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(54) PDA based interface for rotary trowel

(57) An electronic user interface such as a personal data assistant (PDA) based interface system is providing for calibrating, setting, adjusting, monitoring, and/or diagnosing faults in a power steering system for a powered rotary trowel. The PDA is configured to permit the user to navigate through a number of screens permitting rapid and user friendly access to the various functions

by relatively untrained personnel. The PDA is also configured to enable the system's CPU to interface with a remote computer to permit the installation of new or upgraded software in the CPU. Some functions preferably are bifurcated so as to provide broad access to skilled maintenance personnel, while providing more limited access to the users.

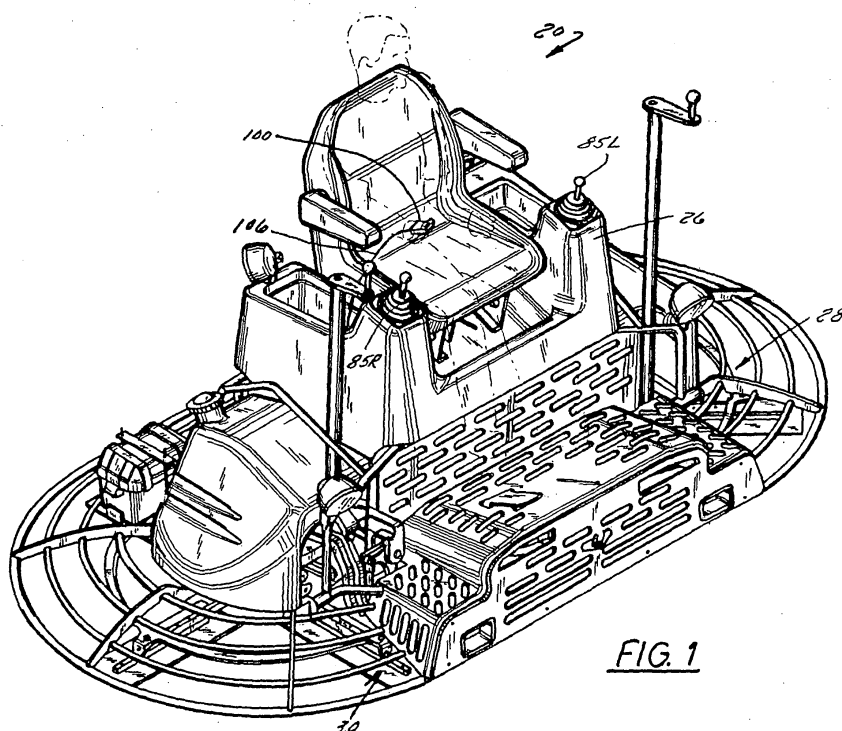


FIG. 1

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Description

CROSS REFERENCE TO A RELATED APPLICATION

[0001] Priority is hereby claimed under 35 U.S.C. 119 (e) on Provisional Patent Application Ser. No., 60/562,832 filed April 16, 2004 and entitled "PDA Based Interface for Rotary Trowel," the subject matter of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates to rotary trowels and, more particularly, to an electronically steered rotary trowel employing a user-friendly PDA interface to set, calibrate, and/or monitor a power steering system for the trowel.

2. Discussion of Related Art

[0003] Powered rotary trowels are widely used for finishing freshly poured concrete. These machines range from simple hand trowels, to walk-behind finishing trowels, to self-propelled finishing trowels including some larger walk-behind machines as well as relatively large two-rotor or even three-rotor machines. Self-propelled finishing trowels, and particularly riding finishing trowels, can finish large sections of concrete more rapidly and efficiently than manually pushed finishing trowels. The invention is directed to self-propelled finishing trowels and is described primarily in conjunction with riding finishing trowels by way of explanation, it being understood that the invention is applicable to other finishing trowels as well.

[0004] Riding concrete finishing trowels typically include a mobile frame including a deck. At least two, and sometimes three or more, rotor assemblies are mounted on an underside of the deck. Each rotor assembly includes a driven shaft extending downwardly from the deck and a plurality of trowel blades mounted on and extending radially outwardly from the bottom end of the driven shaft and supported on the surface to be finished. The driven shafts of the rotor assemblies are driven by one or more self-contained engines mounted on the frame and typically linked to the driven shafts by gearboxes of the respective rotor assemblies. The weight of the finishing trowel and the operator is transmitted frictionally to the concrete by the rotating blades, thereby smoothing the concrete surface.

[0005] The most common steering assemblies are mechanically operated. These assemblies typically include two steering control levers mounted adjacent the operator's seat and accessible by the operator's left and right hands, respectively. Each lever is mechanically coupled, via a suitable mechanical linkage assembly, to a pivoting gearbox of an associated rotor assembly. The

operator steers the vehicle by tilting the levers fore-and-aft and side-to-side to tilt the gearboxes side-to-side and fore-and-aft, respectively.

[0006] Mechanically operated steering control assemblies are difficult to operate because they require the imposition of a significant physical force by the operator. The typical steering control lever requires 20-40 pounds of force to operate in either its fore-and-aft direction or its side-to-side direction. Most operators experience fatigue when exerting these forces, particularly when one considers that the operator must exert these forces continuously or nearly continuously for several hours at a time with little or no rest. Operator fatigue is particularly problematic with respect to side-to-side motions, which, due to the ergonomics of the machines, are considerably more difficult for operators to impose than fore-and-aft motions.

[0007] Because of these limitations, traditional mechanically steered trowels are increasingly giving way to trowels with power steering systems. For instance, Wacker Corporation has developed an electronically steered trowel that employs electronic actuators such as ball screw actuators to tilt the gearbox assemblies. The actuators are controlled indirectly by way of a controller such as one or more electronic joysticks and, when energized, tilt the rotor assemblies to effect the desired steering operation. In the typical case of a riding trowel having two rotor assemblies, two actuators and a biaxially pivoting steering linkage are supplied for one of the rotor assemblies to effect both left/right and forward/reverse steering control, whereas only a single actuator and its associated uniaxially pivoting steering linkage are provided for the other rotor assembly so as to effect only forward/reverse steering control.

[0008] The joysticks are coupled to the actuators via a controller such as a CPU that generates steering command signals in response to joystick movement and transmits the steering command signals to the actuators under feedback to energize the actuators proportionally to the direction and extent of joystick movement. Because the operator input forces are very small, operator fatigue is significantly reduced during operation of the invention when compared to operation of traditional, mechanically steered machines. A system of this type is described in U.S. Pat. No. 6,368,016, the contents of which are incorporated herein by reference.

[0009] The response characteristics of the actuators are set by programming the CPU. These characteristics are preset at the factory, but it is desirable to permit them to be modified, at least within limits, to accommodate user preference and/or changes in concrete conditions or weather conditions. It is also necessary to diagnose faults in the system when they occur. Calibrating and/or setting the controls for these trowels previously required intricate knowledge of electronic controls and of how to calibrate those controls. In addition, diagnosing faults required the use of relatively sophisticated detection equipment by highly trained personnel. As a result, con-

trol calibration, adjustment, and/or fault detection functions had to be performed by very well trained personnel and were difficult, if not impossible, to be performed in the field.

[0010] The need therefore has arisen to provide a user friendly mechanism that facilitates setting, calibration, and fault diagnostics of an electric steering system for a concrete finishing trowel.

SUMMARY OF THE INVENTION

[0011] In accordance with an aspect of the invention, a personal data assistant (PDA) based interface system is provided for calibrating, setting, adjusting, monitoring, and/or diagnosing faults in a power steering system for a powered rotary trowel. The PDA or other electronic user interface is configured to permit the user to navigate through a number of screens permitting rapid and user friendly access to the various functions by relatively untrained personnel. The electronic user interface is also configured to enable the system's CPU to interface with a remote computer to permit the installation of new or upgraded software in the CPU. Some functions preferably are bifurcated so as to provide broad access to skilled maintenance personnel, while providing more limited access to the users. The trowel may be either a riding trowel or a walk behind trowel. It may be steered e.g., via electronic actuator(s) such as ball screw actuator(s) or hydraulically powered actuator(s) controlled by electronically controlled valves and the like. Steering commands may be generated by joysticks, levers, switches, and/or any other suitable manually manipulated controllers.

[0012] These and other features and advantages of the invention will become apparent to those skilled in the art from the following detailed description and the accompanying drawings. It should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the present invention, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a perspective view of an electronically steered riding trowel incorporating a PDA interface arrangement constructed in accordance with the preferred embodiment of the invention;
FIG. 2 schematically illustrates the electronic controls of the electronic steering system of the trowel of FIG. 1;
FIGS. 3 schematically illustrates a flowchart for accessing the screen displays available to both end

users and trained maintenance personnel when using the PDA of Figures 1 and 2; and
FIGS. 4A-4G collectively illustrate the flowchart of FIG. 3 in greater detail.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] According to FIG. 1 by way of explanation, an electronically steered riding trowel 20 incorporating a PDA based interface constructed in accordance with the present invention includes as its major components a rigid metallic frame 22, an upper deck 24 mounted on the frame 22, an operator's platform or pedestal 26 provided on the deck 24, and right and left rotor assemblies 28 and 30, respectively, extending downwardly from the deck 24 and supporting the finishing machine 20 on the surface to be finished. The right and left rotor assemblies 30, 28 are driven by respective gearboxes 32, 34 (FIG. 2) coupled to an engine (not shown). The right and left rotor assemblies 30 and 28 rotate towards the operator, or counterclockwise and clockwise, respectively, to perform a finishing operation.

[0015] Referring to FIG. 2, the trowel is steered by a steering system 76 that tilts the gearboxes of the left and right rotor assemblies 28 and 30 using right and left steering assemblies 80 and 82 controlled by a controller 85. The right steering assembly 80 includes both a forward/reverse actuator 84 and a left/right actuator 86 which tilt the associated gearbox 32 side-to-side and fore-and-aft, respectively. The left steering assembly 82 includes only a forward/reverse actuator 90 that tilts the associated gearbox 34 side-to-side. The actuators 84, 86 and 90 may be of the type that have internal feedback potentiometers which compare the actual position of the actuator's output with the commanded position transmitted by the controller 85. When those positions match, actuator motion stops, and the actuator holds its output in that position. Suitable actuators comprise ball-screw actuators available, e.g., from Warner Electric of South Beloit, Ill. In the preferred embodiment, actuators lacking linear potentiometers are employed and are coupled to load cell strain gauges ("load pins") that provide the desired feedback to the controller 85 by monitoring the loads imposed on the pins on which the actuators are mounted. Suitable actuators are available, for example, from Motion Systems.

[0016] The controller 85 preferably is coupled to the actuators 84, 86, and 90 so that manipulation of the controller 85 in a particular direction steers the machine 20 to move in that same direction, preferably at a speed that is proportional to the magnitude of controller movement. Referring to FIG. 2, one preferred controller 85 for generating steering command signals and transmitting the steering command signals to the actuators 84, 86, and 90 takes the form of two joysticks 85L and 85R electronically coupled to the actuators via a programmed electronic controller such as a central processing unit

(CPU) 180. The feedback capability provided by the actuators 84, 86, and 90 or by the strain gauges or the like permits the actuators to interface with the CPU 180 to correlate actuator motion with joystick motion. As a result, the appropriate actuator 84, 86, or 90 moves in the direction commanded by the joysticks 85L and 85R through a stroke that is proportional to the magnitude of joystick movement. The machine 20 therefore moves in the direction of joystick movement at a speed that is proportional to the magnitude of joystick movement.

[0017] For instance, to steer the concrete finishing machine 20 to move forwardly, the joysticks 85L and 85R are pivoted forwardly about their fore-and-aft axes, and the CPU 180 controls both forward/reverse actuators 84 and 90 to extend or retract their output rods through a stroke that is proportional to the degree of joystick movement, hence driving the gearboxes 32 and 34 to pivot laterally toward or away from each other by an amount that causes the machine 20 to move straight forward or rearward at a speed that is proportional to the magnitude of joystick movement. Similarly, movement of the joystick 85R from side-to-side about its second axis generates a steering command signal that is processed by the CPU 180, in conjunction with the feedback potentiometers on the left/right actuator 86 so as to tilt the associated gearbox 32 forwardly or rearwardly by an amount that is proportional to the magnitude of joystick movement and that results in finishing machine movement to the right or left at a speed that is proportional to the magnitude of joystick movement. If the joysticks 85L and 85R are released and, accordingly, returned to their centered or neutral positions under internal biasing springs (not shown), each of the actuators 84, 86, and 90 also returns to its centered or neutral position.

[0018] Still referring to FIG. 2, an electronic user interface 100 can be selectively coupled to the CPU 180, either wirelessly or via data ports 102 and 104 and a cable 106, to provide an operator interface with the internal electronics of the CPU 180 for the purposes of calibrating, setting, monitoring, and/or diagnosing faults in the electronic steering system 76. The electronic user interface of this embodiment is a PDA 100. PDAs of the illustrated type are well-known, having a touch screen 108 activated using a stylus (not shown). PDAs of this type are widely available, e.g., under the brand name Palm Pilot®. It should be emphasized, however, that other types of electronic user interfaces could be employed, so long as they permit the transfer of information to and from the CPU 180 in a user-friendly fashion. The PDA 100 can also be coupled to a computer such as a personal computer (PC) 110, typically in the form of a laptop, to permit programs in the CPU 180 to be loaded or updated via the PC 110. Again, the connection may either be wireless or via cable and data ports. Those programs may be pre-loaded in the PC 110 or downloaded remotely from a vendor server 112 or similar device, preferably using the internet 114.

[0019] Referring to FIG. 3, the PDA 100 of this embodiment displays a series of screens through which a user can navigate to perform the above-described calibrating, setting, monitoring, and diagnostic functions and possibly other functions as well. FIG. 3 displays all available screens in their actual form and uses arrows to designate the manner in which a user can navigate from screen to screen, starting with a main menu screen FA1, which itself can be accessed by touching an icon on the PDA's main menu screen (not shown).

[0020] As can be appreciated from FIG. 3, all users have access to main menu screen FA1. All users also have full access to screens for performing most other functions such as providing support information, provide diagnostic information, providing file transfer capability (for accessing the PC for file transfer purposes), and providing error codes. Screens accessible by all users are designated by "FA_" in FIGs. 3 and 4A-4G to designate "full access." However, access to the remaining functions is restricted in order to prevent damage to the steering system and to prevent the steering system from being set in a manner that would lead to unacceptable operation. As a result of this bifurcation, setting functions are available both to end users and administrators, but administrators are capable of adjusting the outputs through a wider range than other users. Screens accessible only to administrators are designated "AA_" to designate "administrator access."

[0021] Turning now to FIGs. 3, 4A, and 4B, the main screen FA1 presents a menu that prompts the user to select a desired one of FILE TRANSFER, HANDLING, ERROR CODES, ADVANCED, DIAGNOSTIC, and SUPPORT INFO commands. It should be noted that screen FA1 and several other screens include a CHECK PALM LINK display that flashes if the PDA 100 is not properly connected to its data port. Selecting any command other than the ADVANCED command directs the user to a screen for performing functions or accessing information relating to that command on an unrestricted basis. The information accessed and functions performed upon executing each of these commands will now be described in turn, with some of the automatic displays and more self-explanatory functions being omitted for the sake of conciseness.

[0022] Executing the FILE TRANSFER command on the main menu screen FA1 causes the PDA 100 to display a pop up reminder in screen FA2 (shown in greater detail in FIGS. 4B) to prepare the trowel for file download before beginning the file transfer process. The PDA 100 then displays a screen FA3 that allows the user to transfer a program from another computer to the electronic controller 85. Specifically, upon executing a GET PROGRAM FROM PC command in screen FA3, the user is prompted for a filename in screen FA4. Upon entering that filename, the user is given the option, through navigating to screen FA5, to either rename the file or delete the file from a dropdown list. If he selects either option or simply accepts the entered filename in screen FA4,

suitable pop ups will confirm performance of the commanded option. The user then executes the DONE command to return the PDA to the screen FA4. Once the user selects a file name, the user executes the OK command, whereupon the user is prompted to send the file via screen FA6. Unless the user elects to cancel the file transfer to return to screen FA3, he or she selects the SEND option in screen FA6 to begin the file transfer process. The status of that transfer is displayed in screen FA7 of FIG. 4C. Unless the user chooses to cancel the transfer and return to the main file transfer screen FA3, the user is notified of file transfer completion in screen FA8, and returns to the main file transfer screen FA3 by selecting OK.

[0023] To transfer a file to the controller from the PDA, the user selects the SEND PROGRAM TO TROWEL command, where he or she is again prompted for a filename via screen FA9. The user then enters a filename and clicks OK to begin the file transfer process. The user is then prompted to power up the system in screen FA10 after a pop up display confirms the initiation of file transfer to the controller 85. Unless the user elects to cancel the file transfer to return to screen FA3, the status of the file transfer process is displayed in screen FA11. The user is notified of file transfer completion in screen FA12, and returns to the main file transfer screen FA3 by selecting OK. The user can return to the main menu screen FA1 at any time from screen FA3 simply by executing the CANCEL command.

[0024] Referring to FIGs. 3, 4A, 4D, and 4E, the user executes the HANDLING command when he or she wants to adjust the response characteristics of the steering system as desired. For instance, a machine operator may want to modify how the machine steers to enable customization for the prevailing concrete conditions, weather conditions and/or operator preference. For instance, if the concrete is setting faster than usual on an unusually windy or sunny day, the operator may want the machine to steer and move more quickly than usual.

[0025] Upon executing the HANDLING command, the user scrolls through display screens FA13 and FA14 of FIG. 4D, where he or she is advised of the effects of various adjustments on the machine's steering characteristics. Hence, screen FA13 advises the user that response times and maximum travel speeds are directly responsive to the commanded applied force; and screen FA14 advises the user that adjusting the minimum pulse width modulation (PWM) % setting adjusts the speed at which the actuator responds to input from the joystick and that adjusting the maximum PWM% setting adjusts the rate of acceleration to maximum travel speed.

[0026] Upon being advised of the effects of possible adjustments, the user executes the OK command to proceed to screen FA15, where the user adjusts actuator output force, minimum PWM %, and maximum PWM % for each actuator 84, 86, and 90 as desired. Selecting a given parameter will cause a drop down box FA15' to be displayed to advise the user of the default settings

for each parameter, the possible range of adjustment, and the available increments of adjustment. (It should be noted at this time that the possible range of adjustments is limited for those other than administrators in order to prevent a user from entering a setting that could lead to a response characteristic that could lead to loss of steering system control and/or an inability to steer the trowel. This limitation on unauthorized user adjustment is discussed in more detail below). Alternatively, the user can restore factory default settings simply by executing the RESTORE DEFAULTS command, in which case the execution of that command is confirmed by a pop up display FA16. If the user decides that no adjustment is required, he or she simply executes the CANCEL command to return to the main menu screen FA1. After the user either commands the system to restore defaults or adjusts the settings as desired and executes a NEXT command, a screen FA17 is displayed that prompts the user to save the new settings to the controller 85 or cancel. In either event, control returns to the main menu FA1.

[0027] The PDA 100 can also be used to assist the user in diagnosing faults. In this case, the machine 20 may have a number of fault indicating lights on the dashboard or another visually conspicuous location of the operator's platform. In the illustrated example, one green light and one red light (not shown) are mounted on the dashboard of the machine 20. If all monitored systems are working properly, the green light is constantly illuminated and the red light is off. In the present embodiment, the monitored components include the left and right joysticks 85L and 85R, the actuators 84, 86, and 90, the strain gauge load pins, a temperature gauge, and low battery indicator. If something goes wrong, the red light starts to flash, but only for so long as the problem exists. If the problem ceases, the red light stops flashing and a technician may be unaware that the problem ever existed. However, that history of such problems is stored in the controller 85 in the form of error codes, and those codes can be accessed through the PDA 100 to learn the fault history of the machine 20. Specifically, upon executing the DIAGNOSTIC command on the main menu screen FA1, the above described pop up reminder screen of FA2 is displayed before providing access to diagnostic screens FA18 and FA19 in FIG. 4A and screen FA20 in FIG. 4F. These screens display the error codes of the monitored components of the steering system, including the joystick, load pins, a device driver current, battery voltage, and the controller temperature. A three digit code is displayed for any component for which there has been an error. Upon viewing the errors, the operator can execute the OK command to store the displayed error history in the controller 85 and clear the display. Storage is confirmed by a pop up display FA21 in FIG. 4F.

[0028] These codes can be recorded and decoded, either with reference to a service manual or by executing the ERROR CODES command in the main menu screen

FA1. Executing that command permits the user to scroll through the screens FA22 and FA23 in FIG. 4G to match the recorded error to a corresponding three digit code, hence informing the user of the nature of the error.

[0029] Finally, upon executing the SUPPORT INFO command in the main menu screen FA1 in FIG. 4A, the user accesses screen FA24, which provides information concerning the software running the programs, including the software version. It may also provide the user with online support information, such as a URL and/or a telephone number.

[0030] As indicated above, some capabilities are restricted to trained technicians or others who have a superior knowledge of system constraints and/or need to modify those restraints more than the typical user. These personnel will hereafter be referred to as "administrators" for the sake of convenience. Referring again to FIG. 4A, an administrator accesses restricted capabilities by executing the ADVANCED function in screen FA1, whereupon the administrator will be required to enter a password in screen AA1. Upon successfully entering that password, the administrator will be directed to screen AA2, where the set response characteristics can be adjusted. These adjustments include the same force control, minimum PWM %, and maximum PWM % accessible by all users via screen FA15 in FIG. 4AE. However, a pop up screen (AA3 in FIG. 4G) reveals that the ranges through which an administrator may adjust these settings is considerably broader than by other users. In the case of actuator force, for instance, an administrator can set the maximum force output by all actuators 84, 86, and 90 to anywhere between 300 and 900 lbs. In contrast, other users can adjust maximum force setting of the forward/reverse actuators 84 and 90 in only a much narrower range of 400-600 lbs, and can set the maximum force applied by left/right actuator 86 within a range of only 400-600 lbs. The available ranges of minimum PWM % and maximum PWM % setting adjustment are similarly higher for administrators. The administrators also can adjust joystick tolerance and the maximum correction %, capabilities not available to other users. The administrator can save these settings by executing the SAVE command in screen AA2, whereupon a pop up display AA4 advises him that the settings have been saved. Alternatively, the administrator may also restore defaults by executing the RESTORE DEFAULTS command, whereupon a pop up display (AA5 in FIG. 4G) advises the operators that the defaults have been reset.

[0031] The administrator can then either choose to return to the main menu screen FA1 by executing the DONE command in screen AA2, or can calibrate the machine by executing the CALIBRATION command, whereupon the administrator is directed to screens AA6 and AA7 in FIG. 4AF, which provide instructions for calibrating the joysticks. The administrator then initiates calibration by executing the BEGIN command in screen AA7. The administrator is advised of the initiation and

completion of the calibration process by pop up displays AA8 and AA9. The administrator can then return to the main menu screen by executing the CANCEL command.

[0032] Finally, any user can return to the main PDA menu upon executing the EXIT command in FIG. 4A, whereupon a pop up display FA25 will advise the user that the display is returning to the main menu.

[0033] Although the best mode contemplated by the inventors of carrying out the present invention is disclosed above, practice of the present invention is not limited thereto. It will be manifest that various additions, modifications and rearrangements of the features of the present invention may be made without deviating from the spirit and scope of the underlying inventive concept. The scope of still other changes to the described embodiments that fall within the present invention but that are not specifically discussed above will become apparent from the appended claims and other attachments.

Claims

1. A powered rotary trowel comprising:

- A. at least one rotor assembly, and
- B. a power steering system including

1. an actuator that is configured to tilt at least a portion of the rotor assembly to steer the trowel;
2. a control system that is configured to supply power to the actuator, the control system including

- a. a manually manipulated steering command signal generator,
- b. an electronic controller, and
- c. an electronic user interface that is configured to permit a user to communicate with the electronic controller to perform at least one of calibration, setting, monitoring, and diagnostic functions on the steering system with the assistance of information displayed by the electronic user interface.

2. The trowel of claim 1, wherein the trowel is one of a walk behind trowel and a riding trowel.

3. The trowel of claim 1, wherein the trowel is a riding trowel having a frame, an operator's platform supported on the frame, and first and second rotor assemblies supporting the frame on the ground and each including a gearbox and an actuator that is energizable to tilt the gearbox, one of the gearboxes being tiltable fore and aft side to side to steer the trowel left and right and forward and reverse, re-

spectively, and the other gearbox being tiltable side to side to steer the trowel fore and aft.

4. The trowel of claim 1, wherein the steering command signal generator comprises at least one of a joystick, a lever, and a switch. 5
5. The trowel of claim 4, wherein the steering command signal generator includes first and second joysticks electronically coupled to the first and second actuators. 10
6. The trowel of claim 5, wherein the first joystick is a dual axis joystick and the second joystick is a single axis joystick. 15
7. The trowel of claim 3, further comprises a port located on or in the vicinity of the operator's platform via which the electronic interface can be electronically connected to the controller. 20
8. The trowel of claim 1, wherein the actuator is an electronically powered actuator.
9. The trowel of claim 1, wherein the user interface is a personal data assistant having a visual display. 25
10. The trowel of claim 1, wherein the electronic interface is configured to transmit signals from a computer to the electronic controller. 30
11. The trowel of claim 10, wherein the electronic interface is adapted to receive programs from the computer and to transmit the programs to the electronic controller. 35
12. A powered rotary trowel comprising:
 - A. at least one rotor assembly; and
 - B. a power steering system including 40
 1. an actuator that is configured to tilt at least a portion of the rotor assembly to steer the trowel;
 2. a control system that is configured to supply power to the actuator, the control system including 45
 - a. a manually manipulated steering command signal generator, 50
 - b. an electronic controller, and
 - c. electronic interface means for permitting a user to communicate with the electronic controller to perform at least one of calibration, setting, monitoring, and diagnostic functions on the steering system with the assistance of information displayed by the electronic in- 55

terface means.

13. The trowel as recited in claim 12, wherein the electronic interface means is a personal data assistant.
14. An electronic user interface which is configured to permit a user to communicate with an electronic controller for a gearbox of a rotary trowel steering system to perform at least one of calibration, setting, monitoring, and diagnostic functions on the steering system with the assistance of information displayed by the electronic user interface.
15. The electronic user interface of claim 14, wherein the electronic user interface is a personal data assistant.
16. The electronic user interface of claim 15, wherein the electronic user interface is adapted to be manipulated to transfer programs from a computer to the electronic controller.
17. A method comprising transmitting information between an electronic user interface to an electronic controller to calibrate, set, monitor, and/or diagnose one or more characteristics of a power steering system of a rotary trowel using information displayed by the electronic user interface to assist the user in information transfer.
18. The method of claim 17, further comprising manipulating a steering command signal generator to generate an electronic signal, an actuator being responsive to the electronic signal to steer the trowel.
19. The method of claim 18, wherein the transmitting step comprises transmitting signals to the electronic controller to adjust a response characteristic of the actuator to a steering command signal.
20. The method of claim 19, wherein the response characteristics include at least one of the maximum actuator power output, the minimum rate of change of the actuator output motion, and the maximum rate of change of the actuator output motion.
21. The method of claim 18, wherein the transmitting step comprises transmitting calibration commands to the electronic controller from the electronic user interface.
22. The method of claim 21, wherein the calibration commands calibrate a steering command signal generator.
23. The method of claim 18, wherein the transmitting step comprises transmitting diagnostic information from the controller to the electronic user interface.

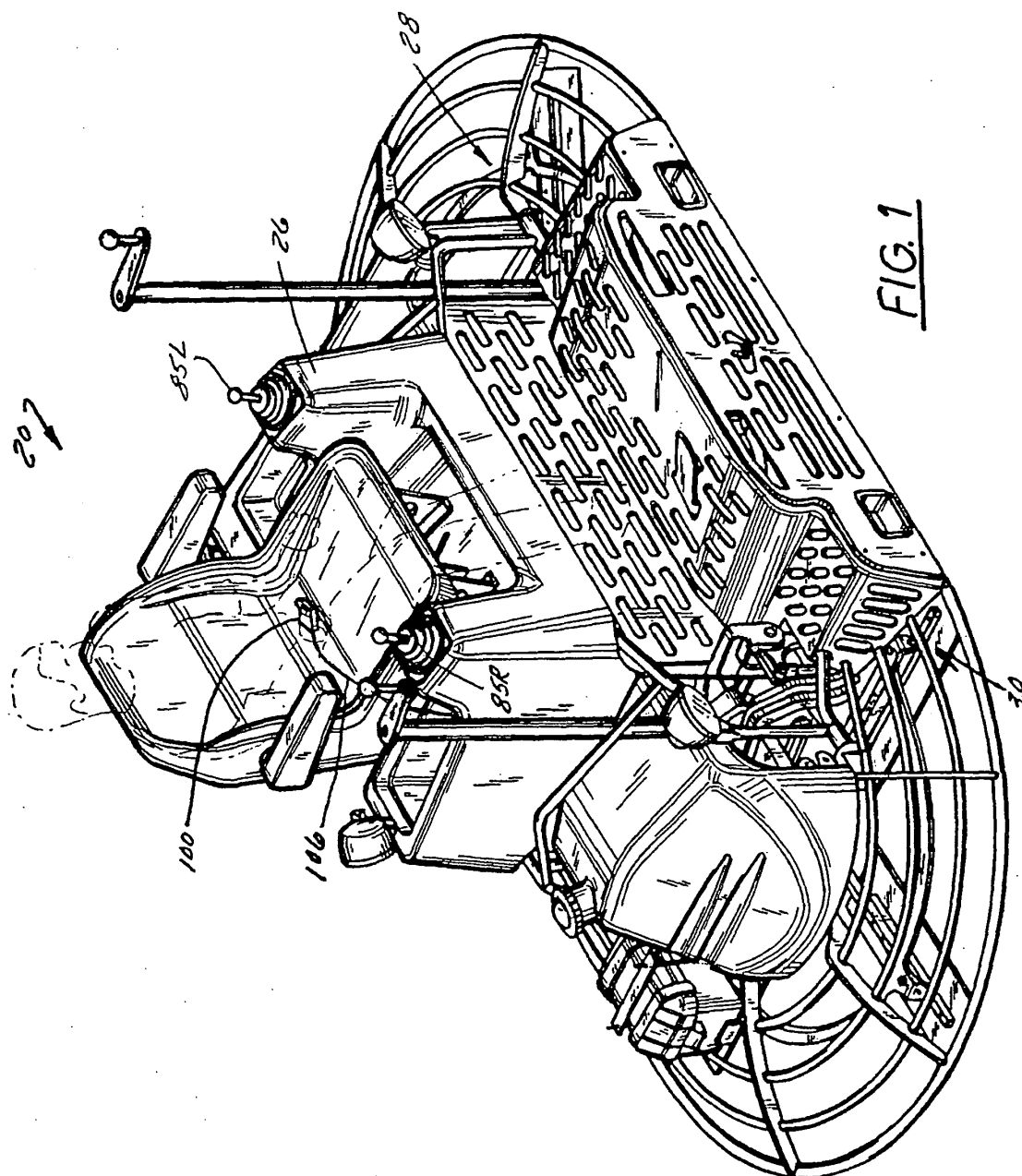
24. The method of claim 23, wherein the diagnostic information comprises information concerning a past but no longer presenting fault condition of an operative component of the steering system. 5
25. The method of claim 17, further comprising permitting a first class of users to perform only a first set of interface functions with the electronic controller and permitting a second class of users to perform both the first and a second set of interface functions with the electronic controller. 10
26. The trowel of claim 17, wherein the trowel is a riding trowel having a frame, an operator's platform supported on the frame, and first and second rotor assemblies supporting the frame on the ground and each including a gearbox and an actuator, and further comprising energizing the actuators in response to manipulation of the steering command generator to tilt the gearbox assemblies to steer the trowel. 15 20
27. The method of claim 17, further comprising downloading a program into the electronic user interface from a computer and manipulating the electronic user interface to install the program in the electronic controller. 25
28. The method of claim 27, further comprising downloading the program into the computer prior to downloading the program into the electronic user interface. 30
29. The method of claim 28, wherein the step of downloading the program into the computer comprises transmitting the program via the Internet. 35

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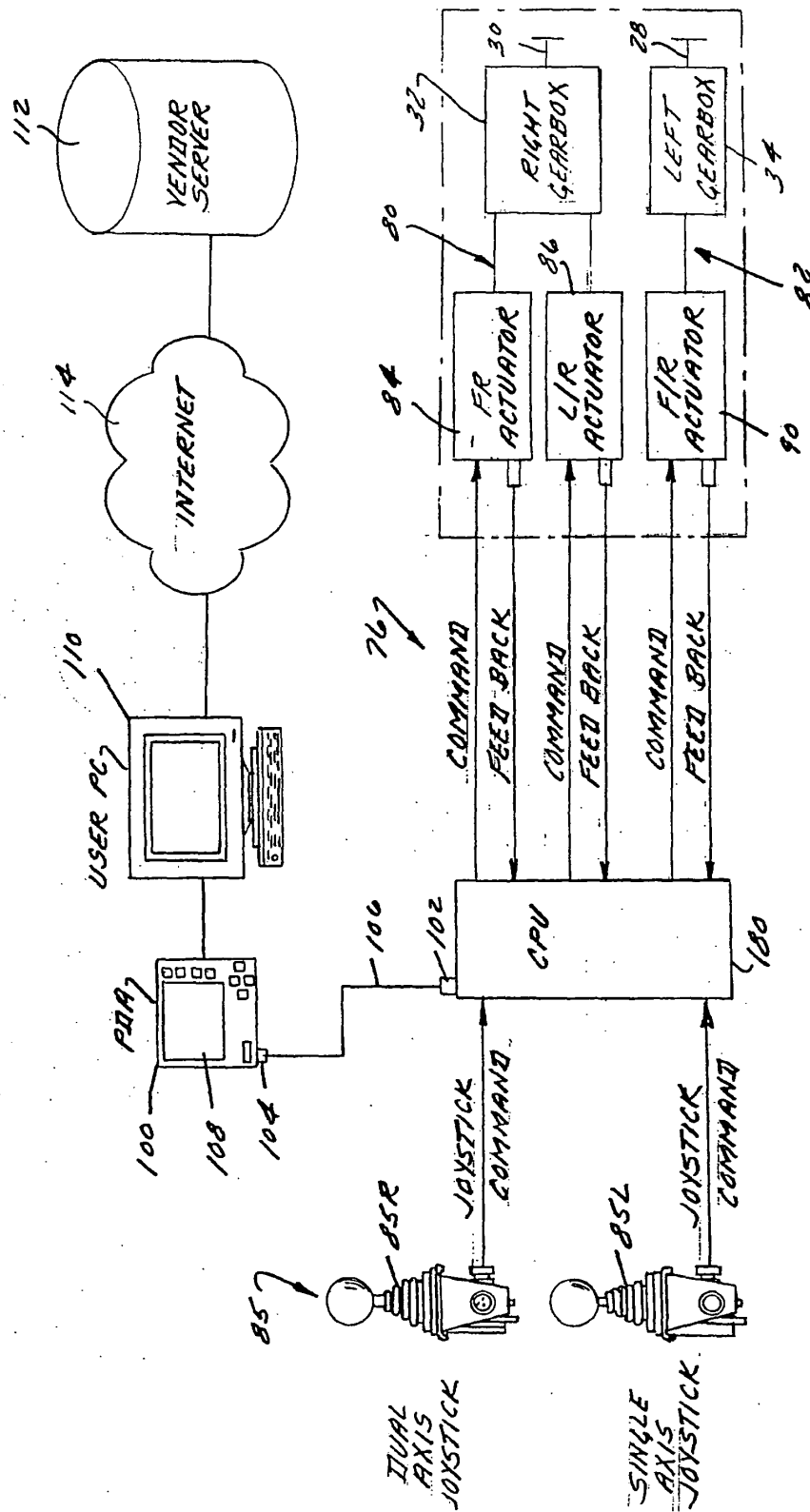
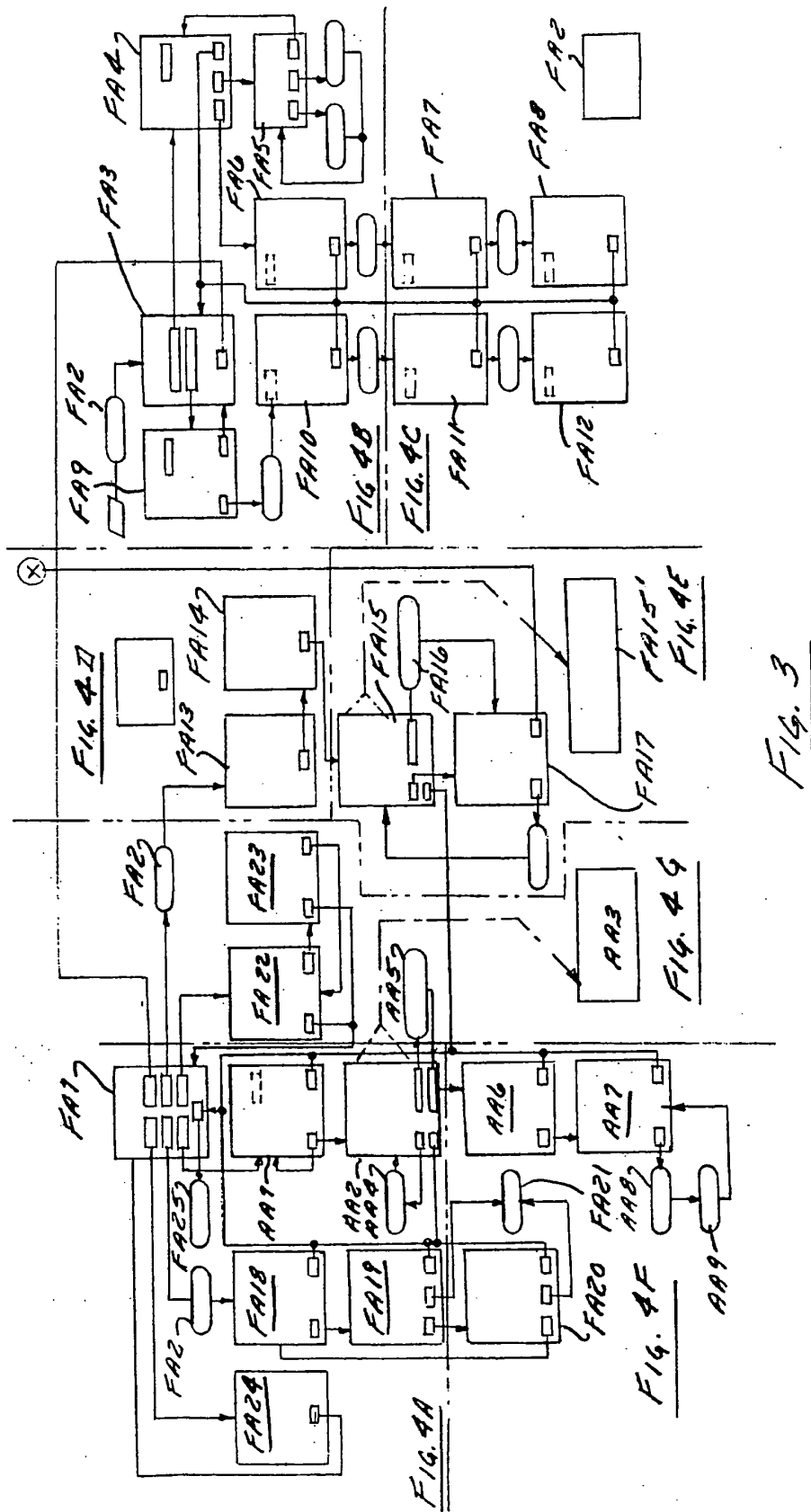


FIG. 2



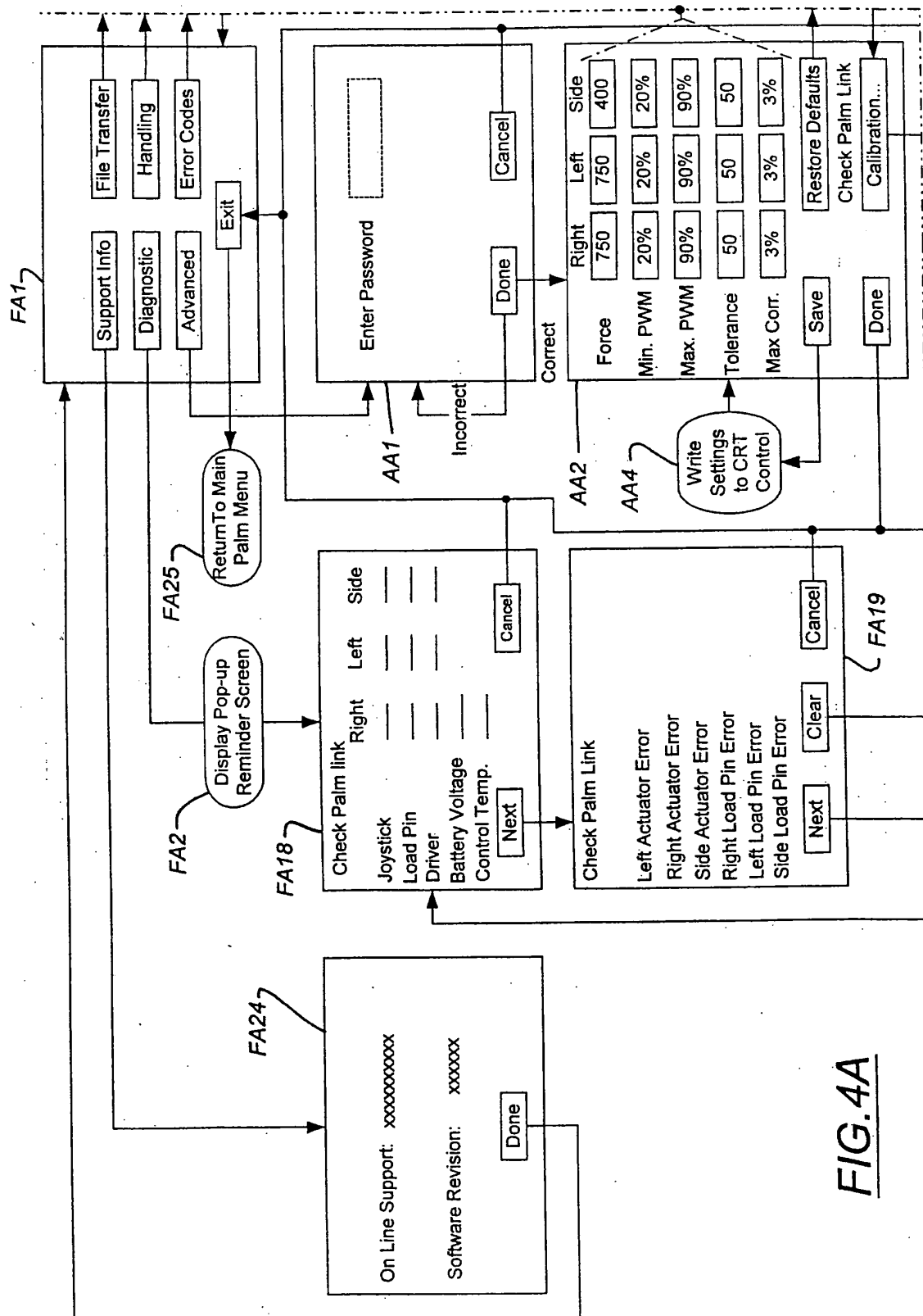


FIG. 4A

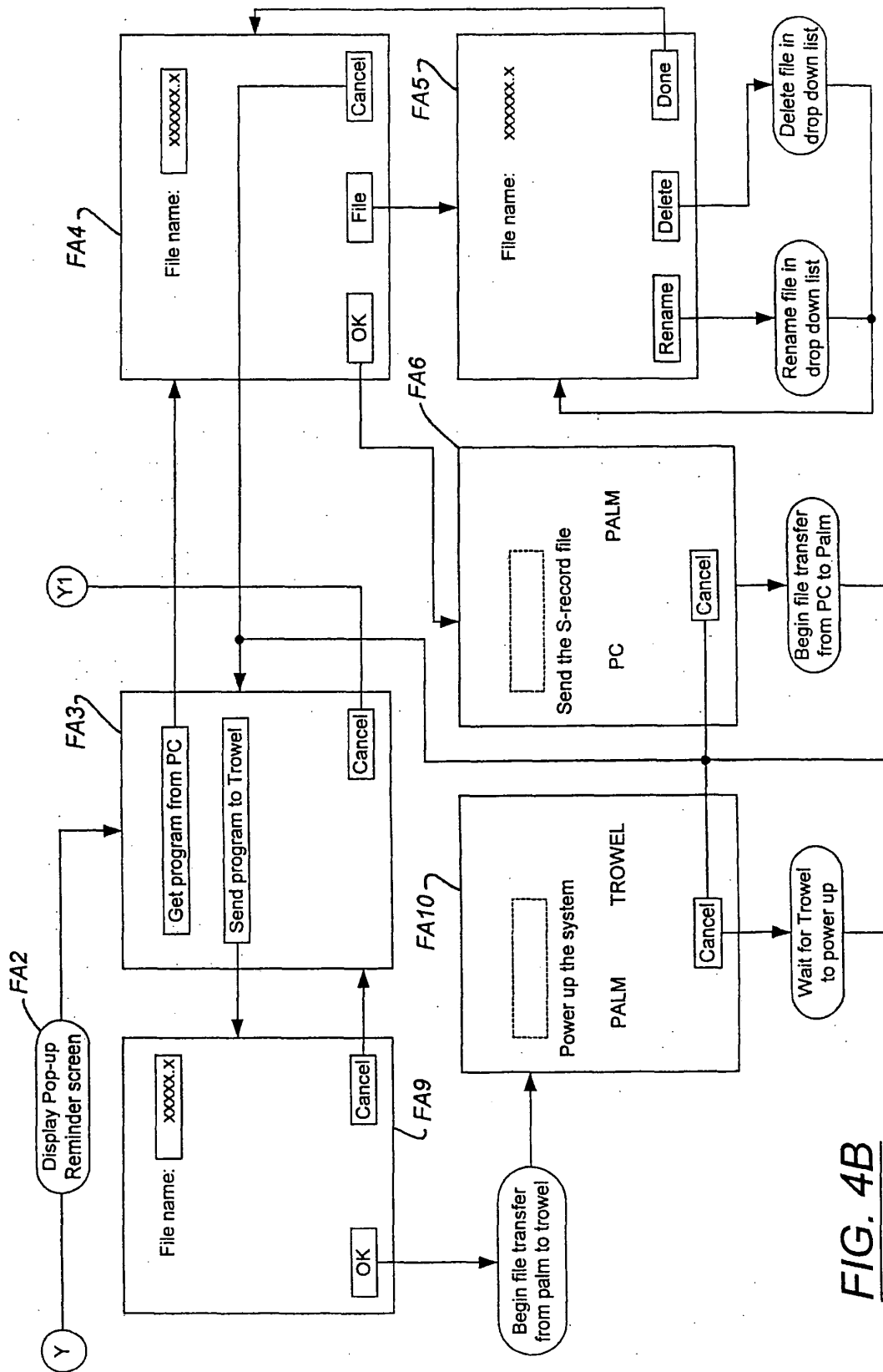


FIG. 4B

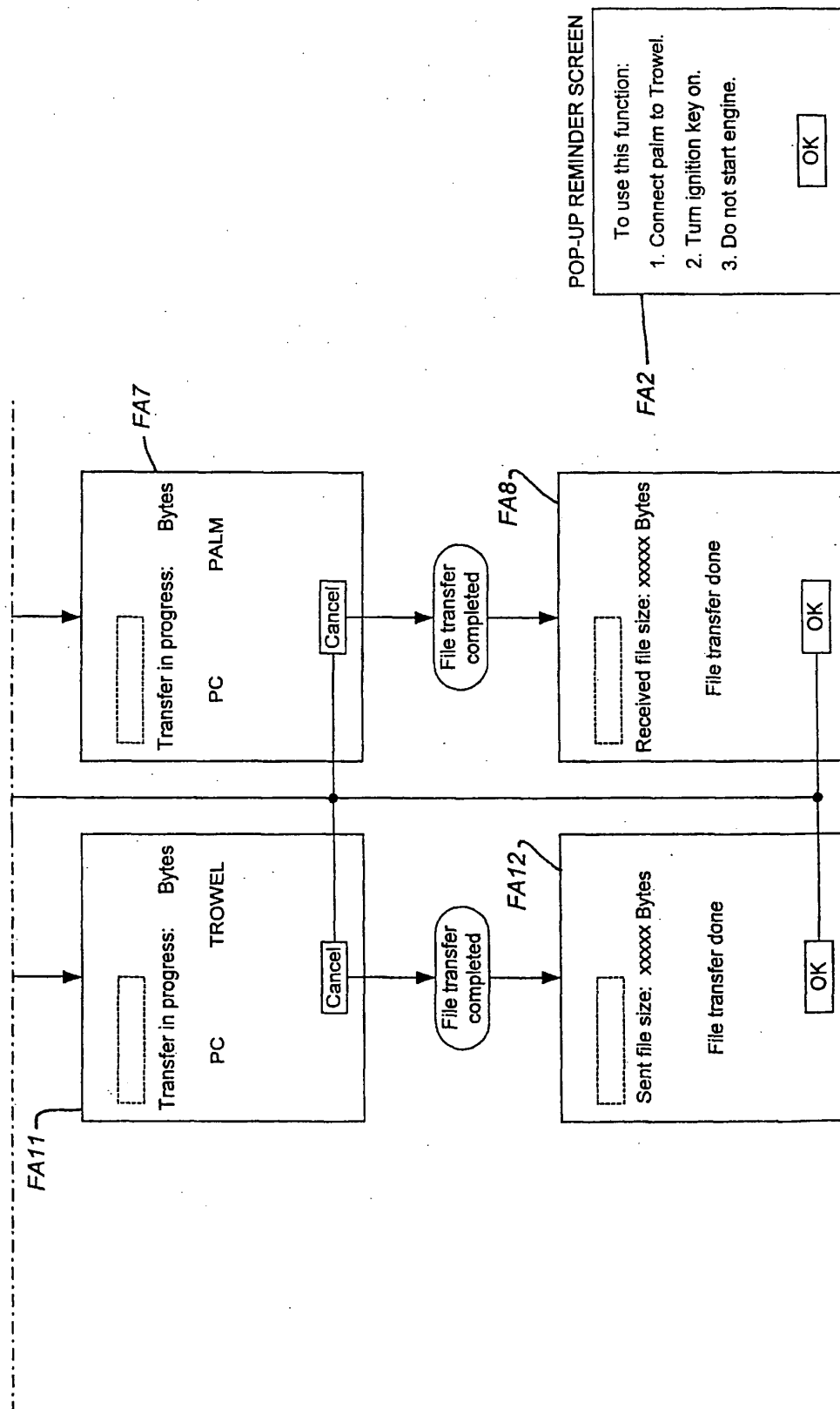


FIG. 4C

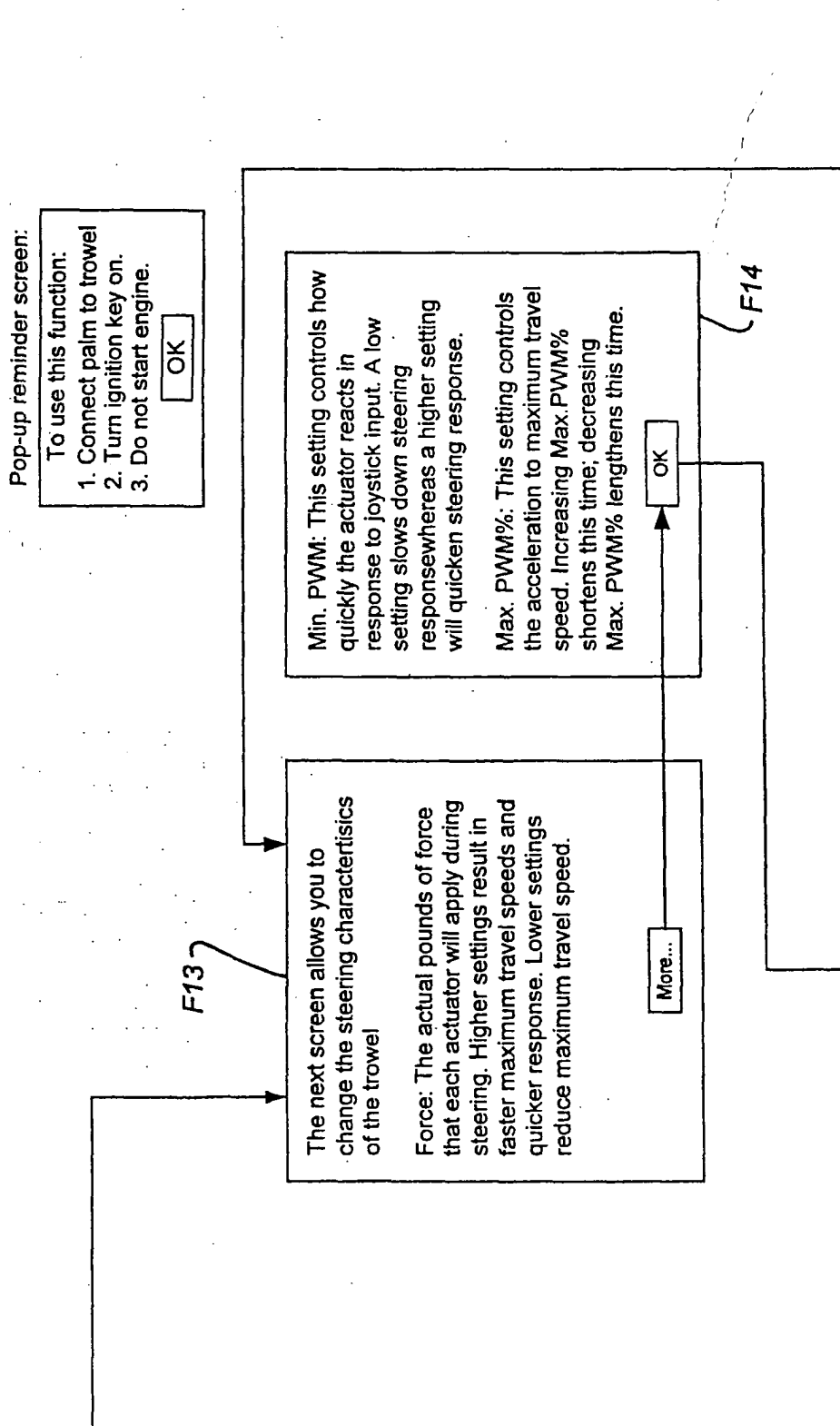


FIG. 4D

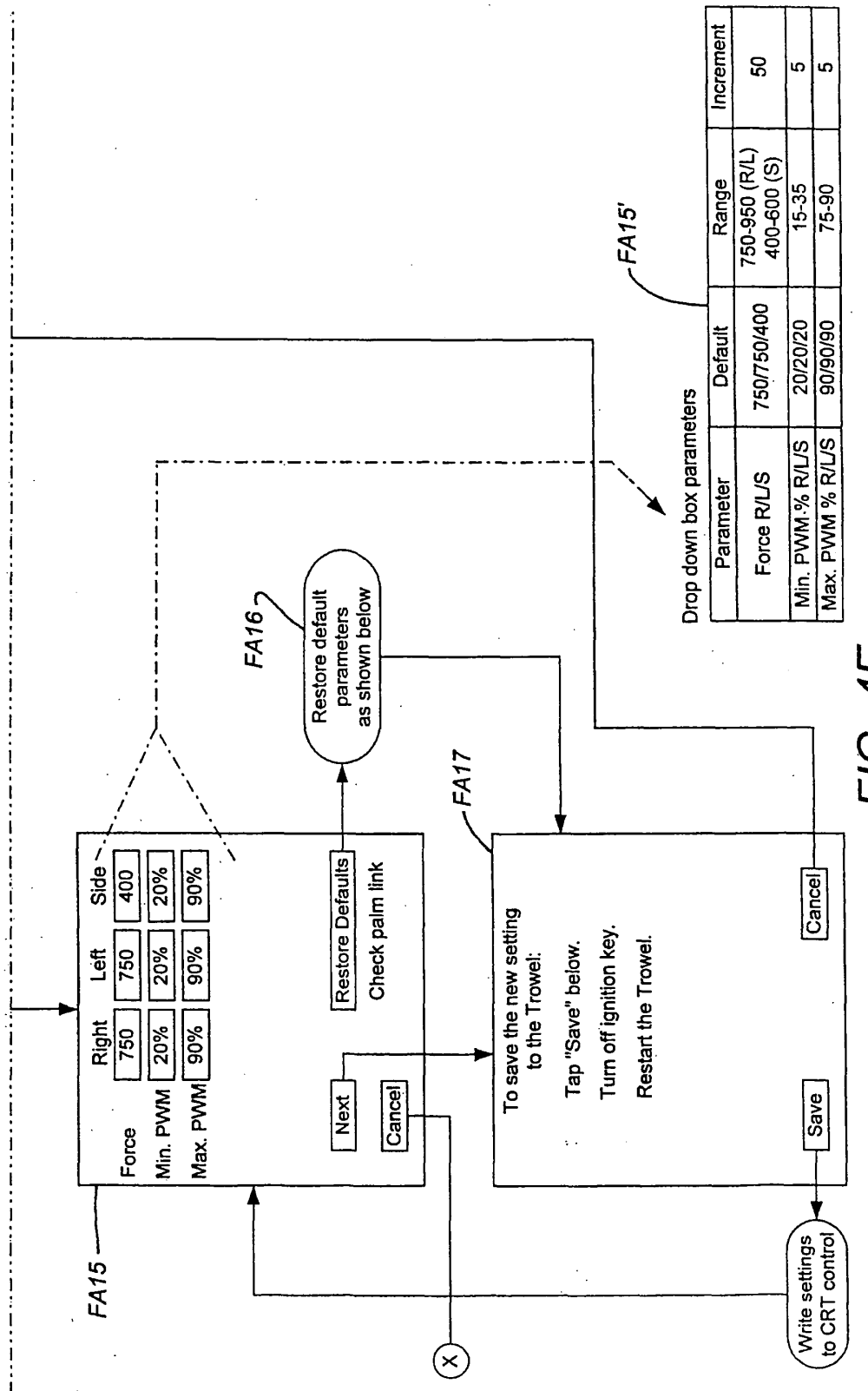


FIG. 4E

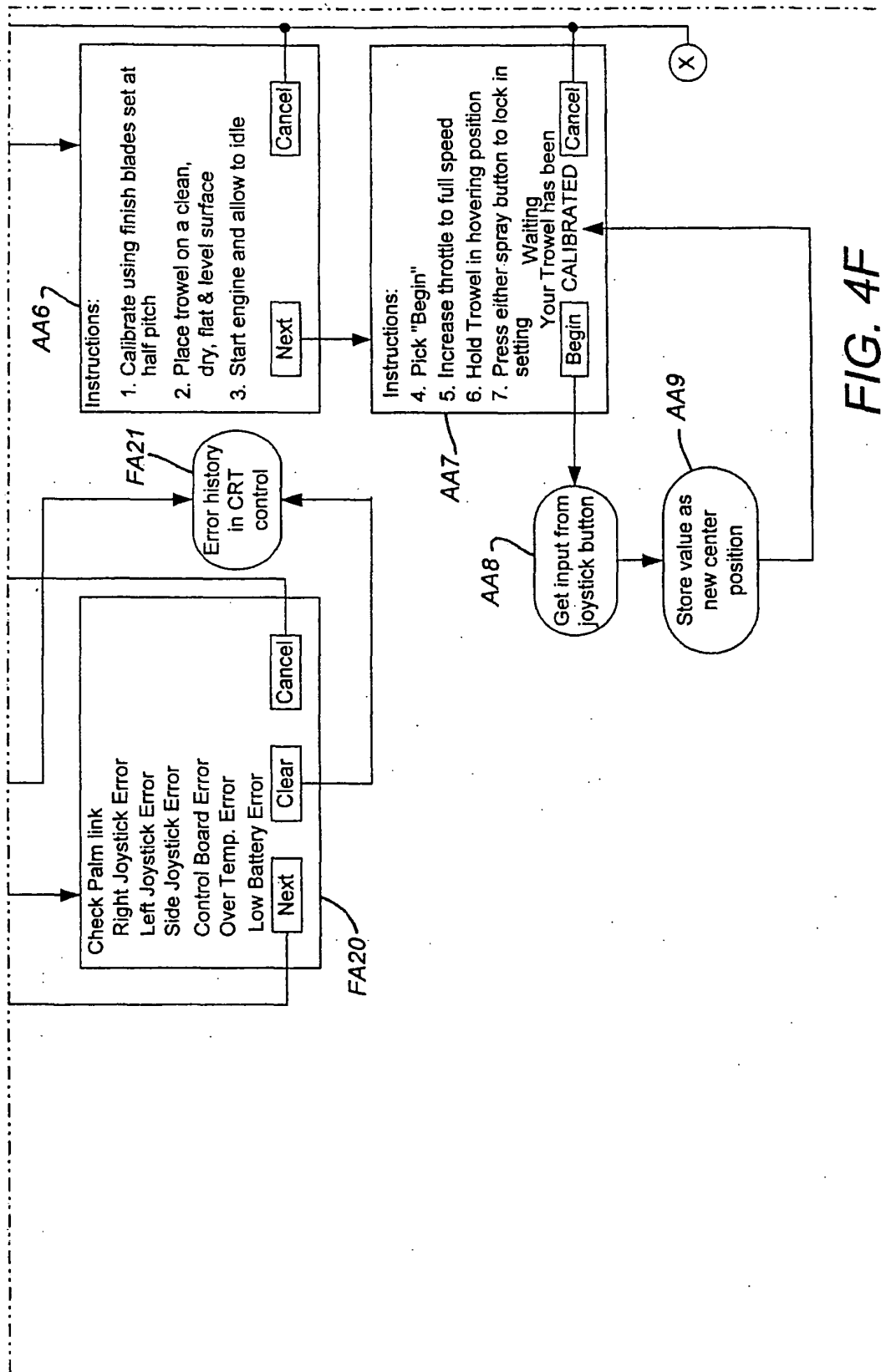


FIG. 4F

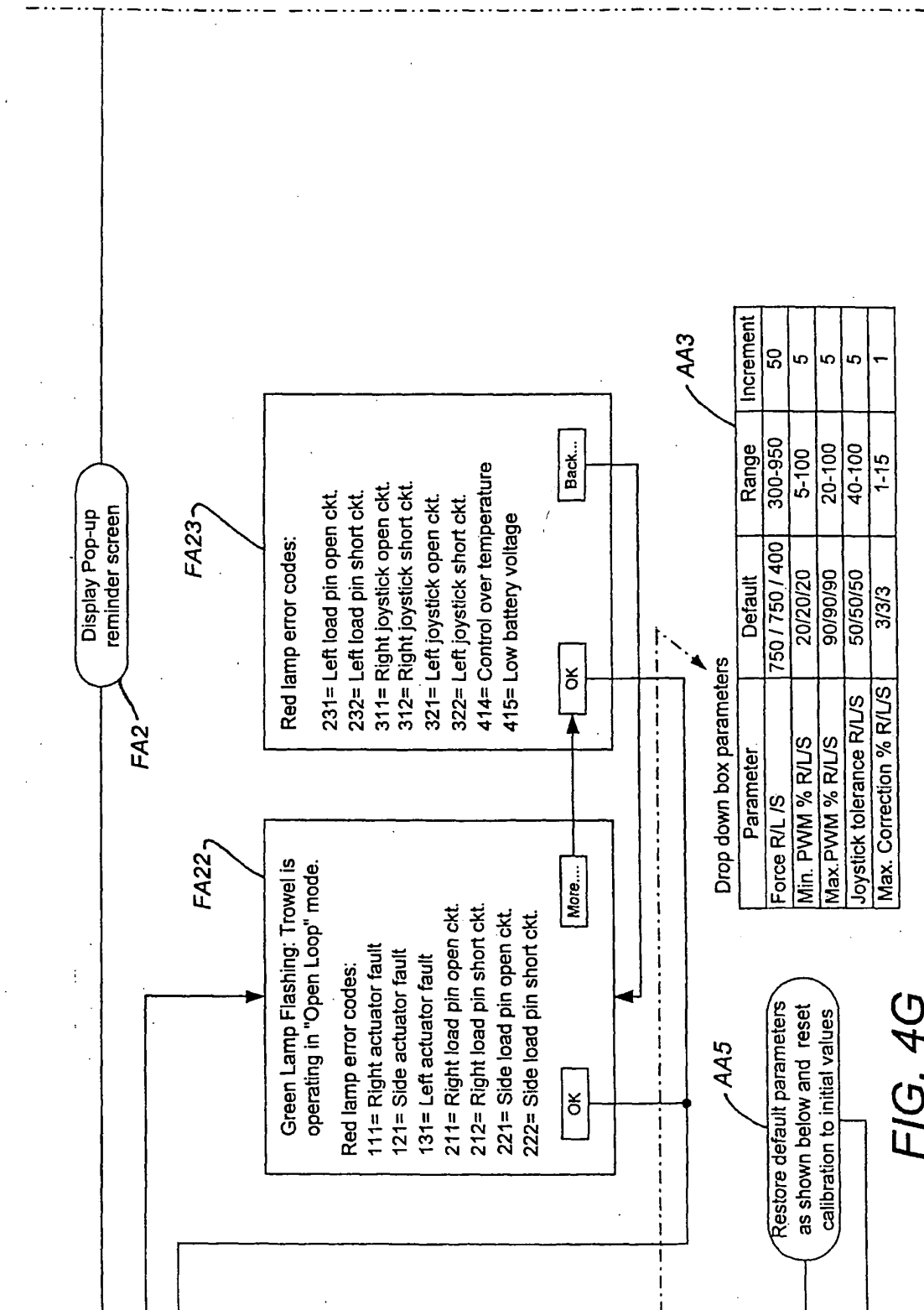


FIG. 4G