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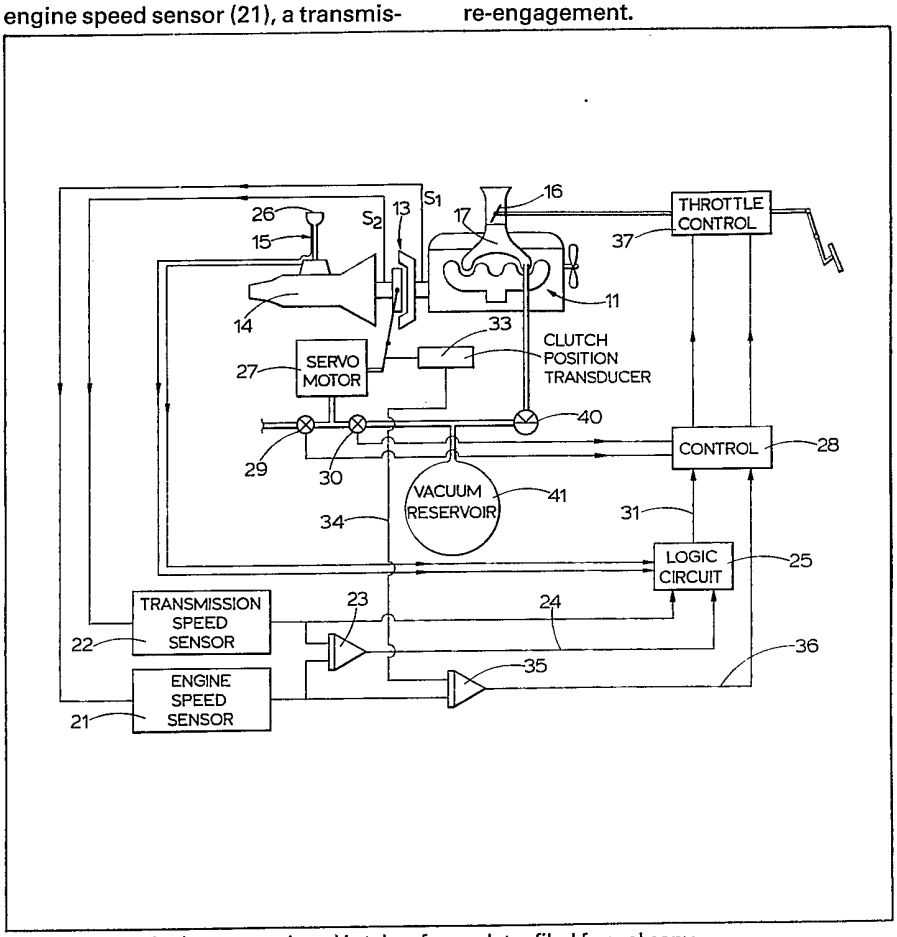
(71) Applicants **Automotive Products Limited, Tachbrook Road, Leamington Spa, Warwickshire CV31 3ER.**
(72) Inventors **Andrew John Wiggin**
(74) Agents **L.H. Street, Solicitor, Automotive Products Limited, Patent Department, Tachbrook Road, Leamington Spa, Warwickshire CV31 3ER.**

(54) **Clutch control apparatus**

(57) A vehicle clutch control apparatus that converts a manually operable gearbox into a semi-automatic comprises an engine speed sensor (21), a transmission speed sensor (22), a clutch servomotor (27) that controls the engagement of the clutch, a position transducer (33) that monitors the clutch engagement, a throttle control (37) that inhibits the driver's control of the throttle when the clutch is disengaged, and an associated electronic control system (23), (25), (28), (35). The electronic system controls the servomotor (27) and from a standing start responds to signals from the transducer (33) and sensors (21) and (22) to disengage the clutch below a first predetermined engine speed, to fully engage the clutch above a second predetermined engine speed, and between said predetermined engine speeds the state of engagement is related to actual engine speed. During subsequent gear changes the electronic system responds to the sensors (21) and (22) to operate the throttle control (37) independently of the driver so as to ensure synchronisation before clutch re-engagement.



The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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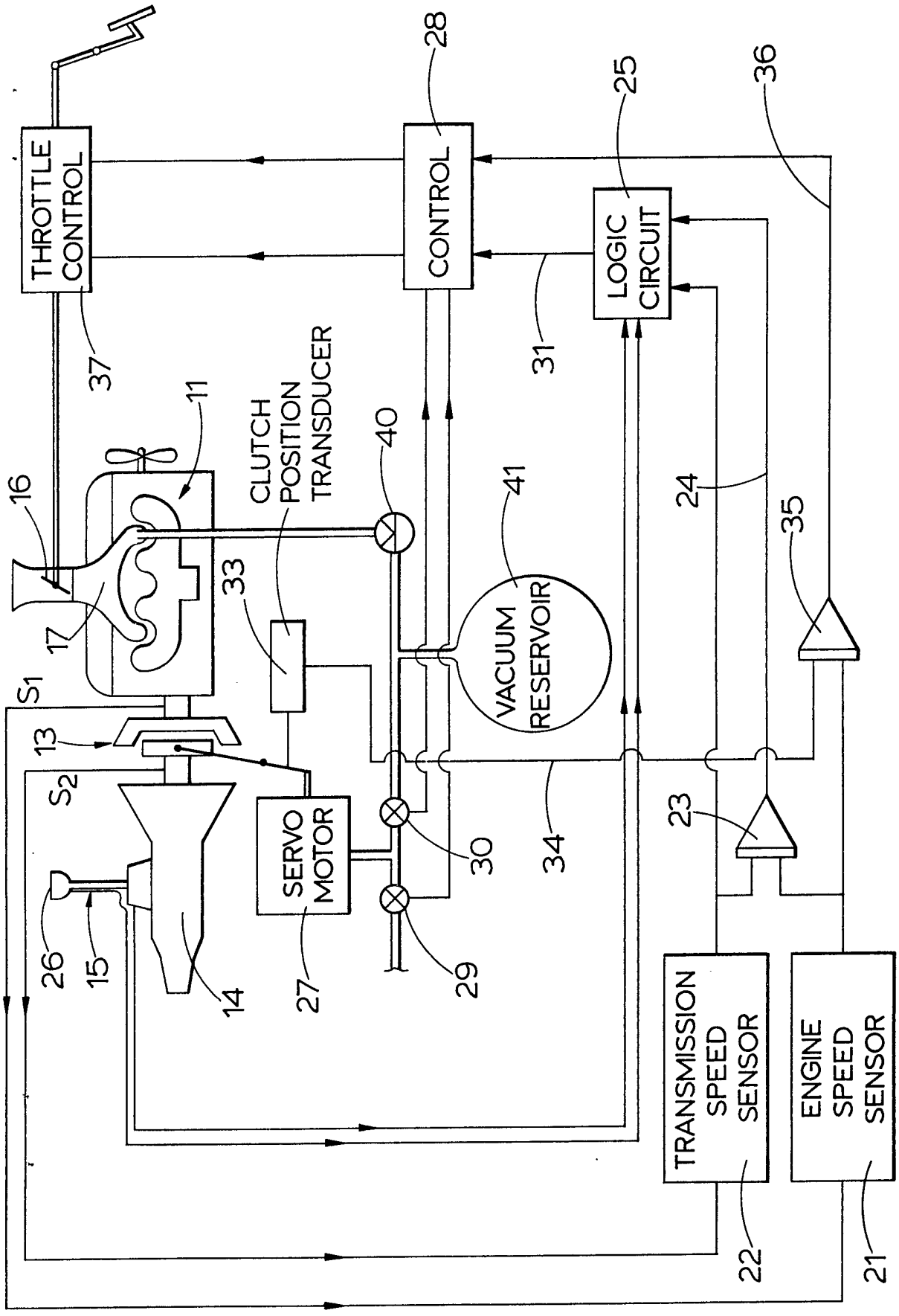
THROTTLE CONTROL
CONTROL
LOGIC CIRCUIT
CLUTCH POSITION TRANSDUCER
VACUUM RESERVOIR
SERVO MOTOR
TRANSMISSION SPEED SENSOR
ENGINE SPEED SENSOR
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S1
S2

SPECIFICATION

Clutch control apparatus

This invention relates to clutch control apparatus for the automatic control of friction clutches between the engine and transmission of motor vehicles.

It is sometimes desirable to convert a motor vehicle having a manually operated gearbox into a semi-automatic vehicle in which the driver does not need to manually operate the clutch or synchronise his gear changes.

Accordingly, there is provided a clutch control apparatus for controlling the friction clutches of a motor vehicle and comprising: an engine speed sensing means, a transmission speed sensing means, a servomotor for controlling the engagement of the clutch with the engine, a clutch position transducer that produces a signal indicative of the state of engagement between the engine and the clutch, and a throttle control means for inhibiting driver control of said vehicle throttle during disengagement of the clutch, the throttle control means and the clutch servomotor both being controlled by an electronic system that receives signals respectively from each of the clutch position transducer and the engine and transmission speed sensing means so that on take off from a standing start the state of engagement of the clutch is controlled so that below a predetermined engine speed reference the clutch is disengaged and above that reference the degree of engagement is related to the engine speed up to a full engaged state, corresponding with a second predetermined reference, and during clutch disengagement for subsequent gear changes the respective signals from the engine and transmission speed sensing means are processed through the electronic system to operate the throttle control independently of the driver to synchronise the transmission and engine speeds before the clutch is re-engaged.

Preferably, the clutch control apparatus is fitted to a motor vehicle having a manual gearbox with a gearshift control lever, wherein the gearshift control lever has a switch connected into the electronic circuit so that upon manual initiation of a gear change operation of the switch, causes the clutch servomotor to disengage the clutch and simultaneously lock the throttle control making the throttle independant of the driver.

The invention will be described by way of example and with reference to the accompanying drawings which is a schematic layout of a clutch control system according to this invention.

With reference to the drawing a conventional motor car has the usual engine 11, clutch 13, gearbox 14, gearshift lever 15, throttle 16 and an inlet manifold 17.

The engine speed S_1 is sensed by a transducer (not shown) which produces a signal proportional to engine speed and a sensor 21 produces a voltage proportional to the engine speed S_1. Similarly, the transmission speed S_2 is also sensed by a transducer which produces a signal representative of transmission speed and which is likewise converted to a voltage by the sensor 22. The two voltages are passed through a comparator 23 which measures the difference between the two voltages and produces a voltage signal 24 proportional to the difference between the engine speed, which is also the clutch input speed, and the transmission speed, which is also the clutch output speed.

The signal 24 is then fed into a logic circuit 25, which also receives signals from the gearbox 14 to indicate which gear the vehicle is in. The logic circuit 25 also receives the signal from the gearshift lever switch 26 on initiation of a gear change so as to cause a servomotor 27 to disengage the clutch 13 prior to the gear change. Also a signal which indicates when the gearbox is in neutral is received by the logic circuit.

The logic circuit 25 then causes a signal 31 to pass to a control circuit 28 which includes an amplifier to provide signals each having a mark space ratio dependent upon the difference between the engine speed and a reference speed signals so as to open and close valves 29 and 30 which control a pressure differential within the servomotor 27.

A throttle control means 37 is also operated by the controlled circuit 28 and the control means 31 when activated renders the throttle 16 independent of driver control so that during gear changes the throttle position is controlled not through the driver but through the control circuit 28. Such a control means is shown in British Patent 810,895.

The state of engagement of the clutch 13 is indicated by a clutch position transducer 33 which sends a signal 34 indicative of the state of engagement to a differential amplifier 35 which also receives a signal from the engine speed sensor 21. The resultant signal 36 is then passed to the control box 28.

The clutch servomotor 27 is of the type having a diaphragm (not shown) movable by a pressure differential across the diaphragm. The pressure differential being created by a vacuum source, in this case the inlet manifold 17 which is connected to the servomotor via a non-return valve 40, vacuum reservoir 41, and variable orifice valve 30. The servomotor 27 is also connected to atmosphere via variable orifice valve 29 and the pressure differential across the diaphragm is created by opening and closing the valves 29 and 30, and also by varying the respective cross sectional area of the orifice present in each valve 29 and 30. The servomotor 27 can be closely controlled by use of the pressure differential across the diaphragm so as to vary the state of engagement of the clutch 13 with the engine 11, the movements of the servomotor and hence the state of engagement of the clutch being sensed by the transducer 33.

The operation of the clutch control apparatus is as follows:-

From a Standing start the position of the gearshift lever 15 indicates to the logic circuit that the gearbox is in neutral. The driver touches operates the switch 26 on the gear lever 15 which causes, via logic circuit 25 and control circuit 28, the clutch servomotor 27 to disengage the clutch 13 by venting the servomotor to atmosphere through valve 29, and also locks the

throttle 16 in position through the throttle control means 37. If the gear lever is left in neutral the logic circuit 25 recognises this condition and status quo is maintained through control loop.

If the driver places the gearshift lever into first, or possibly second gear then the throttle control is freed as the engine speed is increased up to a predetermined engine speed signal, say 1500 r.p.m., nothing happens and the clutch 13 remains disengaged. Once the predetermined engine speed reference has been exceeded the control box 28 causes the servomotor 27 to engage the clutch 13 at a rate proportional to the engine speed. The clutch position transducer 33 tracks the rate of engagement of the clutch and feeds an indicator signal back to the differential amplifier 35, which also receives the engine speed signal from sensor 21. The resultant signal 36 then activates the control box to either increase or decrease the clutch engagement to bring the transducer and engine speed signals into line.

The driver is at liberty to choose his own rate of take-off either, for example, a gentle start or a racing start. The control loop between the servomotor valves 29 and 30, clutch position transducer 33, and engine speed sensor 21 causes the rate of engagement of the clutch 13 to match the engine speed at all times. Thus, as the car moves off and the engine speed and clutch engagement increase the clutch is arranged to become fully engaged at about 2500 r.p.m.

If the engine speed is now dropped for example whilst using the engine compression as a brake, the clutch will not disengage until the engine speed signal drops below 1000 r.p.m.

During subsequent gear changes the operation of the clutch actuation system is as follows:-

The switch 26 or the gearshift lever 15 is activated and this causes, via the logic circuit 25 and control circuit 28, the clutch servomotor 27 to disengage the clutch 13 and also causes the throttle control means 37 to lock the throttle 16 in position.

If the driver then changes his mind about changing gear and releases the gear switch the logic circuit 25 recognises via the comparator 23 that the engine speed and transmission speed are still the same and subsequently causes the servomotor 27 to re-engage the clutch 13.

If the driver changes gear, say from 3rd gear to 4th gear, then the logic circuit 25 recognises via comparator 23 that there has been a gear change and that the engine and transmission speeds are now different because the engine speed will now be higher than the transmission speed. The comparator 23 measures the difference between the engine speed and the transmission speed and the signal 24 is passed to the logic circuit 28. The logic circuit 28 then causes the control box 28 to close the throttle until such times as the engine and transmission speed signals become equal, there being a slight delay until the comparator 23 senses both of said speeds are equal and the logic circuit communicates the fact to the control box 28 which causes the servomotor 27 to engage the clutch.

A similar system will apply for changedown in gear ratio except that logic circuit 28, and comparator 23 will operate the control box 28 to cause the throttle 16 to open to equalise the engine speeds.

The switch 26 on the gear lever can be a normal make and break switch or can be a capacitor touch switch operated by driver touching that particular area of the gear lever knob.

CLAIMS

1. A clutch control apparatus for controlling the friction clutch of a motor vehicle and comprising:-
an engine speed sensing means,
a transmission speed sensing means,
a servomotor for controlling the engagement of the clutch with the engine,
a clutch position transducer that produces a signal indicative of the state of engagement between the engine and clutch;
and a throttle control means for inhibiting driver control of said throttle during disengagement of the clutch, the throttle control means and the clutch servomotor both being controlled through an electronic system that receives signals respectively from each of the clutch position transducer and the engine and transmission speed sensing means so that on standing start of the vehicle the state of engagement of the clutch is controlled for disengagement below a predetermined engine speed reference and above that reference the degree of engagement is related to the engine speed up to a fully engaged state corresponding with a second predetermined reference, and during clutch disengagement for subsequent gear changes, the respective signals from the engine and transmission speed sensing means control the electronic system to operate the throttle control independently of the driver to synchronise the transmission and engine speeds before the clutch is re-engaged.

2. A clutch control apparatus is claimed in Claim 1 when applied to a manual gearbox wherein the gearshift control lever has a switch connected into the electronic circuit so that upon manual initiation of a gear change, operation of the switch causes the clutch servomotor to disengage the clutch, and simultaneously locks the throttle control making the throttle independent of the driver.

3. A clutch control apparatus is claimed in Claim 2 wherein the gearshift control lever switch is as capacitor switch.

4. A clutch control apparatus as claimed in any one of Claims 1 to 3 wherein the clutch servomotor is a vacuum servomotor having a diaphragm moveable by a pressure differential across the diaphragm and state of engagement of the clutch can be controlled by controlling the pressure differential across the diaphragm by the use of variable orifices connected to vacuum source and atmosphere, the cross-section of the orifices being opened and closed by operating coils, each being respectively responsive to a mark-space ratio of a signal generated in the electronic circuit.

5. A clutch control apparatus substantially as described herein and as illustrated in the accompanying drawings.

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