

European Patent Application No. 88118933.6

European Patent No. 0365715

The invention relates to a gearshift device for an automatic transmission of a motor vehicle of the type in claim 1.

DE 38 07 881, not prior-published, discloses a gearshift device for a motor-vehicle automatic transmission which enables a "manual gear preselection" program of an automatic transmission controlled by an electronic control device (according to Bosch, Technische Berichte 7 (1983)4, pages 160-166) to be selected using the selector lever. A program switch which enables a driver to choose between an economy program, a performance program and a program for manually selecting the gears using the selector lever is unnecessary. The transmission can be designed to be more user-friendly and be manufactured more cheaply.

This is mainly achieved by the selector lever being shiftable into a second gearshift path parallel to the first gearshift path via a cross-path and by the forward gears (1, 2, 3, 4) of the transmission being manually shiftable by tilting the selector lever in the second gearshift path. In a particularly advantageous embodiment the selector lever is guided in the second gearshift path as a tilting lever which, when tilted out of a stable centre position (neutral position), causes changing down of the automatic transmission in one direction and changing up in the other.

The object of the invention is to increase further the operational reliability of an automatic transmission of this type.

The object is achieved by the characterising features of claim 1 or claim 2. Further advantageous features of the invention are contained in the sub-claims.

The advantages of the invention are to be seen mainly in that the reliability of use and operation of the automatic transmission is further increased. In particular, unwanted gear changes (occurring unexpectedly for the driver) when moving the selector lever from one path to the other are avoided as a result.

This is achieved by a control device for controlling the transmission comprising a change-over unit which causes the current gear to be retained when the selector lever is moved out of the first gearshift path into the second gearshift path at least for as long as a rotational speed of a driving internal combustion engine does not exceed an upper rotational speed limit or fall below a lower rotational speed limit or the selector lever is not tilted in the second gearshift path for the purposes of changing up or changing down.

Likewise, when the selector lever is moved out of the second gearshift path into the first, the gear currently engaged is retained at least until the control device has carried out an automatic gear readjustment or until the internal combustion engine has reached its rotational speed limits.

The invention is explained by way of example with the aid of the drawings and is described in more detail below.

The drawings show:

Fig. 1: A transmission control system having a gearshift device and a change-over unit according to the invention;

Fig. 2: A circuit diagram of a change-over unit according to Fig. 1.

The different positions P = parking, R = reverse gear, N = neutral zero, D = drive with gears 1 to 4, 3 (restriction to the bottom three gears), 2 (restriction to the bottom two gears), 1 (first gear) of an automatic transmission can be freely selected using a selector

lever 1 which is tiltable in the longitudinal direction of the motor vehicle in a first gearshift path 2. The selection positions are detected by sensors 4 to 10 which transmit electrical signals sp , sr , sn , sd , $s3$, $s2$ and $s1$ to a control device 11 of the transmission 3. From selection position D, the selector lever 1 can be shifted into a gearshift path 13 parallel to the first gearshift path 2 via a cross-path 12. The change-over is detected by a sensor 14 which supplies a signal sm to the control device 11.

When the selector lever 1 is tilted in the direction of travel of the motor vehicle in the second gearshift path 13, a minus sensor 15 responds, the signal kvr from which causes the control device 11 to carry out shifting down by one gear via transmission control signals gs on the transmission 3. The selector lever 1 is then pushed back into the neutral centre position of the gearshift path 13 by a spring 16. Contacting the sensor 15 again results in shifting down by a further gear if the top gear is not already engaged. When the selector lever 1 is tilted counter to the direction of travel, a plus sensor 17 transmits a signal kvh to the control device 11 and causes shifting up by one gear on the transmission 3.

However, a manually requested changing up operation is only carried out if an engine speed n_{mot} of an internal combustion engine 18 driving the transmission 3 does not fall below a minimum rotational speed n_{min} in the next highest gear. Correspondingly, a changing down operation by means of the selector lever 1 is suppressed if the engine speed n_{mot} would exceed the maximum rotational speed n_{max} of the internal combustion engine in the next lowest gear.

The engine speed n_{mot} is determined by an engine speed sensor 19 and, in the same way as a transmission output speed n_e (driving speed detector 20), an engine load signal ml (air quantity, air mass or throttle valve position detector 21) and an accelerator pedal position signal fs from an accelerator pedal position detector 22, is supplied to the control device 11 which, from the given input signal combination and the currently engaged gear step k , determines the transmission control signals

gs according to the manual gear preselection operation or a standard automatic program.

The control device 11, which can be produced according to Bosch Technische Berichte 7 (1983)4, pages 160 to 166, for example, will now be expanded upon as follows: a change-over unit 23 is incorporated therein and has a sub-unit 24 which influences the control device 11, in particular on the basis of the signal sm from the sensor 14, such that when the selector lever 1 is moved out of the first gearshift path 2 into the second gearshift path 13, the gear k currently engaged is retained at least for as long as a rotational speed n_{mot} of a driving internal combustion engine 18 does not exceed the upper rotational speed limit n_{max} or fall below the lower rotational speed limit n_{min} or the selector lever 1 is not tilted in the second gearshift path 13 for the purposes of changing up or changing down.

The sub-unit 24 of the change-over unit 23 also influences the control device 11 such that when the selector lever 1 is moved out of the second gearshift path 13 into the first gearshift path 2, the gear k currently engaged is retained at least until the control device 11 has carried out an automatic gear readjustment or for as long as a rotational speed n_{mot} of a driving internal combustion engine 18 does not exceed the first upper rotational speed limit or fall below the second lower rotational speed limit.

The change-over unit 23 furthermore comprises a second sub-unit 25 which prevents the internal combustion engine from starting when the selector lever is in the second gearshift path 13. In particular, the internal combustion engine is only permitted to start in a parking position P or a neutral position N of the selector lever in the first gearshift path. For this purpose, the second sub-unit 25 of the change-over unit 23 detects the signals sp and sn of the sensors 4 and 6 covering the selector lever positions P and N of the selector lever 1 in the first gearshift path 2.

The signals sp and sn are interlinked via an OR element 26. The OR element 26 activates a relay 27 via a starter release signal as . In

the non-activated state, the relay 27 breaks a control circuit 28 of a starting relay 30 initiating the start-up of the internal combustion engine 18 by means of the starter 29. The control circuit 28 is formed by the series connection of an ignition switch 32 connected to a battery 31, a starting switch 33, the closing member 34 of the relay 27 and a coil 35 of the starting relay 30.

Finally, the (internal and external) wiring of the first sub-unit 24 of the change-over unit 23 will be discussed below with the aid of Fig. 2. It is accepted here that the sensors 14, 15 and 17 are constructed as limit switches which in the non-actuated state are connected to earth (minus pole of the battery 31) and in the actuated state (selector lever in the second gearshift path 13 or in one of the two end positions) are connected to the plus pole of the battery 31 via a series resistor R_v and the ignition switch 32.

The signal s_m thus generated is switched, for the purposes of contact debouncing, to a first, static, retriggerable monoflop 36 (monostable multivibrator), a second, pulse-edge-controlled, non-retriggerable monoflop 37 being activated via its output. This monoflop 37 generates a first interrupt signal INT1 in the case of a positive pulse edge. The output of the first monoflop 36 activates a third, pulse-edge-controlled, non-retriggerable monoflop 38 which generates a second interrupt signal INT2 in the case of a negative pulse edge at the output Q of the first monoflop 36.

The signals k_{vr} and k_{vh} are also debounced by means of fourth and fifth retriggerable, statically activated monoflops 39 and 40 respectively which generate third and fourth interrupt signals INT3, INT4 and which may (but do not have to) be integrated into the change-over unit 23.

The shift from automatic gear selection to manual gear selection takes place in the control device 11 via the first interrupt signal INT1 by setting a flag, for example. The shift in the reverse direction is caused by the second interrupt signal INT2 which resets the flag.

The programme running in the control device 11 and generating the transmission control signals gs generally provides a continuously swept programme loop in which all the input signals of the control device 11 are detected, the limit rotational speeds of the internal combustion engine 18 (n_{max} , n_{min}) are monitored and changing up or down carried out as appropriate, the flag is interrogated and, according to the state of the flag, manual or automatic gear adjustment is swept and changing up or down carried out again as appropriate.

By means of the interrupt signal INT1, automatic gear adjustment can be stopped at any time and the program sweep restarted. In this way, a gear currently engaged is retained. Likewise, manual gear adjustment is stopped by the interrupt signal INT2 and the program sweep restarted. The interrupt signals INT3 and INT4 each reduce or increase a gear step preselection counter. The gear step is then adjusted to the state of the gear step preselection counter in manual gear adjustment.



Claims

1. A gearshift device for a motor-vehicle automatic transmission controlled by an electronic control device, having a selector lever by means of which the different gears to be shifted automatically can be preselected by tilting the said selector lever in a first gearshift path, wherein the selector lever (1) is shiftable into a second gearshift path (13) parallel to the first gearshift path (2) via a cross-path (12), and wherein the forward gears (1, 2, 3, 4) of the transmission are manually shiftable by tilting the selector lever (1) in the second gearshift path (13), characterised in that the control device (11) has a change-over unit (23, 24) which is controlled by a sensor (14) detecting the change-over from the first gearshift path (2) to the second gearshift path (13) and which causes the gear (k) currently engaged to be retained when the selector lever (1) is moved out of the first gearshift path (2) into the second gearshift path (13) at least for as long as the rotational speed (n_{mot}) of the internal combustion engine (18) driving the transmission does not exceed an upper rotational speed limit (n_{max}) or fall below a lower rotational speed limit (n_{min}) or the selector lever (1) is not tilted in the second gearshift path (13).
2. A gearshift device according to claim 1, characterised in that in the second gearshift path, by tilting the selector lever (1) once out of a neutral centre position and by making contact with a plus sensor (17) in one direction, shifting up by one gear can be carried out manually, and by tilting the selector lever (1) once in the opposite direction and making contact with a minus sensor (15), shifting down by one gear can be carried out manually, and in that the selector lever (1) is then automatically returned to the neutral centre position each time.
3. A gearshift device according to claim 1 or 2, characterised in that the change-over unit (23, 24) causes the gear (k) currently engaged to be retained when the selector lever (1)



is moved out of the second gearshift path (13) into the first gearshift path (2) at least until the control device (11) has carried out an automatic gear readjustment or for as long as the rotational speed (n_{mot}) of the driving internal combustion engine (18) does not exceed the upper rotational speed limit (n_{max}) or fall below the second rotational speed limit (n_{min}).

4. A gearshift device according to claim 3, characterised in that the change-over unit (23, 25) prevents the internal combustion engine (18) from starting when the selector lever (1) is in the second gearshift path (13).
5. A gearshift device according to at least one of the preceding claims, characterised in that the change-over unit (23, 25) only allows the internal combustion engine (18) to start when the selector lever (1) is in a parking position (P) or a neutral position (N) in the first gearshift path (2).