6 or 34);
- at least one left wheel braking device (7 or 35);
- at least one device to apply a braking action by the driver (8);
- at least one actuating device (9) to transform the braking action into a braking pressure command, or first pressure, or input pressure (P1);
- at least one right wheel connection (10 or 38) between said at least one actuating device (9) and said first axle right wheel braking device (6 or 34);
- at least one left wheel connection (11 or 39) between said at least one actuating device (9) and said first axle left wheel braking device (7 or 35);
- at least one pressure reducing device (12) is provided in one of said connections (10, 11 or 38, 39);
- said pressure reducing device (12) comprises at least one transfer device (13) which receives said first pressure (P1);

characterized in that

- said at least one transfer device (13) transforms said first pressure (P1) into a reduced braking pressure, or second pressure, or output pressure (P2), whereby avoiding, during the braking action, a fluidic connection between a fluid which has said first pressure (P1) and a fluid which has said second pressure (P2);
- so as to determine, during the braking action, a relationship between said first pressure (P1) and said second pressure (P2) with linear, or proportional, trend without variation of linearity or proportionality throughout the operating field of the pressure reducing device (12);

- and so that the braking action of one of said at least one right wheel braking device (6 or 34) and at least one left wheel braking device (7 or 35) is lower than the other.

2. A system (1) according to claim 1, wherein:
- said pressure reducing device (12) comprises at least one first elastic element (14) which has a first elastic constant (K1) of predetermined entity;
- said at least one first elastic element (14) constantly biases said at least one transfer device (13) acting in opposition to the bias of said first pressure (P1);
and/or wherein
- said device to apply a braking action by the driver (8) is at least one brake pedal (20);
- said actuating device (9) is a brake cylinder, or master cylinder (21), controlled by said brake pedal (20);
- said at least one right wheel connection (10 or 38) is a feeding fluid conduit which fluidically connects said brake cylinder (21) to said right wheel braking device (6 or 34);
- said at least one left wheel connection (11 or 39) is a feeding fluid conduit which fluidically connects said brake cylinder (21) to said left wheel braking device (7 or 35);
and/or wherein
- said vehicle (2) comprises at least two axles, a first front axle (3) and a second rear axle (15);
- each axle (3, 15) comprises a right wheel disc brake (16) comprising a brake disc (17) and a brake caliper (18) located astride the disc brake;
- each axle (3, 15) comprises a left wheel disc brake (19) comprising a brake disc (17) and a brake caliper (18) located astride the disc brake;
and/or wherein
- said device to apply a braking action by the driver (8) is a brake pedal (20) or a brake lever;

- said actuating device (9) is two brake cylinders, or dual master cylinder (21), arranged mutually in parallel and controlled simultaneously by said brake pedal (20) or brake lever;
- a first brake cylinder (21) being intended for the front braking action and a second brake cylinder (21) being intended for the rear braking action or for crossed braking actions between front right or left wheels and rear left or right wheels;

and/or wherein

- there is only one connection in which said pressure reducing device (12) is provided and it is the front right wheel connection (10);

and/or wherein

- there is only one connection in which said pressure reducing device (12) is provided and it is the rear right wheel connection (38);

and/or wherein

- there is only one connection in which said pressure reducing device (12) is provided and it is the front left wheel connection (11);

and/or wherein

- there is only one connection in which said pressure reducing device (12) is provided and it is the rear left wheel connection (39);

and/or wherein

- said pressure reducing device (12) is provided in only one of said right or left wheel connections (10 or 11 or 38 or 39);

and/or wherein

- said pressure reducing device (12) is provided for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle;

and/or wherein

- said pressure reducing device (12) is provided in both the front and rear right wheel connections (10 and 38);

and/or wherein

- said pressure reducing device (12) is provided in both the front and rear left wheel connections (11 and 39);

and/or wherein

- said fluid is a brake fluid;

and/or wherein

- said system (1) is a hydraulic system;

and/or wherein

- said system (1) is an electro-hydraulic system in which some components are electrically actuated;

and/or wherein

- said system (1) is a brake-by-wire system in which all components are electrically actuated;

and/or wherein

- said pressure reducing device (12) is only provided for both wheels of the same side of the vehicle, with respect to the direction of travel of the vehicle.

3. A system (1) according to any one of the preceding claims, wherein

- said system (1) also provides a further symmetric pressure reducing device (33) to reduce the pressure directed to both braking devices (34, 35) of the rear axle (15) to differentiate the braking between the front vehicle axle, or the first vehicle axle (3), and the rear vehicle axle, or the second vehicle axle (15);

and/or wherein

- said further symmetric pressure reducing device (33) is arranged upstream, closer to the actuating device (master cylinder) (9), with respect to the pressure reducing device (12);

and/or wherein

- said further symmetric pressure reducing device (33) is arranged downstream, further from the actuating device (master cylinder) (9), with respect to the pressure reducing device (12);

and/or wherein

- said pressure reducing device (12) is only provided for one only or for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle;

and/or wherein

- said pressure reducing device (12) is only provided for one only or for both wheels of the same side of the vehicle with respect to the direction of travel of the vehicle and wherein said system (1) also provides a further symmetric pressure reducing device (33) to reduce the pressure directed to both braking devices (34, 35) of the rear axle (15) to differentiate the braking between the front vehicle axle, or the first vehicle axle (3), and the rear vehicle axle, or the second vehicle axle (15).

4. A system (1) according to any one of the preceding claims, wherein

- said at least one transfer device (13) transforms said first pressure, or input pressure (P1), into a reduced braking pressure, or second pressure or output pressure (P2), whereby avoiding, during the braking action, a fluidic connection between a fluid which has said first pressure (P1) and a fluid which has said second pressure (P2) and avoiding the creation of a fluid flow between the receiver of said first pressure (P1) and said second pressure (P2);

and/or wherein

- said pressure reducing device (12) comprises a pressure reducing device body (22);
- said pressure reducing device body (22) comprises:
- a first pressure reducing device chamber, or input chamber, (23), in which said first pressure (P1) is provided;
- a second pressure reducing device chamber, or output chamber, (24), in which said second pressure (P2) is provided;

and wherein

- said input chamber (23) has an input chamber dimension (A1) which is transverse to a sliding direction of said transfer device (13); said output chamber (24) has an output chamber dimension (A2) which is transverse to a sliding direction of said transfer device (13);

and wherein said input chamber dimension (A1) is smaller than said output chamber dimension (A2);

and/or wherein

- said pressure reducing device body (22) comprises:

- a third chamber (29), wherein said at least one first elastic element (14) is accommodated in said third chamber (29);

and/or wherein

- said pressure reducing device body (22) comprises:

- a fourth chamber (40) arranged between said first chamber (23) and said second chamber (24) and separated from said first and second chamber (23, 24) in fluid-tight manner by means of one-way seals (30, 31);

and/or wherein

- said second chamber (24) is closed on a side thereof opposite to said first chamber (23) by a separating wall (43) of the pressure reducing device body (22);

- said separating wall (43) comprises a rod through-housing (44) adapted to accommodate said transfer device (13) e.g. a floating rod (25) in fluid-tight and sliding manner;

and/or wherein

- said rod through-housing (44) is arranged between said second chamber (24) and said third chamber (29);

and/or wherein

- said rod through-housing (44) comprises a third one-way fluid-tight seal (41) which confines the fluid in said second chamber;

and/or wherein

- said rod through-housing (44) comprises a scraper seal between body and rod (42) which acts on the outer skirt of said floating rod (25);

and/or wherein

- said first chamber or input chamber (23) comprises an input opening (45) adapted to connect said first chamber (23) to said connection (10 or 11 or 38 or 39) in fluid-tight manner in order to connect said pressure reducing device (12) to said actuating device (9); and wherein

- said second chamber or output chamber (24) comprises an output opening (46) adapted to connect said second chamber (24) to said connection (10 or 11 or 38 or 39) in fluid-tight manner in order to connect said pressure reducing device (12) to said braking device (6 or 7 or 34 or 35);

and/or wherein

- said first chamber or input chamber (23) comprises a bleeding opening (47) adapted to connect said first chamber (23) to a bleeding device (49) in fluid-tight manner;

and/or wherein

- said pressure reducing device body (22) comprises a tank opening (48) adapted to connect said connection (10 or 11 or 38 or 39) to a fluid tank (28) for accommodating a braking system fluid reserve;

and/or wherein

- said tank opening (48) is provided in said fourth chamber (40);

and/or wherein

- said fluid tank (28) being connectable to said second chamber (24) allowing the feeding of fluid during the return stroke of the second plate (27) for recalling by vacuum the fluid into the second chamber by means of said second one-way seal (31) which allows the passage of fluid from the outside, e.g. from the fourth chamber (40) into the second chamber (24), e.g. if the brake pads in a brake caliper 18 are worn;

and/or wherein

- said fluid tank (28) being connectable to said first chamber (23) allowing the feeding of fluid during the return stroke of the first plate (26) for recalling by vacuum the fluid into the first chamber (23) by means of said first one-way seal (30) which allows the passage of fluid from the outside, e.g. from the fourth chamber (40) into the first chamber (23);

and/or wherein

- said pressure reducing device body (22) comprises a third chamber or elastic device chamber (29);

and wherein

- said third chamber (29) receives said first elastic element (14);

and wherein
- said third chamber (29) receives an active rod end (50) which is at least partially accommodated in said third chamber (29) whereby cooperating with said first elastic element (14).

5. A system (1) according to any one of the preceding claims, wherein
- said transfer device (13) is a floating rod (25) which comprises at least two thrust plates (26, 27), an input chamber first thrust plate (26) and an output chamber second thrust plate (27); wherein
- said first and second plate (26, 27) are mechanically connected to one another and integral with the floating rod (25) itself at a mutually predetermined distance, so that said input chamber first thrust plate (26) is arranged in floating and fluid-tight manner in said first chamber or input chamber (23), and said output chamber second thrust plate (27) is arranged in floating and fluid-tight manner in said second chamber or output chamber (24);
and/or wherein
- said first plate (26) comprises a predetermined first plate action area (A1) of predetermined dimensions transverse to the movement direction of said floating rod (25);
- said second plate (27) comprises a predetermined second plate action area (A2) of predetermined dimensions transverse to the movement direction of said floating rod (25);
and wherein
- said first plate action area (A1) of said first plate (26) is smaller than the second plate action area (A2) of said second plate (27);
and/or wherein
- said floating rod (25) is in one piece with said first plate (26) and with said second plate (27);
and/or wherein
- a first one-way seal (30) is associated with said first plate (26) which makes it possible to form a seal in said first chamber or input chamber (23), so as to prevent fluid passage between said

first chamber (23) and said second chamber (24) and/or between said first chamber (23) and said fourth chamber (40);
and/or wherein
- a second one-way seal (31) is associated with said second plate (27) which makes it possible to form a seal in said second chamber or output chamber (24), between said second chamber (24) and said first chamber (23) and/or between said second chamber (24) and said fourth chamber (40);
and/or wherein
- said second plate (27) comprises second plate connecting through holes (51) for the passage of fluid, said second plate connecting through holes (51) being selectively closed by second one-way seal (31) during the braking action;
and/or wherein
- said floating rod (25) between said first plate (26) and said second plate (27) comprises a spacer rod portion (32) which separates the two plates (26, 27);
and/or wherein
- said floating rod (25) is in one piece with an active rod end (50) which is at least partially accommodated in a third chamber (29), whereby cooperating with said first elastic element (14) which is accommodated in said third chamber (29);
and/or wherein
- said floating rod (25) enters into said first chamber (23), said floating rod (25) crosses said fourth chamber (40), said floating rod (25) crosses said second chamber (24) and said floating rod (25) enters into said third chamber (29).

6. A system (1) according to any one of the preceding claims, wherein
- said at least one first elastic element (14) is interchangeable by selecting predetermined and mutually different elastic constants (K1, K2, …. Kn);
and/or wherein

- said transfer device (13) comprises an active rod end (50) which is constantly biased by said at least one first elastic element (14);

and wherein

- said first elastic element (14) is accommodated with a first elastic element end (52) thereof in a supporting and guiding cup (53) for said first elastic element end;

and wherein

- said supporting and guiding cup (53) rests constantly biasing said active rod end (50);

and wherein

- said supporting and guiding cup (53) comprises a rod end-housing (54) which accommodates said active rod end (50);

and/or wherein

- said at least one first elastic element (14) acts between at least one transfer device (13) and a first elastic element support (55);

and/or wherein

- said first elastic element support (55) comprises a bottom (56) and an elastic element guide (57) adapted to cooperate with a second elastic element end (58) so that the second elastic element end (58) rests and is guided during its constant elastic bias;

- said first elastic element support (55) is adjustable in its position relative to said second chamber (24) so as to modify the preload of said at least one first elastic element (14) in controlled manner;

- said first elastic element support (55) comprises a safety nut (59) for locking the first elastic element support (55) in a predetermined position;

- said first elastic element (14) is accommodated in a third chamber (29) formed in a pressure reducing device body (22);

- said third chamber (29) comprises an elastic element opening (60) which allows the insertion of said first elastic element (14) in said chamber;

and/or wherein

- said elastic element opening (60) is delimited by a threaded wall adapted to receive a bottom (56) having a threading adapted to cooperate with said threading of the elastic element opening (60) to adjust the position of the bottom (56);

and/or wherein

- a safety nut (59) comprises an external threading with reverse helix with respect to the threading of the bottom (56) so as to be screwed into said elastic element opening (60) and lock said bottom (56) in position;

and/or wherein

- said pressure reducing device (12) comprises at least one second elastic device (61);

- said at least one second elastic device (61) constantly biases said transfer device (13) in opposition to the bias of said first pressure (P1);

and/or wherein

- said at least one second elastic device (61) is arranged between said second plate (27) and said pressure reducing device body (22);

and/or wherein

- said at least one second elastic device (61) is arranged in said second chamber (24);

and/or wherein

- said at least one first elastic element (14) is a helical spring;

and/or wherein

said at least one second elastic element (61) is a helical spring of predetermined elastic constant (K2).

7. A system (1) according to any one of the preceding claims, wherein

- said pressure reducing device (12) comprises a pressure reducing device body (22);

- said pressure reducing device body (22) comprises at least two half-bodies, a first half-body (62) and a second half-body (63);

and/or wherein

- said first half-body (62) delimits said first chamber (23);

- said first half-body (62) delimits said second chamber (24);
and/or wherein
- said first half-body (62) delimits said fourth chamber (40);
and/or wherein
- said first half-body (62) comprises a half-body coupling end (64) for connecting to said second half-body (63);
- said half-body coupling end (64) comprises a mounting opening (65) closed by said second half-body (63);
and wherein
- said transfer device (13) is inserted through said mounting opening (65) having previously separated said second half-body (63);
and/or wherein
- said first half-body (62) and said second half-body (63) are connected to each other in fluid-tight manner;
and/or wherein
- said second half-body (63) comprises a half-body extension (66) which is inserted in fluid-tight manner in said mounting opening (65);
and/or wherein
- said second half-body (63) delimits said third chamber (29);
and/or wherein
- said second half-body (63) comprises lightening side windows (67).

8. A vehicle braking system pressure reducing device (12), comprising
- at least one transfer device (13) which receives a first pressure (P1), or input pressure, or control pressure;
characterized in that
- said at least one transfer device (13) transforms said first pressure (P1) into a reduced braking pressure, or second pressure (P2), whereby avoiding, during the braking action, a fluidic connection between the fluid which has said first pressure (P1) and the fluid which has said second pressure (P2);
- at least one first elastic element (14) which has an elastic constant (K1) of predetermined entity;

- said at least one first elastic element (14) constantly biases said at least one transfer device (13) in opposition to the bias applied by said first pressure (P1);
- so as to determine a relationship between said first pressure (P1) and said second pressure (P2) with linear, or proportional, trend, without variation of linearity or proportionality throughout the operating field of the pressure reducing device (12).

9. A device (12) according to claim 8, wherein one or more of the features listed in any one of claims 2 to 7 are comprised.

10. An assembly or kit comprising a device (12) as described in any one of claims 8 and/or 9 and a plurality of first mutually interchangeable elastic elements (14) having mutually different elastic constants (K1, ... Kn) to determine different linear relationships between said first pressure (P1) and said second pressure (P2).

11. A vehicle (2) comprising a braking system (1) as defined in any one of the claims 1 to 7.

12. A braking pressure reducing method comprising the steps of:
- applying a first pressure (P1) to a first means or fluid;
- with said first pressure (P1), moving a transfer device (13), whereby transferring the force generated by said first pressure (P1) to a second means or fluid, avoiding a fluidic connection between said first and second means or fluid during the transfer of the force;
- equal force being transmitted, reducing the pressure to a second pressure (P2);
- so as to have a linear, or proportional relationship between said first pressure (P1) and said second pressure (P2) without variation of linearity or proportionality throughout the operating field of the method.

13. A method according to claim 12, wherein there is a further step of:
- elastically and constantly biasing said transfer device (13) with a first elastic element (14) of predetermined elastic constant (K1); and/or the further step of
- adjusting the proportional relationship law between said first pressure (P1) and second pressure (P2) by modifying the elastic constant (K1) of the elastic element (14).

14. A method according to claim 12 or claim 13, wherein there is a further step of:
- adjusting the preload of the elastic element (14) so as to achieve a delay in the response of the second pressure (P2) as the first pressure (P1) varies.

15. A method according to any one of the preceding claims from 12 to 14, wherein there is the further step of:
- applying a force with a pedal (20) or lever;
- transforming said force into a first control pressure or input pressure or first pressure (P1);
- obtaining said first pressure P1 in a first chamber (23) of a pressure reducing device (12), in which said first chamber has a predetermined first thrust section (A1);
- transferring the force generated by the first pressure (P1) on said first thrust section (A1) to a second chamber (24) of said pressure reducing device (12) wherein said second chamber (24) has a predetermined second thrust section (A2) so as to generate a reduced second pressure (P2) in said second chamber (24);
- avoiding, during the braking action, a fluidic connection between said first chamber (23) and said second chamber (24);
- elastically and constantly biasing said second thrust section (A2) of said second chamber (24) with a first elastic element (14) of predetermined elastic constant (K1) in a direction opposite to said first pressure (P1);

- conveying said second pressure (P2) to a braking device (6 or 7 or 34 or 35).

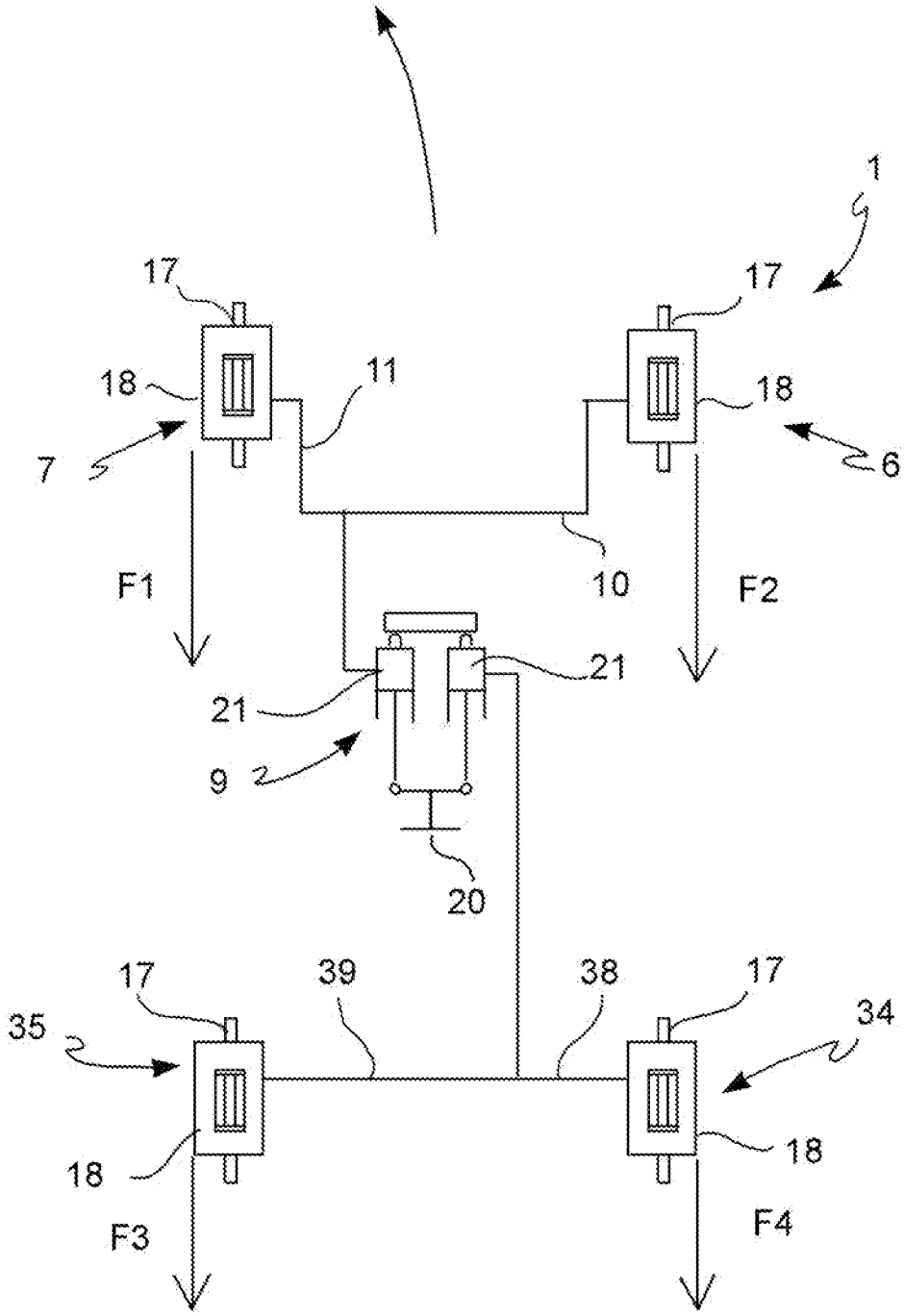

FIG. 1

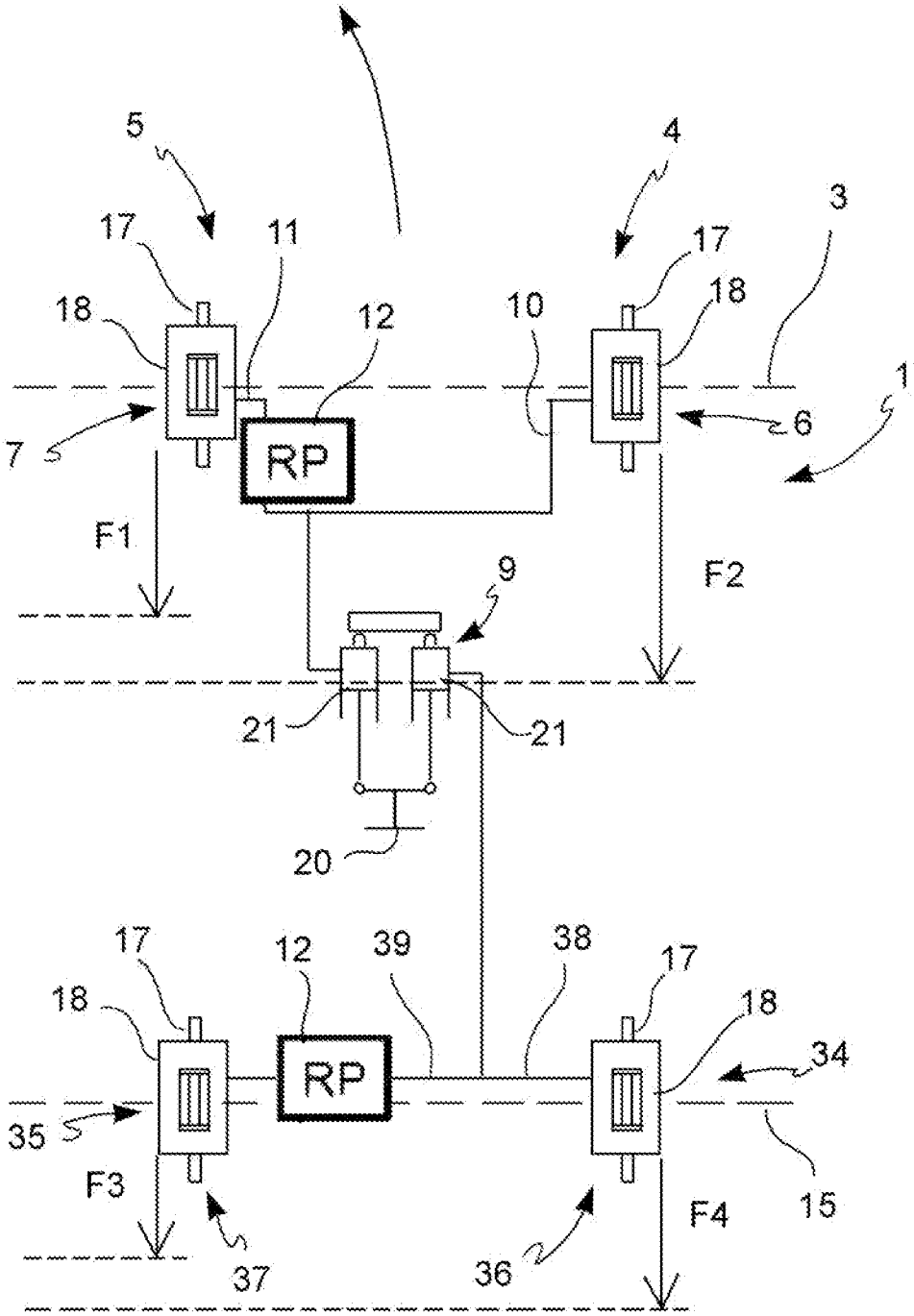
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FIG. 2

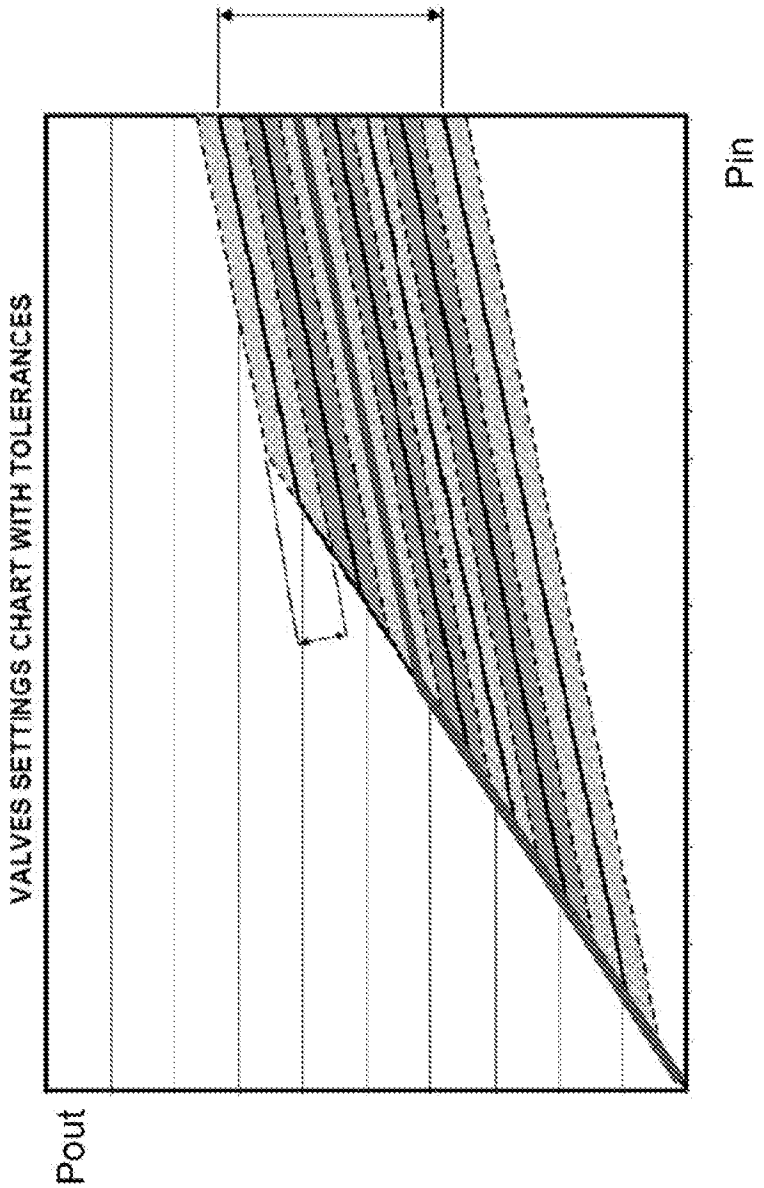

FIG. 3
(STATE OF THE ART)

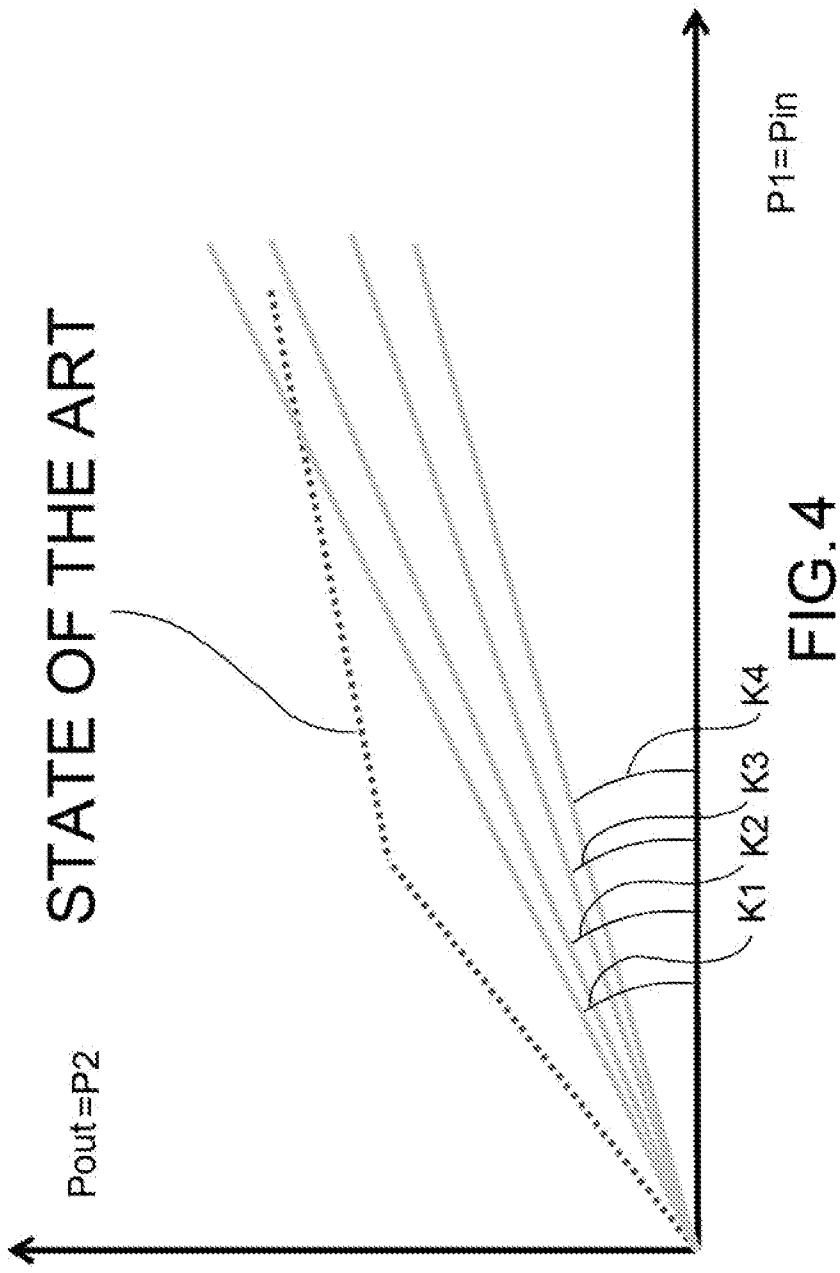

FIG. 4

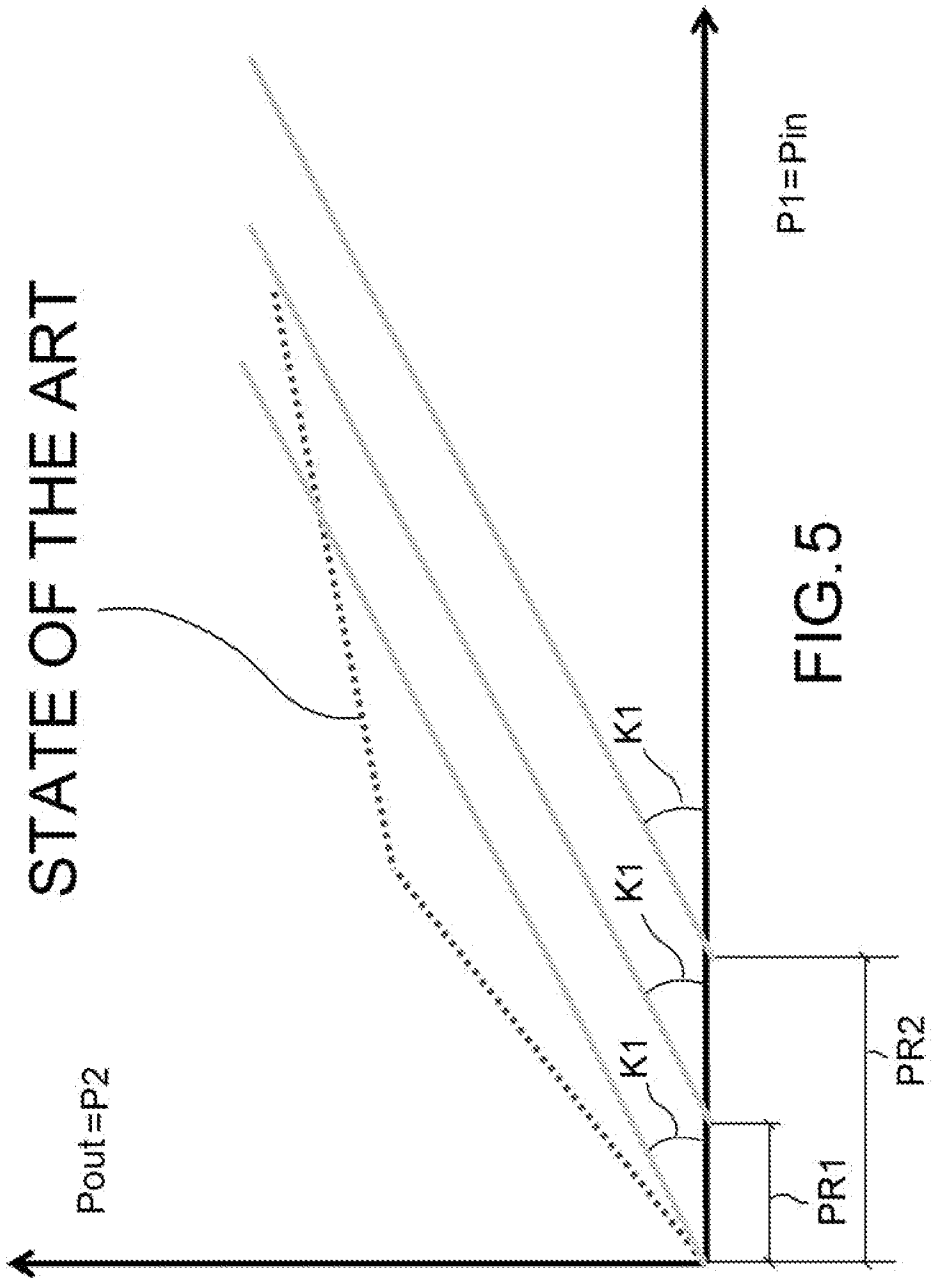

FIG.5

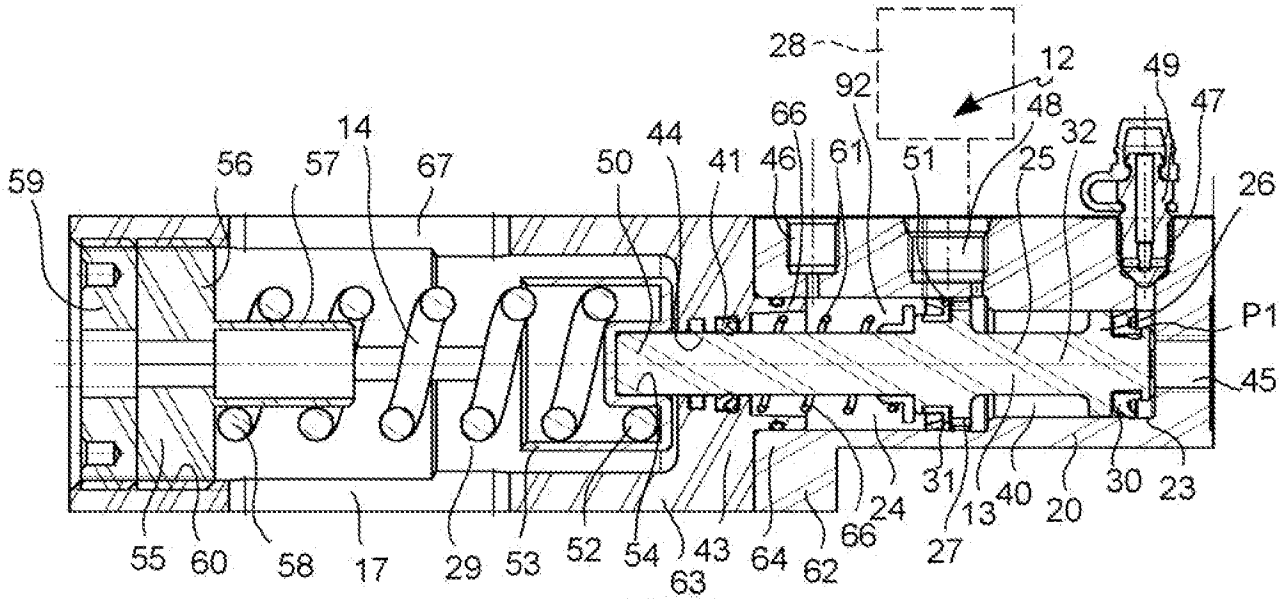

FIG. 6

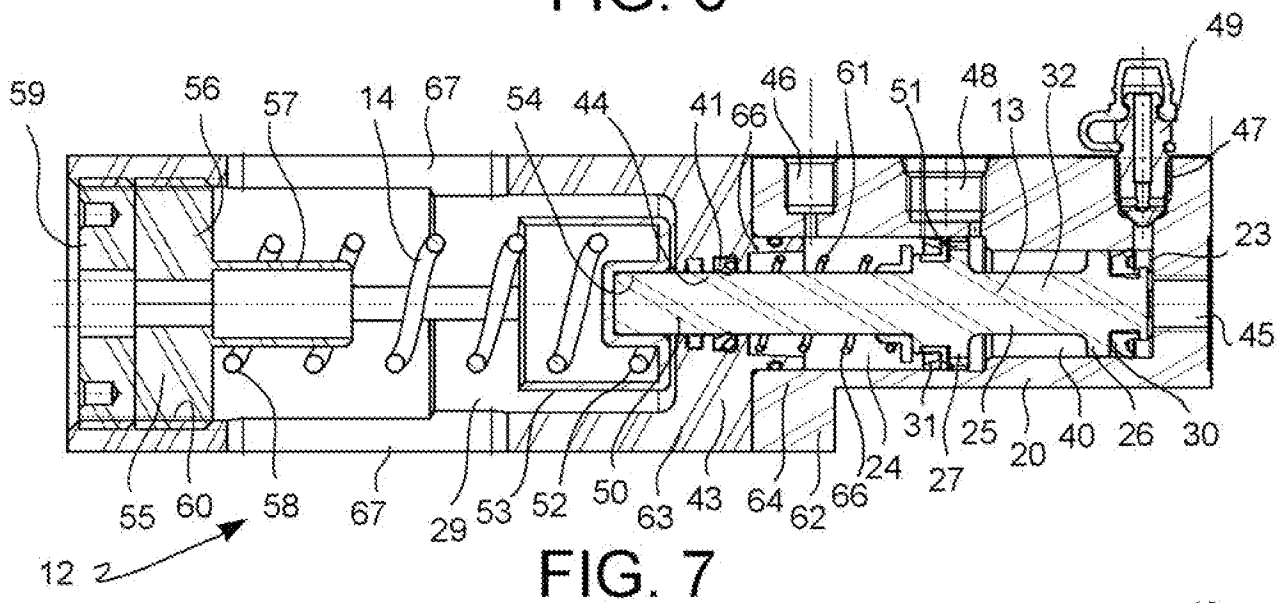

FIG. 7

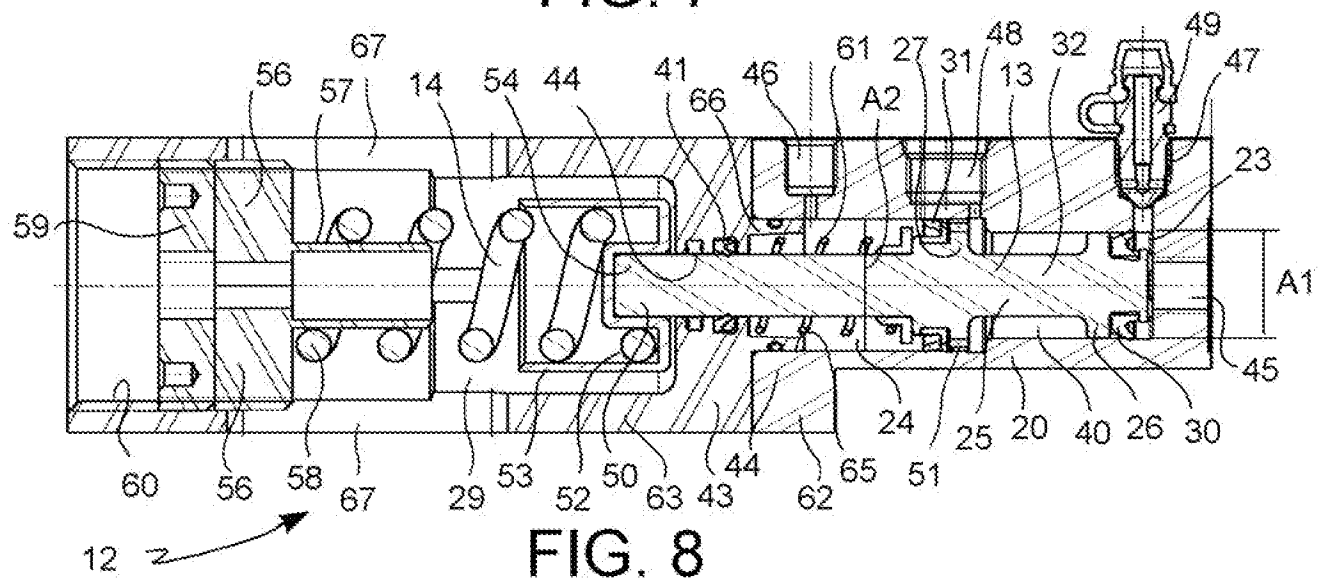

FIG. 8

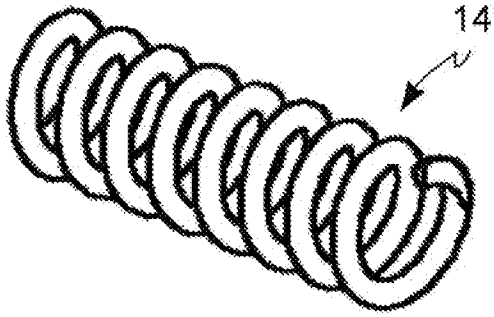

FIG. 9

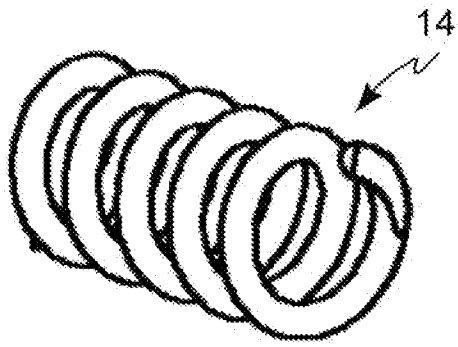

FIG. 10

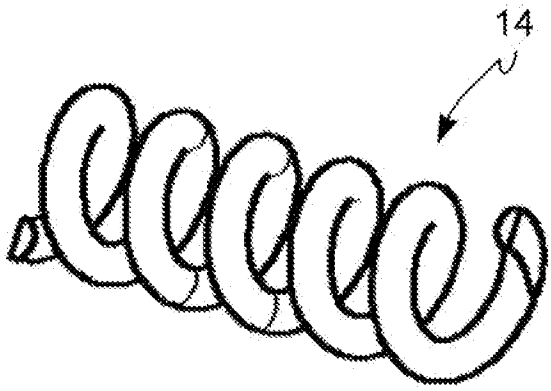

FIG. 11

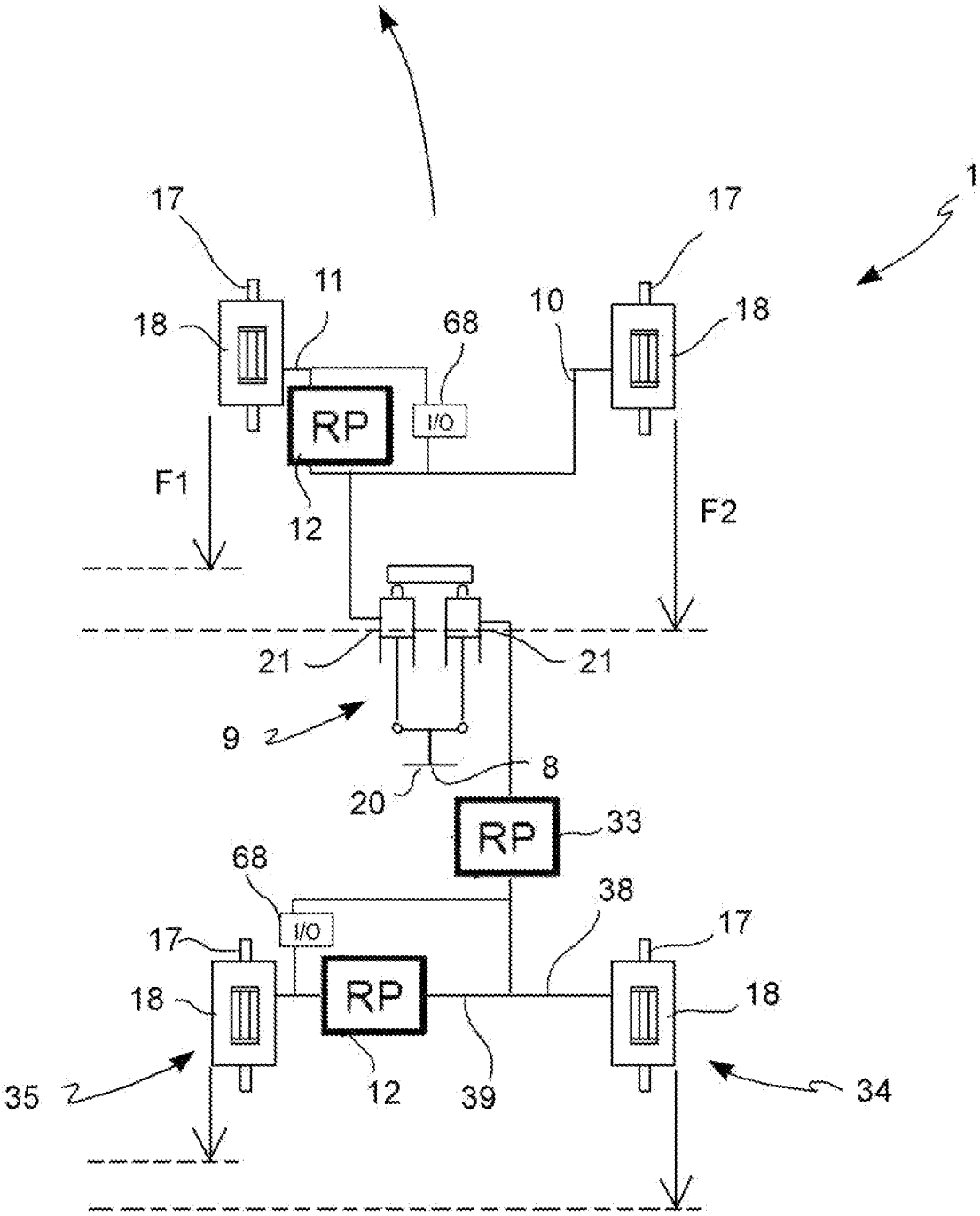
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FIG.12

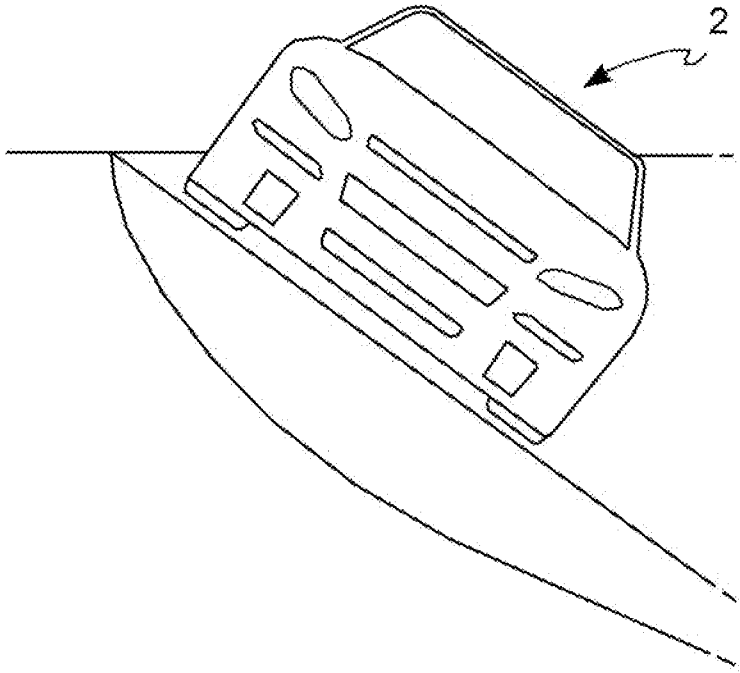

FIG. 13

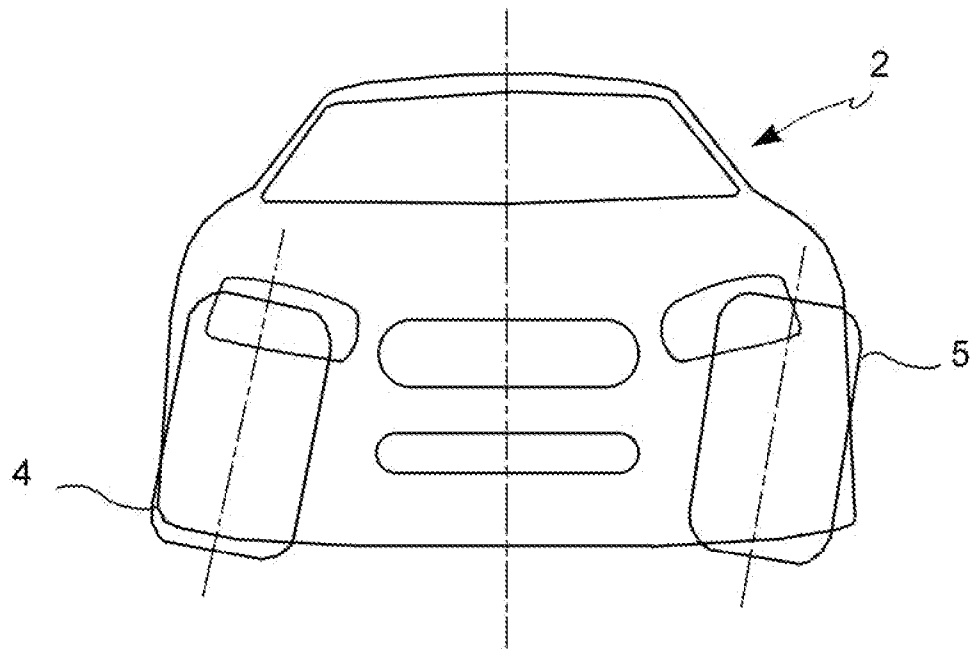

FIG. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/056774

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60T8/17 B60T8/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 546 118 A1 (TOYOTA MOTOR CO LTD [JP]) 16 January 2013 (2013-01-16)	1,2,4-15
Y	paragraphs 11, 42, 45 and 59 and figure 1	3
X	US 2010/270855 A1 (SAWADA MOTOTSUGU [JP]) 28 October 2010 (2010-10-28)	1,8,12
Y	paragraphs 31 and 33	3
Y	WO 2011/036527 A1 (TOYOTA MOTOR CO LTD [JP]; FUJIWARA SHINICHI [JP]; KOZONO KOHEI [JP]) 31 March 2011 (2011-03-31) paragraph 27	3
A	DE 10 2013 218919 A1 (FORD GLOBAL TECH LLC [US]) 26 March 2015 (2015-03-26) the whole document	1-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 September 2019	27/09/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Ranieri, Sebastiano

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/056774

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3 326 876 A1 (TOYOTA MOTOR CO LTD [JP]; ADVICS CO LTD [JP]) 30 May 2018 (2018-05-30) the whole document -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2019/056774

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