



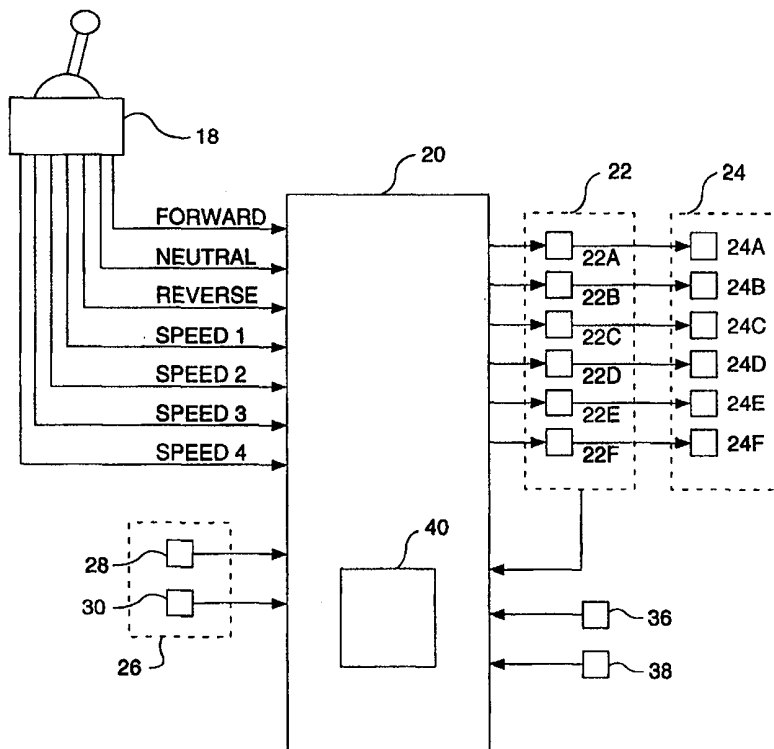
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(54) Title: METHOD AND APPARATUS FOR CONTROLLING A TRANSMISSION ASSOCIATED WITH A NEUTRALIZE MODE

(57) Abstract

A method and apparatus for controllably engaging, or disengaging, or both engaging and disengaging, a neutralize mode (34) associated with a transmission (14) located on a machine (10) is disclosed. The machine (10) has a controller (20), a memory associated with the controller (20), and a braking system (26). A determined system brake pressure (32) is compared with at least one of an established neutralize pressure value (36) and in gear pressure value (38). The neutralize mode (34) is engaged or disengaged in response to the comparison.



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DescriptionMethod And Apparatus For Controlling A Transmission
Associated With A Neutralize Mode

5

Technical Field

This invention relates to a machine having an electronically controlled transmission, and more particularly, to a method and apparatus for
10 controllably engaging, and disengaging, a neutralize mode associated with the transmission.

Background Art

Often, in machines, such as small wheel
15 loaders, a neutralize function enables the transmission to be shifted to neutral when the service brakes are applied. In prior systems, the neutralize function typically utilizes an on/off limit switch. The limit switch is usually located beneath a service
20 brake pedal. As the service brake pedal is depressed, the travel limit for the limit switch is reached, inducing the limit switch contacts to close. The closed state of the limit switch contacts is communicated to an electronic controller associated
25 with the machine, and a signal for brake actuation is subsequently produced.

A problem with this form of engaging and disengaging a neutralize function is the nonspecific amount of brake pedal travel that may occur prior to
30 the brakes being applied. As a result of the nonspecific amount of brake pedal travel, the transmission may be neutralized at an undesirable time. If, the transmission is neutralized later than desirable, premature wear on the break pads may occur

due to the service brakes being applied prior to the transmission being placed in neutral. Also, excessive wear on the service brakes occurs if the transmission is neutralized sooner than desirable.

5 Also, due to wear of mechanical parts and lack of proper maintenance, the brake pedal travel distance may alter. If, the brake pedal travel distance alters, the enabling time of the neutralize function could alter.

10 The present invention is directed to overcoming one or more of the problems as set forth above.

Disclosure of the Invention

15 In one aspect of the present invention, a method of controlling a transmission included in a machine is disclosed. The machine has a controller and a brake system. A neutralize pressure value is established, and a system brake pressure associated
20 with the brake system is determined. A comparison is made between the system brake pressure and the neutralize pressure value, and a neutralize mode associated with the transmission is responsively engaged.

25 In another aspect of the present invention, a method of controlling a transmission included in a machine is disclosed. The machine has a controller and a brake system. A in gear pressure value is established, and a system brake pressure associated
30 with the brake system is determined. A comparison is made between the system brake pressure and the in gear pressure value, and a neutralize mode associated with the transmission is responsively disengaged.

In a third aspect of the present invention, a machine having a controllable transmission, is disclosed. The machine has a brake system. Associated with the machine is a controller configured to
5 communicate with the transmission and the brake system. A neutralize pressure value is stored in a memory device, associated with the controller. Also, associated with the brake system is a pressure sensor configured to sense a system brake pressure. A
10 neutralize mode, associated with the transmission, is configured to be controllably engaged.

In a fourth aspect of the present invention, a machine having a controllable transmission, is disclosed. The machine has a brake system. Associated
15 with the machine is a controller configured to communicate with the transmission and the brake system. A in gear pressure value is stored in a memory device, associated with the controller. Also, associated with the brake system is a pressure sensor
20 configured to sense a system brake pressure. A neutralize mode, associated with the transmission, is configured to be controllably disengaged.

In a fifth aspect of the present invention, a system for controlling a transmission on a machine
25 is disclosed. A brake system is located in the machine. Associated with the machine is a controller configured to communicate with the transmission and the brake system. A memory device, associated with the controller, stores a neutralize pressure value.
30 Also, associated with the brake system is a pressure sensor configured to sense a system brake pressure. A neutralize mode is configured to be engaged in response to a comparison of the system brake pressure and the neutralize pressure value.

In a sixth aspect of the present invention, a system for controlling a transmission on a machine is disclosed. A brake system is located in the machine. Associated with the machine is a controller
5 configured to communicate with the transmission and the brake system. A memory device, associated with the controller, stores a in gear pressure value. Also, associated with the brake system is a pressure sensor configured to sense a system brake pressure. A
10 neutralize mode is configured to be disengaged in response to a comparison of the system brake pressure and the neutralize pressure value.

These and other aspects and advantages of the present invention, as defined by the appended
15 claims, will be apparent to those skilled in the art from reading the following specification in conjunction with the drawings and the claims.

Brief Description of the Drawings

20 For a better understanding of the invention, reference may be made to the accompanying drawings, in which:

FIG. 1 is a diagrammatic side elevational view of a preferred embodiment of a machine
25 constructed for operation in accordance with the present invention;

FIG. 2 is a schematic block diagram of the transmission controller of the machine of FIG. 1;

FIGS. 3A-3B are a diagram depicting at least
30 one of an increase and decrease in a system brake pressure of the machine of FIG. 1.

Best Mode for Carrying Out the Invention

The present invention provides a method and an apparatus for controlling a transmission by controllably engaging, and disengaging a neutralize mode associated with the transmission. The application of the neutralize mode, in the preferred embodiment, is dependent on a comparison of a system brake pressure with at least one predetermined pressure value. The following description uses a small wheel loader as an example only. This invention can be applied to other types of earth moving machines, such as backhoe loaders.

Referring to FIGS. 1-2, a preferred embodiment of a machine such as a wheel loader 10, having an engine 12 with a transmission 14 coupled to the engine 12, is shown. The transmission 14 is operatively connected to the wheels on the machine 10 in a manner well known to one skilled in the art. The transmission output may be measured in terms of the speed of rotation of the transmission output shaft 16 in revolutions per minute (RPM). A shift control lever 18, associated with the transmission 14 is for shifting the transmission 14 between its various gears, includes at least one of a neutral gear, a direction gear, and a speed gear.

Preferably the shift control lever 18 is a multi-contact switch that sends position information to a controller 20 to indicate a desired gear for the transmission 14. When the transmission speed and the engine speed permit a shift to the desired gear, the controller 20 operates the appropriate transmission solenoids 22. The controller 20 used in the preferred embodiment is a Motorola microcontroller, Model No. 68HC11. However, many suitable controllers including

analog and/or digital circuitry may be used in connection with the present invention, as would be known to one skilled in the art.

In a preferred embodiment, six transmission solenoids, three relating to direction and three relating to speed, are used and are illustrated and labeled 22A through 22F. As is known in the art, the transmission solenoids 22 operate a plurality of corresponding transmission clutches 24 and thereby determine the actual gear of the transmission 14. For each transmission solenoid 22A-22F there is a corresponding transmission clutch 24. The three direction clutches are illustrated and labeled 24A through 24C, and the three speed clutches are illustrated and labeled 24D through 24F. The controller 20 actuates appropriate ones of the solenoids 22A - 22F for shifting the transmission 14 to the desired gear.

The foregoing description uses six transmission solenoids 22 and six corresponding transmission clutches 24 as an example only. This invention can readily be implemented in connection with transmissions having less than, or more than, six solenoids and six corresponding clutches.

The machine 10 is controllably slowed down or stopped by a brake system 26 located on the machine 10. Advantageously, at least one service brake 28 and at least one brake pressure sensor 30 is included in the brake system 26. The brake pressure sensor 30 is preferably configured to monitor the fluid pressure in the brake system 26, and communicate the system brake pressure 32 with the controller 20.

A neutralize mode 34 is a state where the direction clutch 24A-24C is disabled and the

transmission is in neutral, while the speed clutch 24D-24F remains enabled. A neutralize pressure value 36 is a predetermined value. The neutralize pressure value 36 advantageously represents a point just before
5 excessive force will be placed on the service brakes 28 prior to the neutralize mode 34 being engaged. A in gear pressure value 38 is a predetermined value. The in gear pressure value 38 advantageously represents a point just before the machine could roll
10 down a slope prior to re-engaging the transmission 14. A memory device 40, associated with the controller 20, is configured to store the neutralize pressure value 36 and the in gear pressure value 38.

In the preferred embodiment, the neutralize
15 pressure value 36 and the in gear pressure value 38, are values that are provided to the controller 20 during the manufacturing process by an electronic service tool, or by an operator input device, such as an electronic keypad accessible to the operator.
20 However, one skilled in the art could readily implement the present invention in connection with at least one of the neutralize pressure value 36 and the in gear pressure value 38 being determined by the controller 20. The controller 20 may determine at
25 least one of the neutralize pressure value 36 and the in gear pressure value 38 from various inputs. One example being, the slope of the incline indicated by an inclination indicator (not shown), and the force created by the mass of the machine 10, may be inputs
30 used by the controller 20 to determine at least one of the neutralize pressure value 36 and the in gear pressure value 38.

In the preferred embodiment, the service brake 28 is maintained in the engaged position by the

application of fluid pressure, and spring-biased in the disengaged position. Alternatively, the service brake 28 may also be spring-biased in the engaged position, and maintained in the disengaged position by application of fluid pressure. Many suitable types of service brakes may be used in connection with the present invention as would be known to one skilled in the art.

Referring to FIG. 3A, a diagram depicting an increase in the system brake pressure 32 of a preferred embodiment of the machine 10, is shown. When the system brake pressure 32 is less than the neutralize pressure value 36, the direction clutches 24A-24C and the speed clutches 24D-24F are enabled, and the service brake 28 is not engaged. The position of the shift control lever 18 determines which gear the transmission is placed in when the system brake pressure 32 is less than the neutralize pressure value 36.

If, the system brake pressure 32 increases to a value equal to or greater than the neutralize pressure value 36 and less than the in gear pressure value 38, the neutralize mode 34 is engaged, whereby the direction clutch 24A-24C is disabled and the transmission is in neutral. If, the system brake pressure 32 continues to increase to a value equal to or greater than the in gear pressure value 38, the transmission 14 will remain in the neutralize mode 34.

Referring to FIG. 3B, a diagram depicting a decrease in the system brake pressure 32 of a preferred embodiment of the machine 10, is shown. In the preferred embodiment, while the system brake pressure 32 has a value greater than the in gear pressure value 38, the transmission will remain in the

neutralize mode 34. When the system brake pressure 32 is decreasing, the value for the in gear pressure value 38 may be equal to, or greater than, or less than, the value used for the in gear pressure value 38 when the system brake pressure was increasing.

When the system brake pressure 32 decreases to a value equal to or less than the in gear pressure value 38 the neutralize mode 34 is disengaged. The service brake 28 is disengaged and the direction clutches 24A-24C are enabled when the neutralize mode 34 is disengaged. The neutralize mode 34 will remain disengaged as long as the system brake pressure 32 continues to have a value less than the in gear pressure value 38. However, if the system brake pressure 32 first decreases to a value less than the neutralize pressure value 36, and subsequently the system brake pressure 32 increases to a value equal to or greater than the neutralize pressure value 36, the neutralize mode 34 will be engaged, as shown in the increasing brake pressure diagram in FIG 3A.

Referring again to FIGS. 1-2, various operator controls are located in an operator's compartment 42. These controls include the shift control lever 18, the service brake 28 and a neutralize mode override switch 44 configured to nullify the neutralize mode 34. When the neutralize mode 34 is nullified the machine 10 will remain in gear regardless of the system brake pressure 32.

30 Industrial Applicability

A method and apparatus for controllably engaging and disengaging a neutralize mode associated with the transmission located on a machine is disclosed. The present invention reduces premature

wear on the service brakes due to the neutralize mode being engaged later than desirable. Using the system brake pressure to determine when the neutralize mode is engaged, results in the transmission being placed
5 in neutral prior to the application of the service brakes. Additionally, excessive wear on the service brakes due to the transmission being neutralized sooner than desirable is reduced. Also, the method and apparatus for controllably engaging and
10 disengaging the neutralize mode adapts to changes on the machine as mechanical parts wear.

Other aspects, objects and advantages of the present invention can be obtained from a study of the drawings, the disclosure and the appended claims.

Claims

1. A method of controlling a transmission (14) included in a machine (10), the machine (10) having a controller (20) and a brake system (26), including the steps of:
- establishing a neutralize pressure value (36);
- determining a system brake pressure (32) associated with the brake system (26);
- comparing the system brake pressure (32) to the neutralize pressure value (36); and
- responsively engaging a neutralize mode (34) associated with the transmission (14).
2. A method as set forth in claim 1, including the step of controllably engaging the neutralize mode (34) in response to comparing the system brake pressure (32) to the neutralize pressure value (36).
3. A method as set forth in claim 1, including the steps of:
- establishing a in gear pressure value (38);
- comparing the system brake pressure (32) to the in gear pressure value (38); and
- responsively disengaging the neutralize mode (34) associated with the transmission (14).
4. A method as set forth in claim 3, including the step of controllably disengaging the neutralize mode (34) response to comparing the system brake pressure (32) to the in gear pressure value (38).

5. A method as set forth in claim 1, the transmission (14) having at least one direction clutch (24A-24C), and including the step of disengaging the
5 at least one direction clutch (24A-24C) in response to engaging the neutralize mode (34).

6. A method as set forth in claim 3, the transmission (14) having at least one direction clutch
10 (24A-24C) and including the step of engaging the at least one direction clutch (24A-24C) in response to disengaging the neutralize mode (34).

7. A method as set forth in claim 1,
15 including the step of utilizing an operator interface configured to communicate the neutralize pressure value (36) with the controller (20).

8. A method as set forth in claim 3,
20 including the step of utilizing an operator interface configured to communicate the in gear pressure value (38) with the controller (20).

9. A method as set forth in claim 1,
25 including the step of selectively utilize a neutralize mode override switch (44) associated with the neutralize mode (34), the neutralize mode override switch (44) being configured to disable the neutralize mode (34).

30

10. A method of controlling a transmission (14) included in a machine (10), the machine (10) having a controller (20) and a brake system (26), including the steps of:

establishing a in gear pressure value (38);
determining a system brake pressure (32)
associated with the brake system (26);
comparing the system brake pressure (32) to
5 the in gear pressure value (38); and
responsively disengaging a neutralize mode
(34) associated with the transmission (14).

11. A method as set forth in claim 10,
10 including the step of controllably disengaging the
neutralize mode (34) in response to comparing the
system brake pressure (32) to the in gear pressure
value (38).

12. A method as set forth in claim 10, the
15 transmission (14) having at least one direction clutch
(24A-24C), and including the step of, engaging the at
least one direction clutch (24A-24C) in response to
disengaging the neutralize mode (34).

20

13. A method as set forth in claim 10,
including the step of utilizing an operator interface
to communicate the in gear pressure value (38) with
the controller (20).

25

14. A method as set forth in claim 10,
including the step of selectively utilizing a
neutralize mode override switch (44) associated with
the neutralize mode (34), the neutralize mode override
30 switch (44) being configured to disable the neutralize
mode (34).

15. A machine having a controllable
transmission (14), comprising:

a brake system (26) associated with the machine (10);

a controller (20) associated with the machine (10), the controller (20) being configured to
5 communicate with the transmission (14) and the brake system (26);

a memory device (40) associated with the controller (20);

a neutralize pressure value (36) stored in
10 the memory device (40);

a brake pressure sensor (30) associated with the brake system (26), the pressure sensor (30) configured to sense a system brake pressure (32); and

a neutralize mode (34) associated with the
15 transmission (14), the neutralize mode (34) being configured to controllably engage in response to a comparison of the system brake pressure (32) and the neutralize pressure value (36).

20 16. A machine (10) having a controllable transmission (14) as set forth in claim 15, further comprising a in gear pressure value (38) stored in the memory device (40), the neutralize mode (34) being configured to controllably disengage in response to a
25 comparison of the system brake pressure (32) and the in gear pressure value (38).

17. A machine (10) having a controllable transmission (14) as set forth in claim 15, further
30 comprising at lest one direction clutch (24A-24C) associated with the transmission (14), the at least one direction clutch (24A-24C) being configured to controllably disengage in response to the neutralize mode (34).

18. A machine (10) having a controllable transmission (14) as set forth in claim 16, further comprising at least one direction clutch (24A-24C) associated with the transmission (14), the at least one direction clutch (24A-24C) configured to controllably engage in response to the neutralize mode (34).

19. A machine (10) having a controllable transmission (14) as set forth in claim 15, further comprising an operator interface configured to communicate the neutralize pressure value (36) with the controller (20).

20. A machine (10) having a controllable transmission (14) as set forth in claim 16, further comprising an operator interface configured to communicate the in gear pressure value (38) with the controller (20).

21. A machine (10) having a controllable transmission (14) as set forth in claim 15, further comprising a neutralize mode override switch (44) associated with the neutralize mode (34), the neutralize mode override switch (44) being configured to disable the neutralize mode (34).

22. A machine (10) having a controllable transmission (14), comprising:
a brake system (26) associated with the machine (10);
a controller (20) associated with the machine (10), the controller (20) being configured to

communicate with the transmission (14) and the brake system (26);

a memory device (40) associated with the controller (20);

5 a in gear pressure value (38) stored in the memory device (40);

a brake pressure sensor (30) associated with the brake system (26), the brake pressure sensor (30) configured to sense a system brake pressure (32); and

10 a neutralize mode (34) associated with the transmission (14), the neutralize mode (34) being configured to controllably disengage in response to a comparison of the system brake pressure (32) and the in gear pressure value (38).

15

23. A machine (10) having a controllable transmission (14) as set forth in claim 22, further comprising at least one direction clutch (24A-24C) associated with the transmission (14), the at least
20 one direction clutch (24A-24C) configured to controllably engage in response to the neutralize mode (34).

24. A machine (10) having a controllable
25 transmission (14) as set forth in claim 22, further comprising an operator interface configured to communicate the in gear pressure value (38) with the controller (20).

30 25. A machine (10) having a controllable transmission (14) as set forth in claim 22, further comprising a neutralize mode override switch (44) associated with the neutralize mode (34), the

neutralize mode override switch (44) being configured to disable the neutralize mode (34).

26. A system for controlling a transmission
5 (14) on a machine (10), comprising:
a brake system (26) located in the machine
(10);
a controller (20) configured to communicate
with the transmission (14) and the brake system (26);
10 a memory device (40) associated with the
controller (20);
a neutralize pressure value (36) stored in
the memory device (40);
a brake pressure sensor (30) associated with
15 the brake system (26) configured to sense a system
brake pressure (32) and communicate the system brake
pressure (32) with the controller (20); and
a neutralize mode (34) associated with the
transmission (14), the neutralize mode (34) being
20 configured to controllably engage in response to a
comparison of the system brake pressure (32) and the
neutralize pressure value (36).

27. A system for controlling a transmission
25 (14) on a machine (10) as set forth in claim 26,
further comprising a in gear pressure value (38)
stored in the memory device (40), and the neutralize
mode (34) being configured to disengaged in response
to a comparison of the system brake pressure (32) and
30 the in gear pressure value (38).

28. A system for controlling a transmission
(14) on a machine (10) as set forth in claim 26,
further comprising at least one direction clutch (24A-

24C) associated with the transmission (14), the at least one direction clutch (24A-24C) being configured to controllably disengage in response to the neutralize mode (34).

5

29. A machine (10) having a controllable transmission (14) as set forth in claim 27, further comprising at least one direction clutch (24A-24C) associated with the transmission (14), the at least
10 one direction clutch (24A-24C) being configured to controllably engage in response to the neutralize mode (34).

30. A system for controlling a transmission
15 (14) on a machine (10) as set forth in claim 26, further comprising an operator interface configured to communicate the neutralize pressure value (36) with the controller (20).

20 31. A system for controlling a transmission (14) on a machine (10) as set forth in claim 27, further comprising an operator interface configured to communicate the in gear pressure value (38) with the controller (20).

25

32. A machine (10) having a controllable transmission (14) as set forth in claim 26, further comprising a neutralize mode override switch (44) associated with the neutralize mode (34), the
30 neutralize mode override switch (44) being configured to disable the neutralize mode (34).

33. A system for controlling a transmission (14) on a machine (10), comprising:

a brake system (26) located in the machine (10);

a controller (20) configured to communicate with the transmission (14) and the brake system (26);

5 a memory device (40) associated with the controller (20);

a in gear pressure value (38) stored in the memory device (40);

10 a brake pressure sensor (30) associated with the brake system (26) configured to sense a system brake pressure (32) and communicate the system brake pressure (32) with the controller (20); and

a neutralize mode (34) associated with the transmission (14), the neutralize mode (34) being
15 configured to controllably disengage in response to a comparison of the system brake pressure (32) and the neutralize pressure value (36).

34. A system for controlling a transmission
20 (14) on a machine (10) as set forth in claim 33, further comprising at least one direction clutch (24A-24C) associated with the transmission (14), the at least one direction clutch (24A-24C) being configured to controllably engage in response to the neutralize
25 mode (34).

35. A system for controlling a transmission (14) on a machine (10) as set forth in claim 33, further comprising an operator interface configured to
30 communicate the in gear pressure value (38) with the controller (20).

36. A machine (10) having a controllable transmission (14) as set forth in claim 33, further

comprising a neutralize mode override switch (44) associated with the neutralize mode (34), the neutralize mode override switch (44) configured to disable the neutralize mode (34).

FIG. 1

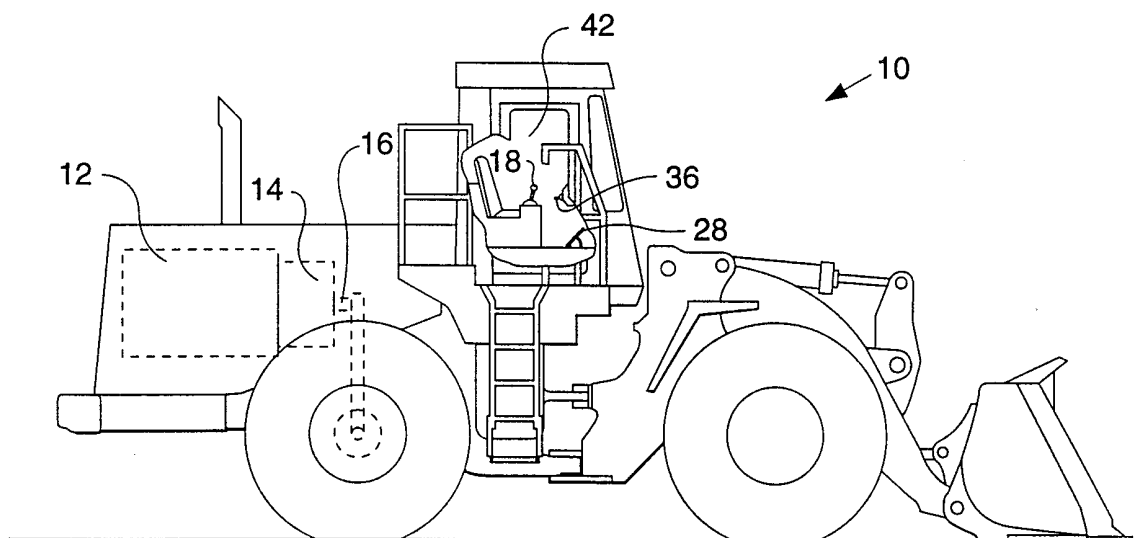
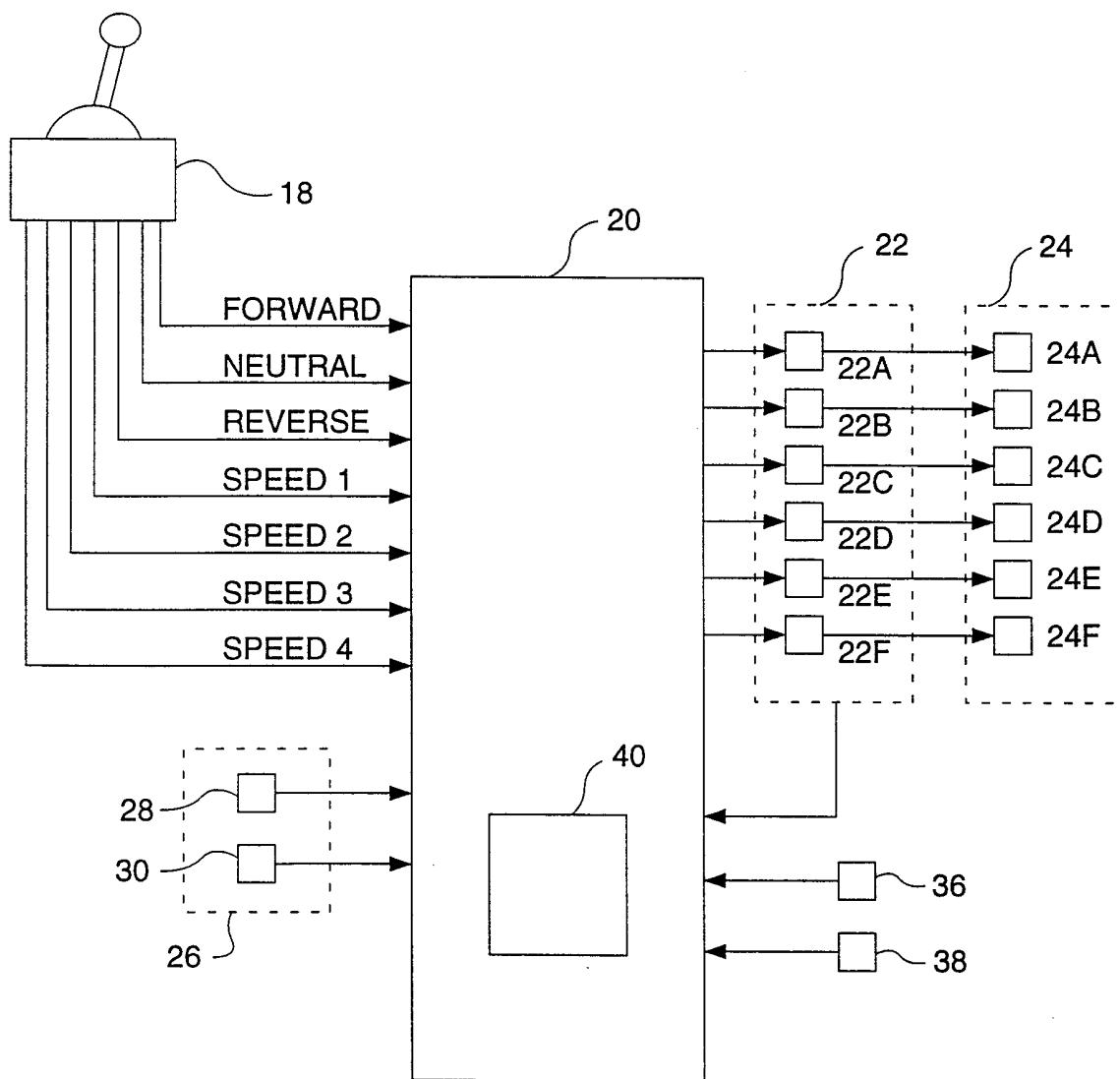
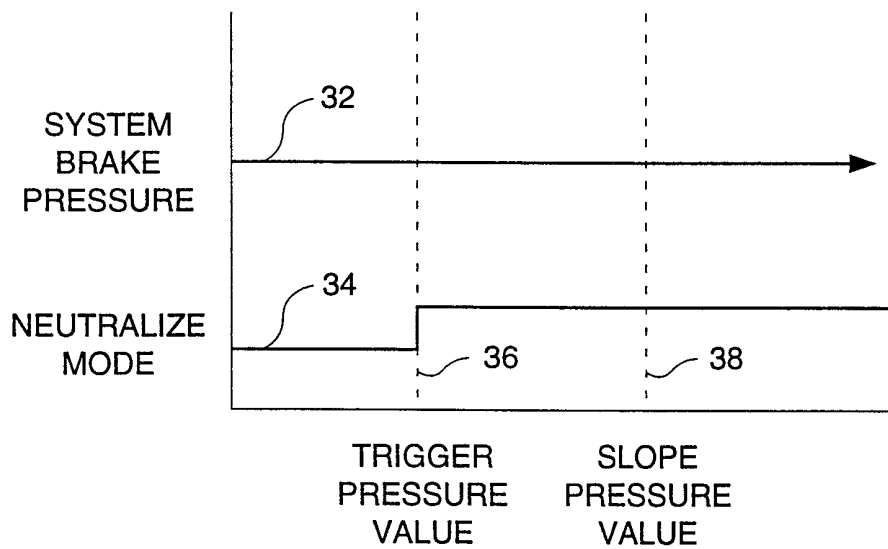


FIG. 2

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Fig. 3a.Fig. 3b.