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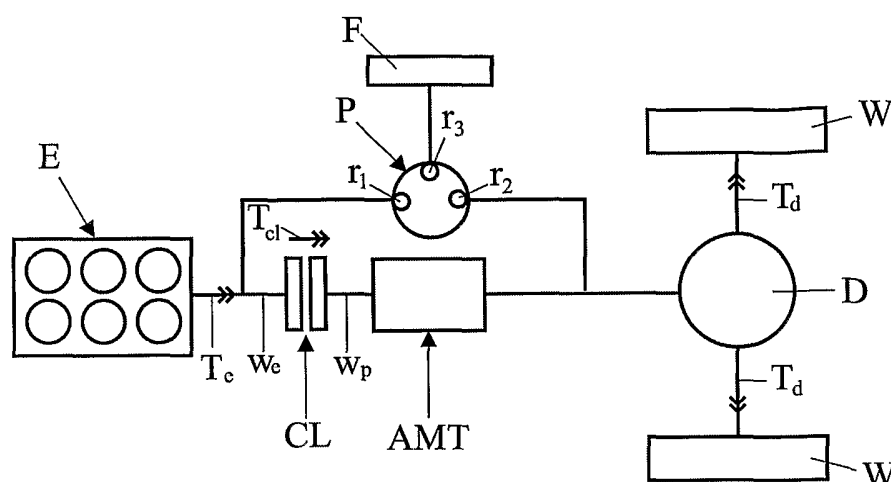
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(54) Title: METHOD FOR REGULATING THE DRIVE TORQUE TO THE WHEELS OF A VEHICLE



(57) Abstract: A vehicle has an engine E that drives the wheels W via a drive line, with therein an automatically operated clutch CL and an automatically operated manual transmission AMT. The vehicle also has a planetary gear P, which is connected to the drive line via two rotation bodies r_1 and r_2 . The third rotation body r_3 is connected to supports, which are formed by a flywheel F and/or a brake B. In a method for regulating the drive torque T_d to the wheels W, the engine torque T_e is either not lowered to zero or less or this is done for only a fraction of the time that the clutch is activated when the clutch CL is disengaged, during the disengagement, and is engaged in order to change the gear ratio.

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METHOD FOR REGULATING THE DRIVE TORQUE TO THE WHEELS OF A VEHICLE

BACKGROUND OF THE INVENTION:

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Field of the invention

The invention relates to a method for regulating the drive torque to the wheels of a vehicle, which vehicle comprises an engine, as well as wheels to be driven, where the engine is connected to the wheels via a drive line, which vehicle also comprises an automatic manual transmission that is present in the drive line between the engine and the wheels, as well as a clutch, which is also present in the drive line between the engine and the transmission, and a planetary gear with three rotation bodies, of which a first is connected to supports for supporting torque, a second is connected to the drive line between the engine and the clutch, and the third is connected to the drive line between the transmission and the wheels. Changing gear in a vehicle with an automatic manual transmission occurs automatically by a mostly hydraulically or electro-mechanically operated fork and the clutch is automatically operated, mostly hydraulically or electro-mechanically. During gear change (in a vehicle with an automatic manual transmission) the clutch is disengaged and the engine torque is brought to zero by an electronically operated valve.

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Prior art

A vehicle of the sort described above is known from the international patent application WO 2004/103755 A1. In this there is a further drive line parallel to the clutch and the transmission of the drive line that is formed by a planetary gear, which is connected by two rotation bodies to the drive line and via the third rotation body to a brake for supporting torque. If the gear is changed in this known vehicle in the same way as in a vehicle with an automatic manual transmission, the drive to the wheels would be interrupted for a short time as the engine torque is brought to zero when the clutch is disengaged.

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Summary of the invention

An objective of the invention is to provide a method in which the drive torque on the driven wheels of a vehicle of the sort described in the preamble is maintained during gear change. For this purpose the method according to the invention is characterised in that power is supplied from the engine and/or the supports to the wheels to be driven via the planetary gear when changing the gear ratio. The vehicle passengers feel little or nothing during gear change because power remains supplied to the wheels or drive torque continues to be exerted on the wheels when the clutch is disengaged when changing the gear ratio.

An embodiment of the method according to the invention is characterised in that when the clutch is disengaged, during disengagement and is engaged, in order to change the gear ratio, the action to lower the drive torque to the wheels to zero or less is performed either not at all or for only a fraction of the time that the clutch is activated, by lowering the engine torque to zero or less either not at all or for only a fraction of the time that the clutch is activated, and/or by increasing the torque supplied by the supports, if this can be regulated, at any rate when the clutch is disengaged. This latter torque can for example be regulated if the supports comprise a brake. The torque can be changed by applying more or less pressure to the brake. The engine torque is preferably increased or is mainly kept constant (only slight changes to keep torque to the wheels constant or to change it gradually) when the clutch is disengaged and is mainly kept constant when the clutch is engaged at a value equal to or higher than the value for disengaging the clutch.

An embodiment of the method according to the invention that is suitable for a vehicle in which the supports are formed by a mass inertia, is characterised in that when the clutch is disengaged, during disengagement and is engaged, the engine torque is not reduced to zero or less in order to change the gear ratio.

In order not to allow the drive torque to the wheels to decrease by too much during gear change in such a vehicle, a further embodiment of the method according to the invention is characterised in that the engine torque is increased when the clutch is disengaged. Preferably, the engine torque is also kept constant when the clutch is disengaged at a value higher than during drive via the drive line. Moreover, the engine torque is also preferably lowered when the clutch is engaged.

The above vehicle preferably has a regulator to ensure that the drive torque to the wheels becomes equal to a desired value by adapting the engine torque and the clutch torque. The rpm of the engine will increase if the drive torque to the wheels is kept constant during gear change. In order to limit the rpm of the engine, a further embodiment of the method according to the invention is characterised in that the desired drive torque to the wheels is lowered when the clutch is disengaged. The regulator regulates the drive torque to the wheels, as the introduced desired value of the drive torque is lower than the current drive torque, the regulator will attempt to lower the drive torque by reducing the engine torque and thereby also the rpm of the engine.

Again a further embodiment of the method according to the invention for the above vehicle is characterised in that the torque is lowered by the clutch shortly before the rpm of the engine becomes equal to the rpm of the input shaft of the transmission so that both rpms become smoothly equal each other. This can be achieved for example by including a generally known PI or PID regulator to operate the clutch, in which the rpms of both clutch sections are used as input and to determine a suitable value for the clutch torque. The clutch torque is adapted by changing the force with which both clutch sections are pressed against each other. This embodiment of the method according to the invention prevents a jolt on engaging the clutch and this also prevents vibrations in the drive line.

Another embodiment of the method according to the invention that is suitable for a vehicle in which the supports are formed by a mass inertia and a brake, is characterised in that pressure is applied to the brake when the clutch is disengaged, during the disengagement and during a first phase of the engagement of the clutch when changing to a higher gear.

A further embodiment of the method for this vehicle is characterised in that when the clutch is disengaged, during disengagement and is engaged, pressure is applied to the brake so that the rpm of the engine drops according to a mainly straight line between the rpm of the engine in the gear for the disengagement of the clutch and the rpm of the engine in the new gear after the clutch is engaged.

Still a further embodiment of the method for this vehicle is characterised in that when the clutch is disengaged, during disengagement and is engaged, the engine torque is adjusted so that the drive torque to the wheels remains constant or, if this appears to be physically impossible, drops according to a mainly straight line between the drive torque

in the gear for the disengagement of the clutch and the drive torque in the new gear after the clutch is engaged.

For this purpose the pressure on the brake is preferably kept constant when the clutch is disengaged in order to allow the rpm of the engine to drop according to the
5 above gradient. Moreover, for this purpose, the pressure on the brake is preferably decreased when the clutch is engaged and is kept constant for a short time during the decrease to allow the rpm of the engine to drop according to the above gradient.

Again a further embodiment of the method for this vehicle is characterised in that the brake is fully released before the speed of the first rotation body has become zero
10 to prevent the brake from stopping the first rotation body.

Preferably, the pressure of the clutch is then increased, in which the clutch torque is made higher than the engine torque. This will further continue the synchronisation of the rpm of the engine with the rpm of the input shaft of the transmission.

Moreover, the engine torque and the clutch torque are then preferably
15 brought towards each other by a regulator for the rpm difference between the engine and the input shaft of the transmission, so that the slip rate over the clutch is brought smoothly to zero.

Still another embodiment of the method according to the invention that is suitable for a vehicle in which the supports are formed by a brake, is characterised in that
20 the engine torque is first increased when changing to a higher gear when the clutch is disengaged and during the disengagement of the clutch, so that the rpm of the engine does not drop too quickly during the gear change, and pressure is applied to the brake in order to allow the drive torque to the wheels to reach a desired value as far as possible.

Still another embodiment of the method according to the invention that is
25 suitable for a vehicle in which the supports are formed by a brake, is characterised in that the clutch torque is first lowered to a level lower than that of the engine torque when changing to a higher gear, until the torque to the wheels has dropped to the level required by the next gear and the rpm of the engine becomes disassociated from the input rpm of the transmission.

Preferably, the clutch torque is then kept at the lower level for some time,
30 lower than that of the engine torque, so that the rpm of the engine is further disassociated from the input rpm of the transmission and the rpm of the engine does not become equal

to the input rpm of the transmission during the next phase so that the clutch would again engage/lock.

Moreover, the clutch torque is then preferably further lowered to zero so that the braking torque and engine torque are increased. In this phase the brake will facilitate the torque transfer of the engine to the wheels.

A further embodiment of the method for this vehicle is characterised in that less pressure is then applied to the brake when the clutch is engaged until it is fully released and it is then kept released and the engine torque is lowered to keep the drive torque to the wheels constant.

Still a further embodiment of the method for this vehicle is characterised in that the engine torque and the clutch torque are then brought towards each other by a regulator for the rpm difference between the engine and the input shaft of the transmission, so that the slip rate over the clutch is brought smoothly to zero.

Another embodiment of the method according to the invention is characterised in that in a vehicle in which the supports are formed by a brake, the clutch torque is first lowered to zero when changing to a lower gear in order to facilitate a gear change, in which the engine torque is raised, in order to increase the rpm of the engine to a value just above the rpm needed for the next gear, and in that the clutch then remains disengaged for some time and the engine torque is kept constant in order to allow the rpm of the engine to increase to the value needed, and pressure is applied to the brake as soon as the rotation direction of the brake changes, whilst the clutch remains disengaged and the engine torque is kept constant until the rpm of the engine reaches the value needed, and that after the new gear has been selected the clutch is engaged and the brake released, so that the torque to the wheels goes to a level close to the level of the desired torque to the wheels. In this way it is possible to change gear down comfortably in this vehicle. Preferably, this method is suitable for changing down from fifth or sixth gear to a gear lower than the fourth gear.

A further embodiment of this method is characterised in that when the clutch is engaged, after the new gear has been selected, the clutch torque is raised to a value just above the engine torque and in that the pressure on the clutch is gradually decreased after the brake is completely free, so that the clutch gradually engages completely with a slip-action.

Still a further embodiment of this method is characterised in that further pressure is applied to the clutch, up to the maximum value, after it has been fully engaged in order to prevent it from disengaging accidentally.

5 In a vehicle in which the supports comprise a brake it is possible to brake the vehicle by applying the brake with an engaged or slip-action clutch instead of applying the disc brakes.

Moreover, it is possible in such a vehicle to dampen vibrations by applying slight, controlled pressure to the brake. These vibrations are induced by engine vibrations or by low frequency vibrations in the drive shaft. Particularly vibrations that are caused by
10 load changes in the drive (reversing the direction of the torque) can be prevented by controlled activation of the brake and engine torque.

Further in a vehicle in which the supports comprise a brake it is possible for strong pressure to be applied to the brake when changing the gear down, in which the accelerator pedal is released, so that the rpm of the engine rises to the level desired for the
15 next gear, and for the engine to be strongly braked so that the vehicle decreases speed sharply. The engine can also be sharply braked in this way on changing down gear from the sixth to the fifth or fourth gear or from the fifth to the fourth gear, which is only possible in conventional drives (with for example a manual transmission or an automatic manual gear box) when changing down between lower gears (between third and second gear or
20 third and first gear or second and first gear). The braking action between all changing down actions with a released accelerator pedal is for example desirable when entering a bend, where the driver has little or no need to apply the brake pedal, but instead achieves as many braking actions of the vehicle on the engine as possible by changing down the gear using a manually operated element, for example a gear lever.

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Brief description of the drawings

The method according to the invention will be elucidated more fully below on the basis of drawings in which embodiments of the method according to the invention
30 are shown. In these drawings:

Figures 1, 2 and 3 are diagrams of respectively a first, second and third embodiment of a vehicle that is suitable for different embodiments of the method according

to the invention;

Figures 4, 5 and 6 are graphs of respectively the rpms of both parts of the clutch, of the drive torque, and of the engine torque and the clutch torque, when changing to a higher gear in a vehicle with an automatic manual transmission and the first
5 embodiment of the vehicle shown in figure 1 that is suitable for the carrying out the method according to the invention;

Figures 7, 8 and 9 are graphs of respectively the rpms of both parts of the clutch, of the drive torque and of the engine torque and the clutch torque, when changing to a lower gear, again in a vehicle with an automatic manual transmission and the first
10 embodiment of the vehicle shown in figure 1 that is suitable for carrying out the method according to the invention;

Figures 10, 11, 12 and 13 are graphs of respectively the rpms of both parts of the clutch, the rpm of the first rotation body, the braking torque, engine torque and clutch torque, and the drive torque to the wheels, when changing to a higher gear, with the second
15 embodiment of the vehicle shown in figure 2 that is suitable for carrying out the method according to the invention;

Figures 14, 15, 16 and 17 are graphs of respectively the drive torque to the wheels, the braking torque, engine torque and clutch torque, the activation force of the brake and clutch, and the rpms of both parts of the clutch, when changing to a higher gear,
20 according to a first embodiment of the method according to the invention, with the third embodiment of the vehicle shown in figure 3;

Figures 18, 19, 20 and 21 are graphs of respectively the drive torque to the wheels, the braking torque, engine torque and clutch torque, the activation force of the brake and clutch, and the rpms of both parts of the clutch, when changing to a higher gear,
25 according to a second embodiment of the method according to the invention, with the third embodiment of the vehicle shown in figure 3; and

Figures 22, 23, 24 and 25 are graphs of respectively the drive torque to the wheels, the braking torque, engine torque and clutch torque, the activation force of the brake and clutch, and the rpms of both parts of the clutch, when changing to a lower gear,
30 according to a third embodiment of the method according to the invention, with the third embodiment of the vehicle shown in figure 3.

Detailed description of the drawings

Figure 1 is a diagram of a first embodiment of the vehicle that is suitable for the method according to the invention. The vehicle has an engine E, which supplies a torque T_e and of which the output shaft turns with a rpm of ω_e . The engine drives the wheels W that exert a drive torque T_d on the road via a drive line. There is an automatically operated clutch CL and an automatically operated manual transmission AMT in the drive. The clutch passes on a torque T_{cl} in which a part of the clutch has the same rpm ω_e as the engine E and the other part the same rpm ω_p as the input (primary) shaft of the transmission AMT. The drive line also comprises a differential D. Such a drive line is usual in a vehicle with an automatic manual transmission.

The vehicle also has a further drive line that is switched parallel over the clutch CL and the transmission AMT. There is a planetary gear P with three rotation bodies r_1 , r_2 and r_3 in this further drive line. The latter are formed by a sun wheel, an annulus and a planet carrier. The planetary gear P is connected via two rotation bodies r_1 and r_2 to the drive line, in which a rotation body r_1 is connected to the drive line between the engine E and the clutch CL and the other rotation body r_2 is connected to the drive line between the transmission AMT and the differential D. The third rotation body r_3 is connected to a mass inertia, which is formed by a flywheel F.

Figures 4, 5 and 6 are graphs of various parameters of the drive of the vehicle when changing to a higher gear, each in a vehicle with an automatic manual transmission (indicated by AMT) and the vehicle shown in figure 1, which is suitable for carrying out the method according to the invention (indicated by IST). Figure 4 shows the rpms ω_e , ω_p of both parts of the clutch CL, figure 5 the drive torque T_d and the desired drive torque $T_{d,d}$, and figure 6 the engine torque T_e and the clutch torque T_{cl} when disengaging the clutch, interval A, during disengagement of the clutch, interval B, and the engagement of the clutch, interval C. Figures 7, 8 and 9 are graphs of these parameters when changing to a lower gear.

The engine torque T_e is not lowered to zero (which is the case in the known method, indicated by $T_{e,AMT}$ in figures 6 and 9) when disengaging A, during disengagement B and when engaging C the clutch CL to change the gear ratio. Instead, the engine torque $T_{e,IST}$ is increased when the clutch is disengaged A, kept constant at this high value during

the time the clutch is disengaged B, and lowered when the clutch is engaged C.

It is desirable to keep the drive torque $T_{d,d}$ constant when changing to a higher gear, see figure 5. However, this would cause the rpm of the engine ω_e to increase greatly, which is undesirable. Therefore, the desired value of the drive torque is lowered to a value $T_{d,d,IST}$ when the clutch is disengaged, which is lower than the original desired value $T_{d,d}$. The torque to the wheels $T_{d,IST}$ must be increased when changing to a lower gear. The desired value of the drive torque $T_{d,d,IST}$ is increased, see figure 8, to ensure that the rpm of the engine ω_e will increase strongly. Figures 4 and 7 show that this causes the rpm of the engine $\omega_{e,IST}$ to increase within acceptable limits.

Shortly before the rpm of the engine $\omega_{e,IST}$ becomes equal to the rpm $\omega_{p,IST}$ of the input shaft of the transmission (see figures 4 and 7) the clutch torque $T_{cl,IST}$ is lowered (see figures 6 and 9) so that both rpms $\omega_{e,IST}$ and $\omega_{p,IST}$ become smoothly equal each other. This is achieved by a generally known PI or PID regulator (which the professional can easily implement), and is not explained further here, in which the rpms $\omega_{e,IST}$ and $\omega_{p,IST}$ of both clutch sections are used as input and a suitable value for the clutch torque $T_{cl,IST}$ is determined on this basis.

Figure 2 is a diagram of a second embodiment of the vehicle that is suitable for the method according to the invention. All parts of this vehicle which are equal to those of the first embodiment shown in figure 1, are indicated by the same symbols. The difference between this second embodiment of the vehicle and the first embodiment shown in figure 1 is that the supports for the torque also have a brake B as well as a flywheel F.

Figures 10-13 are graphs of various parameters of the drive of the vehicle shown in figure 2 when changing to a higher gear. The gear changing process is driven by a command unit, which decides when each gear change is made, e.g. depending on the position of the accelerator pedal and the speed at which it is depressed. The drive torque T_d is changed as gradually as possible when changing to a higher gear in order to give little or no feeling of the gear changing process to the vehicle passengers. When disengaging, during the disengagement, and during a first phase of the engagement of the clutch (respectively periods B, C and D in figures 10-13), when changing to a higher gear, the clutch is disengaged (see figure 12: T_{cl} becomes zero) as is usual with an automatic manual transmission. In the method according to the invention, pressure is also applied to the brake (see figure 12: T_{br} is introduced) and the engine torque T_e is not brought to zero but changed

only slightly in order to change the drive torque to the wheels T_d gradually from the value that the drive torque had in the old gear (period A, figure 13) to the corresponding (by change of gear in the transmission the torque to the wheels changes) value in the new gear (period F, figure 13). For this purpose the pressure on the brake is kept constant, whilst the

5 clutch is disengaged, in order to allow the rpm of the engine to drop according to the above gradient. Moreover, the pressure applied to the brake is decreased when the clutch is being engaged (period D) and kept constant for a short time whilst it is being decreased in order to allow the rpm of the engine to drop according to the above gradient (see figure 12, T_{br}).

Moreover, when the clutch is disengaged, during the disengagement, and

10 during the first phase of the engagement (periods B, C and D), pressure is applied to the brake so that the rpm of the engine drops according to a mainly straight line between the rpm of the engine in the gear for the disengagement of the clutch and the rpm of the engine in the new gear after the clutch is engaged (ω_e , figure 10).

The brake is fully released ($T_{br}=0$, see figure 12) at the moment the speed of

15 the first rotation body ω_{sun} becomes zero (transition period D to E when the clutch is engaged, see figure 11), in order to prevent the brake from stopping the first rotation body. The pressure of the clutch is then increased, T_{cl} increases, (see period D, figure 12), in which the clutch torque T_{cl} is made higher than the engine torque T_e . This will further continue the synchronisation of the rpm of the engine ω_e with the rpm ω_p of the input shaft

20 of the transmission (see figure 10, period E). The engine torque T_e and the clutch torque T_{cl} will then be brought towards each other (see figure 12, period F) by a regulator for the rpm difference between the engine and the input shaft of the transmission, so that the slip rate ($\omega_e - \omega_p$, see figure 10, period F) over the clutch is brought smoothly to zero.

Figure 3 is a diagram of a third embodiment of the vehicle that is suitable

25 for the method according to the invention. All parts of this vehicle that are equal to those of the first embodiment shown in figure 1 are indicated by the same symbols. The difference between this third embodiment of the vehicle and the first embodiment shown in figure 1 is that the supports for the torque are formed by a brake B instead of a flywheel F.

30 Figures 14-17 are graphs of various parameters of the drive of the vehicle shown in figure 3 when changing to a higher gear. The method according to the invention for this type of vehicle ensures as much as possible that the drive torque to the wheels T_d

has the desired progress ($T_{d,d}$ in figure 14). In a first embodiment of the method according to the invention the engine torque T_e is first increased and then kept constant (see figure 15) when the clutch is disengaged (period A) and during disengagement (periods B and C, T_{cl} is zero), when changing to a higher gear, in order to ensure that the rpm of the engine ω_e does not drop too quickly (see figure 17), and pressure is applied to the brake (see T_b , figure 15) in order to allow the drive torque to the wheels T_d to maintain a constant desired value $T_{d,d}$.

Proportionally less pressure is then preferably applied to the brake (see T_b , figure 15) when the clutch is engaged (period D) until it is fully free of pressure and simultaneously the engine torque T_e is lowered in order to prevent (excessive) increase in the rpms of the engine. Simultaneously the clutch torque is also increased, so that the drive torque to the wheels T_d remains constant. The engine torque T_e and the clutch torque T_{cl} are then brought towards each other by a regulator for the rpm difference between the engine and the input shaft of the transmission, so that the slip rate over the clutch ($\omega_e - \omega_p$, see figure 17) is brought smoothly to zero and the drive torque to the wheels T_d remains constant.

Figures 18-21 are graphs of various parameters of the drive of the vehicle shown in figure 3 with a second embodiment of the method according to the invention when changing to a higher gear. It is also ensured as much as possible here that the drive torque to the wheels T_d has the desired progress ($T_{d,d}$ in figure 18). This method ensures that the drive torque T_d to the wheels does not fall under the desired torque $T_{d,d}$ when changing gear, as was the case with the first embodiment of this method as described above.

The clutch torque is first lowered during a first phase (period A) of the disengagement of the clutch when changing to a higher gear, whilst the engine torque is kept higher than the clutch torque until the torque to the wheels has dropped to the level that pertains to the next gear, so that the rpm of the engine disassociates from the input rpm of the transmission.

After this phase the situation at the end of the last phase is maintained for a short time (period B), so that the rpm of the engine further disassociates from the input rpm of the transmission, and the rpm of the engine during the next phase does not become equal to the input rpm of the transmission so that the clutch should again engage/lock.

The clutch is then disengaged further until it is fully disengaged (period C). In this phase the braking torque and engine torque are increased and the brake will facilitate

the torque transfer of the engine to the wheels.

The braking torque and engine torque are kept constant whilst the clutch is disengaged (period D). Proportionally less pressure is then preferably applied to the brake (see T_b , figure 19) when the clutch is engaged (period E) until it is fully released and simultaneously the engine torque T_e is lowered to prevent (excessive) increase in the rpm of the engine. Simultaneously the clutch torque is also increased, so that the drive torque to the wheels T_d remains constant. The engine torque T_e and the clutch torque T_{cl} are then brought towards each other by a regulator for the rpm difference between the engine and the input shaft of the transmission, so that the slip rate over the clutch ($\omega_e - \omega_p$, see figure 21) is brought smoothly to zero and the drive torque to the wheels T_d remains constant.

Figures 22-25 are graphs of various parameters of the drive of the vehicle shown in figure 3 with a third embodiment of the method according to the invention when changing to a lower gear. It is also ensured as much as possible here that the drive torque to the wheels T_d has the desired progress ($T_{d,d}$ in figure 22). This method ensures that the drive torque T_d to the wheels during the gear change comes as near as possible under the desired torque $T_{d,d}$.

The engine torque T_e is increased when the clutch is disengaged (period A) to change to a lower gear, in order to increase the rpm of the engine ω_e to a value that is slightly higher than the rpm needed for the next gear. The clutch then (period B) remains disengaged for some time and the engine torque T_e is kept constant in order to allow the rpm of the engine ω_e to approach more closely to the value needed. Pressure is applied to the brake (period C, see F_b and T_b) as soon as the rotation direction of the brake changes, whilst the clutch is disengaged and the engine torque remains constant, until the rpm of the engine ω_e reaches the value needed. The clutch is engaged (period D) and the brake is released after the new gear has been selected, so that the torque T_d to the wheels is kept constant.

After the new gear has been selected and the clutch is activated (period D, see F_b and T_b) the clutch torque T_{cl} is increased to a value just above the engine torque T_e . The clutch is gradually released (period E) after the brake is completely free, so that the clutch engages completely via a slip-action.

More pressure is applied to the clutch (period F) after it has been fully engaged, up to the maximum value, in order to prevent undesired slipping of the clutch.

Although in the above the invention is explained on the basis of the drawings, it should be noted that the invention is in no way limited to the embodiments shown in the drawings. The invention also extends to all embodiments deviating from the embodiments shown in the drawings within the context defined by the claims.

CLAIMS:

1. Method for regulating the drive torque to the wheels of a vehicle, which vehicle comprises an engine, as well as wheels to be driven, in which the engine is connected to the wheels via a drive line, which vehicle also comprises an automatic manual
5 transmission that is present in the drive line between the engine and the wheels, as well as a clutch that is also present in the drive line between the engine and the transmission, and a planetary gear with three rotation bodies, of which a first is connected to supports for supporting torque, a second is connected to the drive line between the engine and the clutch, and the third is connected to the drive line between the transmission and the wheels,
10 characterised in that power from the engine and/or the supports to the wheels to be driven is transmitted via the planetary gear when changing the gear ratio.
2. Method according to claim 1, characterised in that when the clutch is disengaged, during disengagement and is engaged, in order to change the gear ratio, the action to lower the drive torque to the wheels to zero or less is performed either not at all
15 or for only a fraction of the time that the clutch is activated, by lowering the engine torque to zero or less either not at all or for only a fraction of the time that the clutch is activated, and/or by increasing the torque supplied by the supports, if this can be regulated, at any rate when the clutch is disengaged.
3. Method according to claim 1 or 2, characterised in that in a vehicle in which
20 the supports are formed by a mass inertia the engine torque is not lowered to zero or less when the clutch is disengaged, during disengagement and is engaged, in order to change the gear ratio.
4. Method according to claim 3, characterised in that the engine torque is raised when the clutch is disengaged.
- 25 5. Method according to claim 4, characterised in that the engine torque is kept at a value higher than during drive via the drive line when the clutch is disengaged.
6. Method according to claim 4 or 5, characterised in that the engine torque is lowered when the clutch is engaged.
7. Method according to one of the above claims 3 to 6, characterised in that the
30 vehicle comprises a regulator that ensures that the drive torque to the wheels becomes equal to a desired value by changing the engine torque and the clutch torque, in which the desired drive torque to the wheels is lowered when the clutch is disengaged when changing to a

higher gear.

8. Method according to one of the above claims 3 to 7, characterised in that the clutch torque is lowered shortly before the rpm of the engine becomes equal to the rpm of the input shaft of the transmission so that both rpms smoothly become equal each other.

5 9. Method according to claim 1 or 2, characterised in that in a vehicle in which the supports are formed by a mass inertia and a brake, pressure is applied to the brake when the clutch is disengaged, during disengagement, and during a first phase of the engagement of the clutch, when changing to a higher gear.

10 10. Method according to claim 9, characterised in that when the clutch is disengaged, during disengagement and is engaged, pressure is applied to the brake so that the rpm of the engine drops according to a mainly straight line between the rpm of the engine in the gear before the clutch is disengaged and the rpm of the engine in the new gear after the clutch is engaged.

15 11. Method according to claim 10, characterised in that when the clutch is disengaged, during the disengagement and is engaged, the engine torque is arranged so that the drive torque to the wheels remains constant or, if this appears to be physically impossible, drops according to a mainly straight line between the drive torque in the gear before the clutch is disengaged and the drive torque in the new gear after the clutch is engaged.

20 12. Method according to claim 11, characterised in that the pressure applied to the brake is kept constant when the clutch is disengaged.

13. Method according to claim 11, characterised in that when the clutch is engaged the pressure applied to the brake is decreased and kept constant for a short time during the decrease.

25 14. Method according to one of the above claims 9 to 13, characterised in that the brake is fully released before the speed of the first rotation body becomes zero.

15. Method according to claim 14, characterised in that the pressure of the clutch is then increased, in which the clutch torque is made higher than the engine torque.

30 16. Method according to claim 15, characterised in that the engine torque and the clutch torque are then brought towards each other by a regulator for the rpm difference between the engine and the input shaft of the transmission, so that the slip rate over the clutch is brought smoothly to zero.

17. Method according to claim 1 or 2, characterised in that in a vehicle in which the supports are formed by a brake, the engine torque is first raised when the clutch is disengaged, and during disengagement, when changing to a higher gear, so that the rpm of the engine does not drop too quickly when changing gear, and pressure is applied to the
5 brake to allow the drive torque to the wheels to assume a desired value as much as possible.

18. Method according to claim 1 or 2, characterised in that in a vehicle in which the supports are formed by a brake, the clutch torque is first lowered to a level lower than that of the engine torque when changing to a higher gear, until the torque to the wheels has dropped to the level desired with the next gear and the rpm of the engine is disassociated
10 from the input rpm of the transmission.

19. Method according to claim 18, characterised in that the clutch torque is then kept at the lower level for some time, lower than that of the engine torque, so that the rpm of the engine disassociates further from the input rpm of the transmission and the rpm of the engine does not become equal to the input rpm of the transmission during the next
15 phase so that the clutch would again engage/lock.

20. Method according to claim 19, characterised in that the clutch torque is then lowered further to zero in which the braking torque and engine torque are increased so that the desired torque to the wheels is achieved.

21. Method according to claim 17 or 20, characterised in that when the clutch
20 is engaged less pressure is then applied to the brake until it is fully released and then kept released and the engine torque is lowered in order to allow the drive torque to the wheels to retain a desired value.

22. Method according to claim 21, characterised in that the engine torque and the clutch torque are then brought towards each other by a regulator for the rpm difference
25 between the engine and the input shaft of the transmission so that the slip rate over the clutch is brought smoothly to zero.

23. Method according to claim 1 or 2, characterised in that in a vehicle in which the supports are formed by a brake, the clutch torque is first lowered to zero when changing to a lower gear in order to facilitate a gear change, in which the engine torque is increased,
30 in order to increase the rpm of the engine to a value just above the rpm needed for the next gear, and in that the clutch then remains disengaged for some time and the engine torque is kept constant in order to allow the rpm of the engine to move towards the value needed,

and as soon as the rotation direction of the brake changes, pressure is applied to the brake whilst the clutch remains disengaged and the engine torque is kept constant until the rpm of the engine reaches the value needed, and that after the new gear is selected the clutch is engaged and the brake released, so that the torque to the wheels goes to a level close to the desired value.

24. Method according to claim 23, characterised in that the clutch torque is increased to a value just above the engine torque when the clutch is activated, after the new gear has been selected, and in that, after the brake is completely free, gradually less pressure is applied to the clutch, so that the clutch gradually fully engages via a slip-action.

25. Method according to claim 8, 16, 22 or 24, characterised in that after the clutch is fully engaged further pressure is applied to the clutch up to the maximum value in order to prevent accidental disengagement.

26. Method according to one of the above claims 9 to 25, characterised in that pressure is applied to the brake with an engaged or slip-action clutch in order to brake the vehicle.

27. Method according to one of the above claims 9 to 26, characterised in that slight, controlled pressure is applied to the brake in order to dampen vibrations.

28. Method according to one of the above claims 9 to 27, characterised in that when changing down gear, in which the accelerator pedal is released, strong pressure is applied to the brake so that the rpm of the engine rises to the level desired for the next gear and the engine is strongly braked so that the vehicle's speed diminishes rapidly.

1 / 7

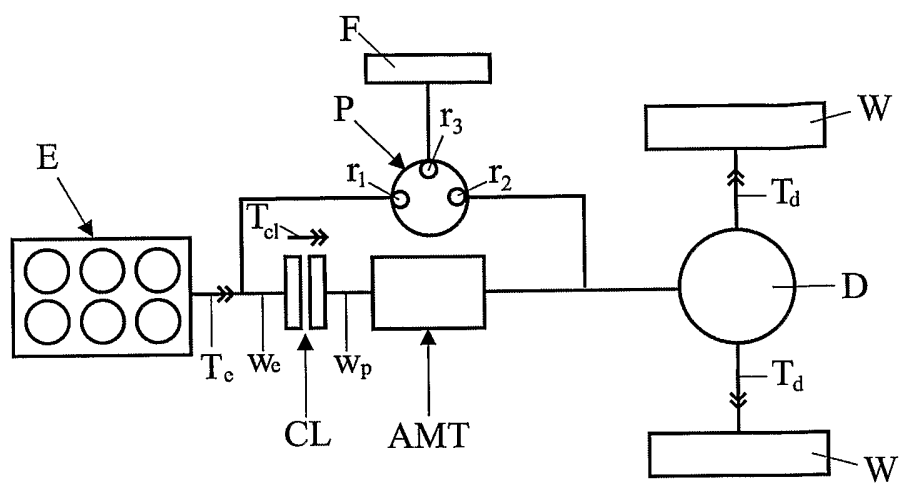


FIG. 1

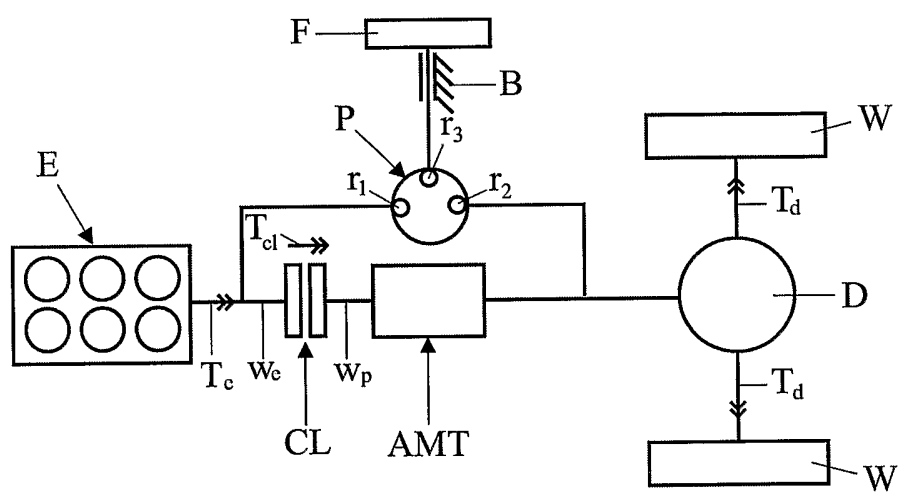


FIG. 2

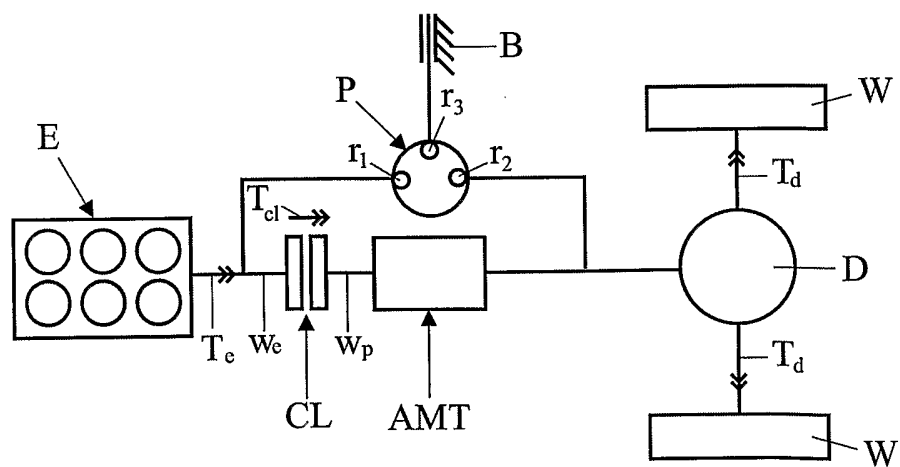


FIG. 3

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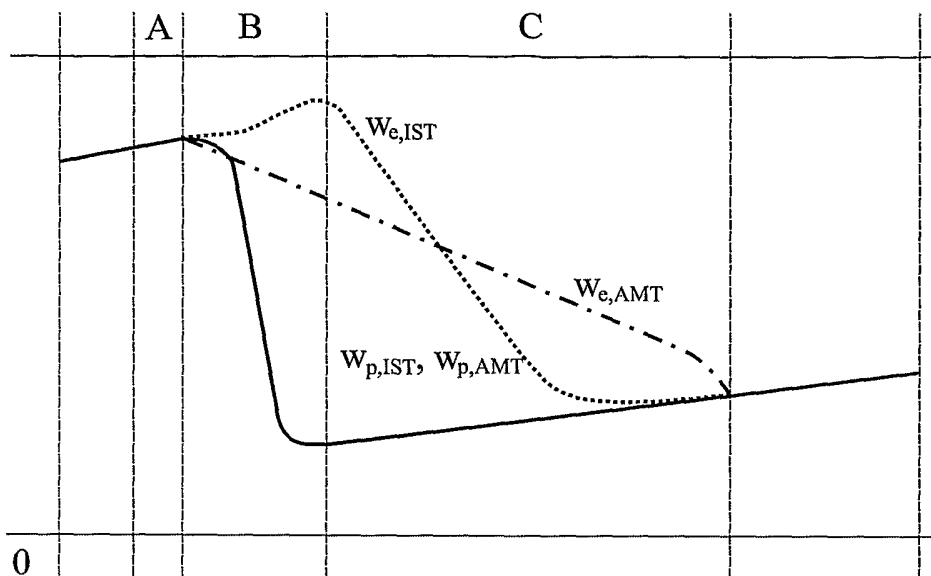


FIG. 4

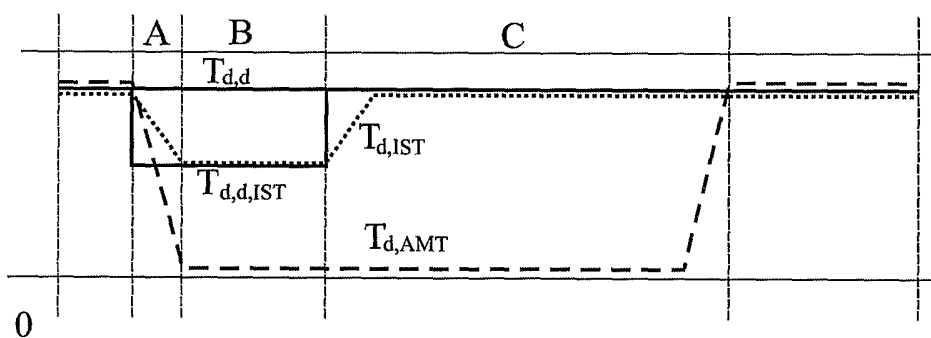


FIG. 5

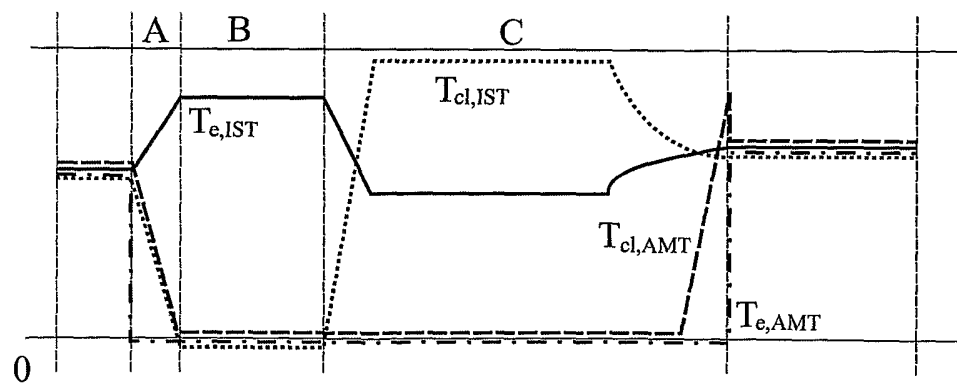


FIG. 6

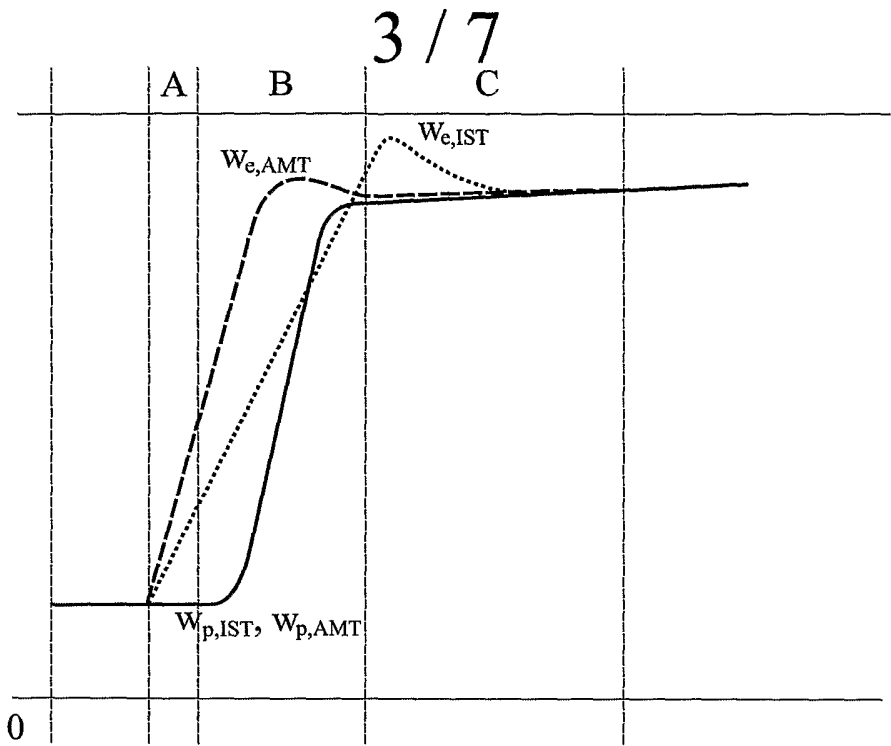


FIG. 7

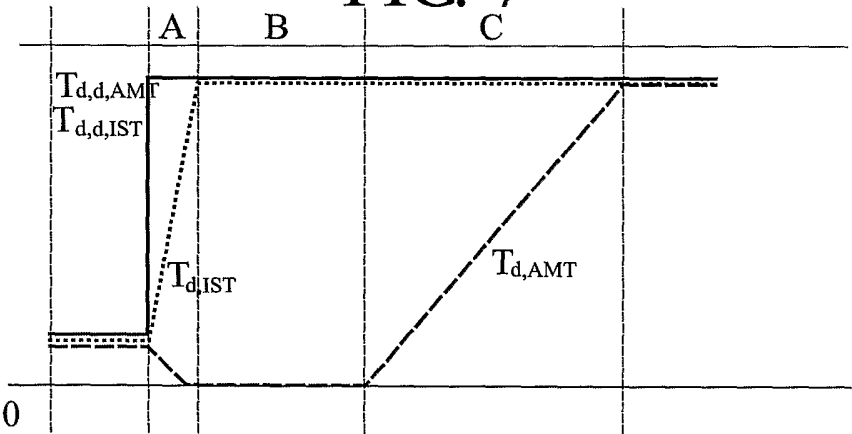


FIG. 8

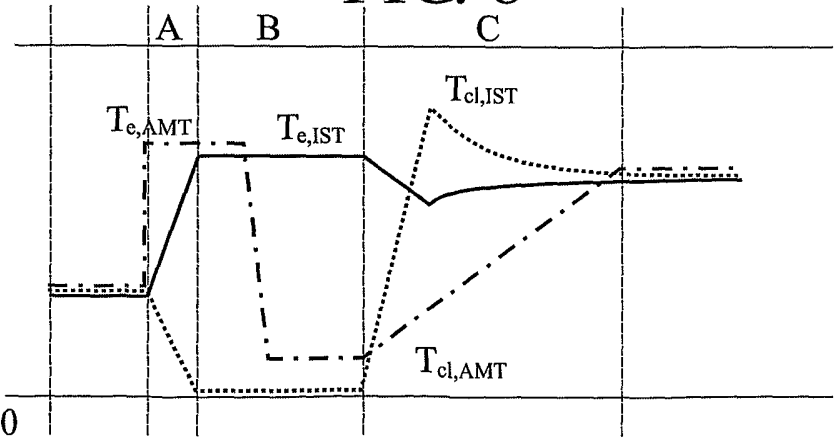


FIG. 9

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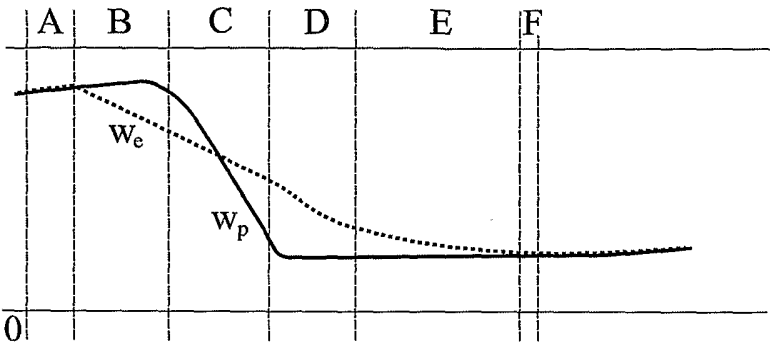


FIG. 10

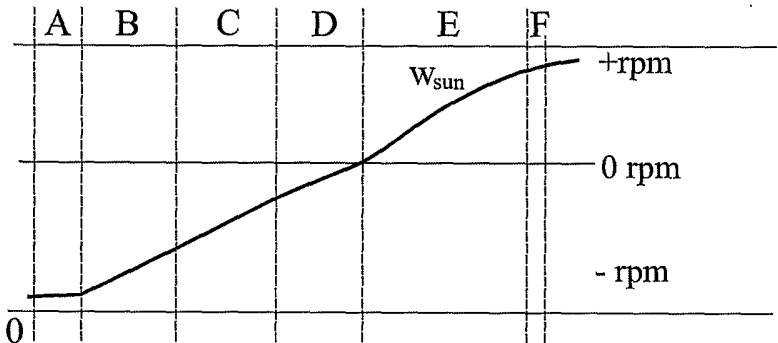


FIG. 11

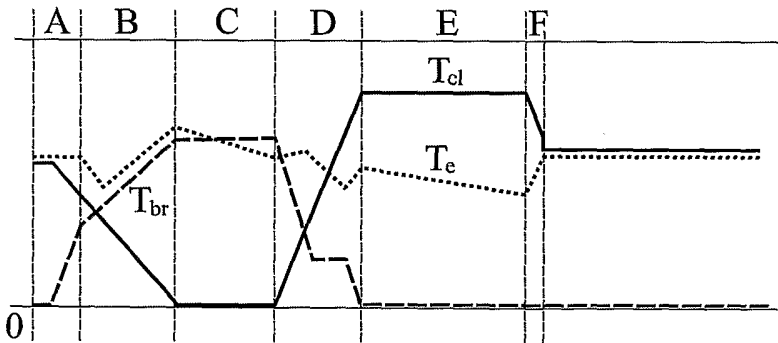


FIG. 12

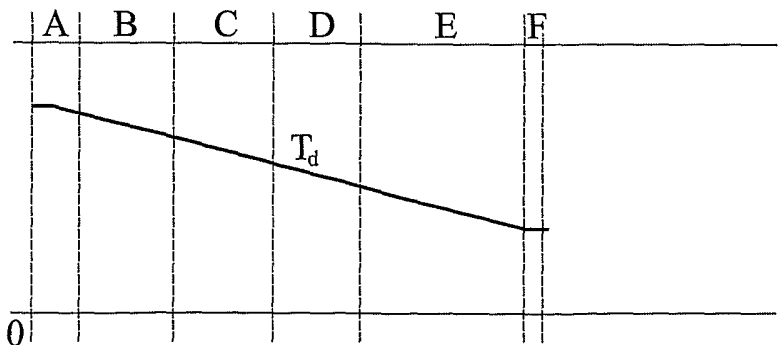


FIG. 13

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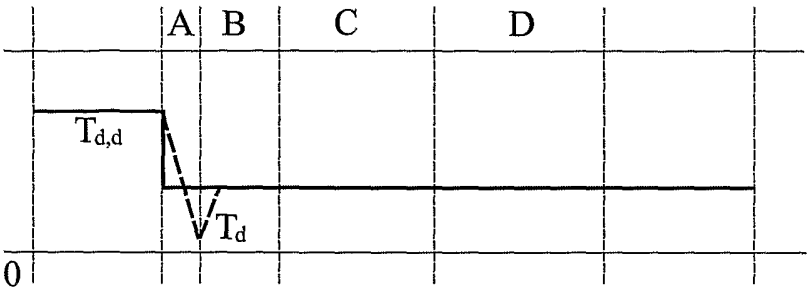


FIG. 14

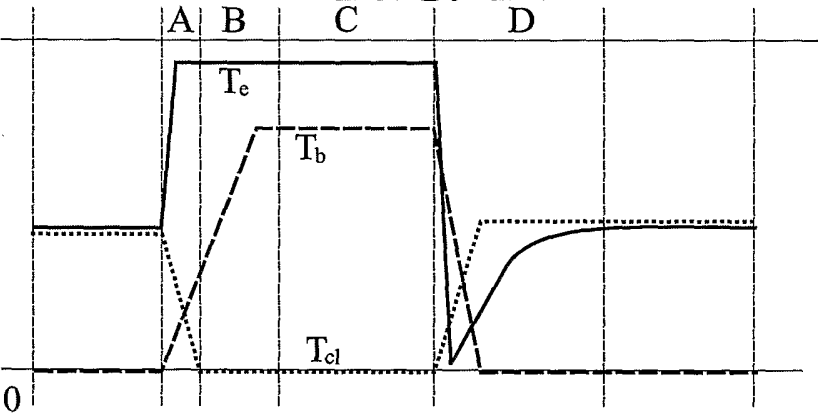


FIG. 15

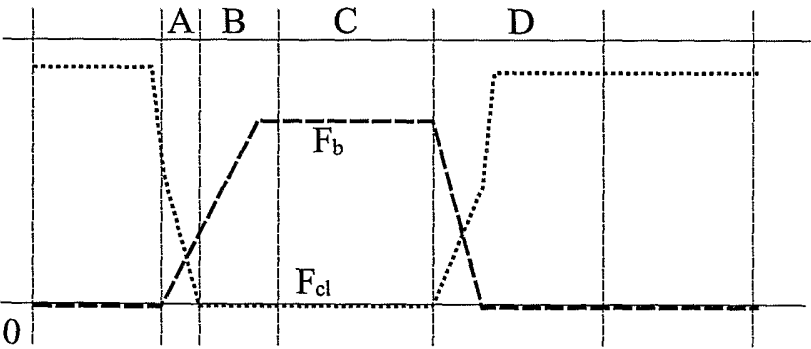


FIG. 16

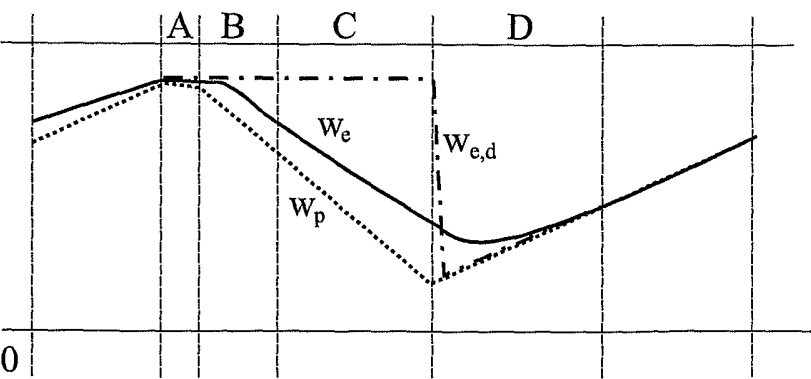


FIG. 17

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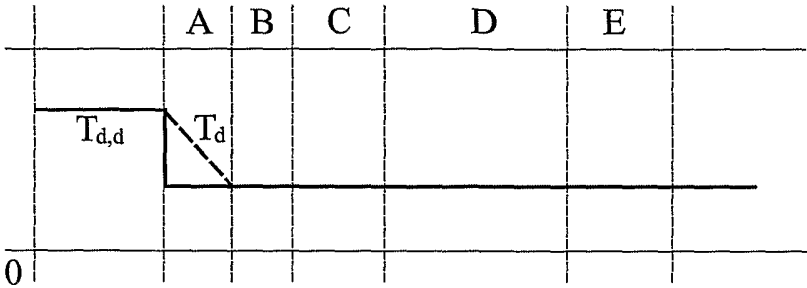


FIG. 18

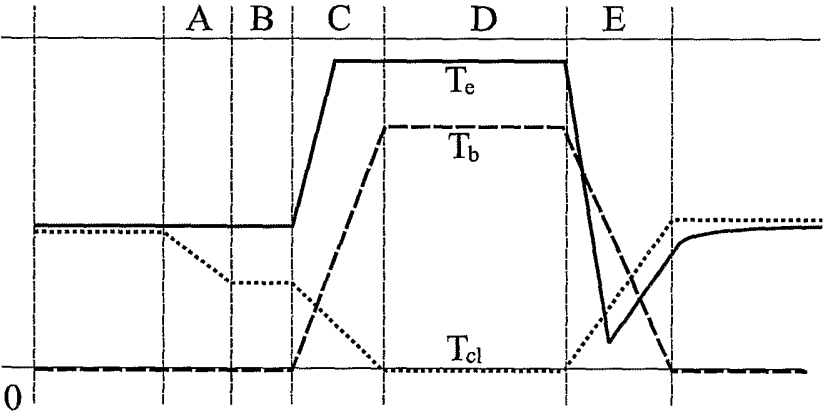


FIG. 19

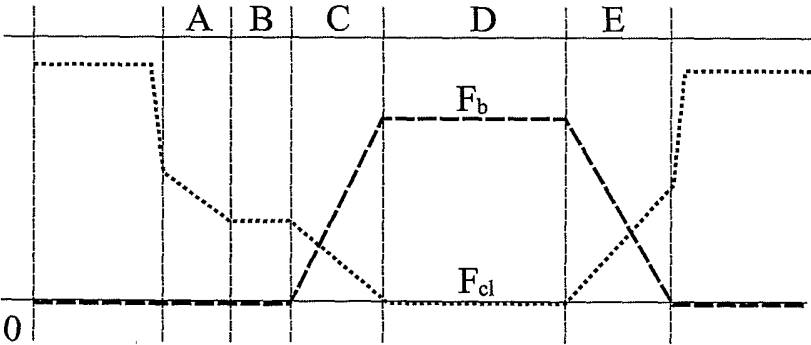


FIG. 20

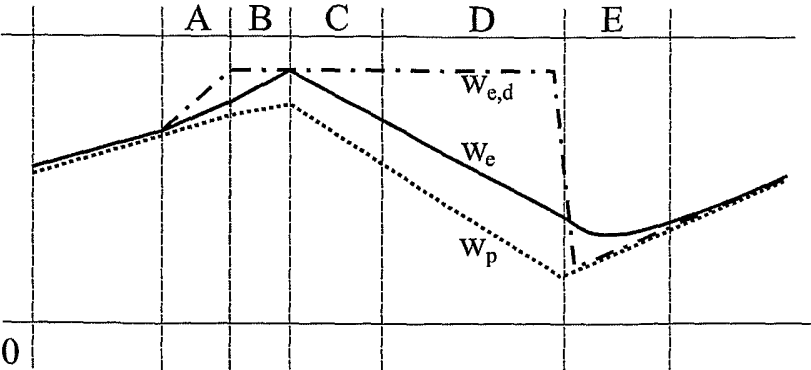


FIG. 21

