

[54] SWITCH CONTROL MEANS

[76] Inventor: **Charles D. Nightengale**, Rural Route 3, Box 70, Scott City, Kans. 67871

[22] Filed: **Jan. 7, 1972**

[21] Appl. No.: **216,134**

[52] U.S. Cl. **200/4, 200/6 A, 317/137**

[51] Int. Cl. **H01h 3/02**

[58] Field of Search **200/4, 6 A; 317/137, 317/157, 155.5; 307/115**

[56] References Cited

UNITED STATES PATENTS

3,293,381	12/1966	Eitel	200/6 A
2,621,241	12/1952	Jensen	317/137 X
3,623,583	11/1971	Schimanckas	317/155.5
2,453,035	11/1948	Ponsy	200/6 A

Primary Examiner—J. D. Miller

Assistant Examiner—Harry E. Moose, Jr.

Attorney—Hyman Berman et al.

[57]

ABSTRACT

A new and improved switch controller is described which permits any one of a predetermined number of switch controlled devices to be actuated in any one of a predetermined number of states. In the embodiment described, a rotary switch having a predetermined number of positions is interconnected with a plurality of push-button switches, so that for any position of the rotary switch one of four push-button switches may be selectively actuated. Each push-button switch can actuate the winding of a relay which in turn closes its associated contacts to provide current to the solenoid of a solenoid activated device. Thus, the rotary switch selects the apparatus to be actuated, while the selected push-button switch determines which solenoid winding associated with the selected apparatus will be energized with current. Described in conjunction with the aforesaid switch control device is a particular solenoid actuated device, comprising a unit for operating hydraulic valve box plungers.

11 Claims, 10 Drawing Figures

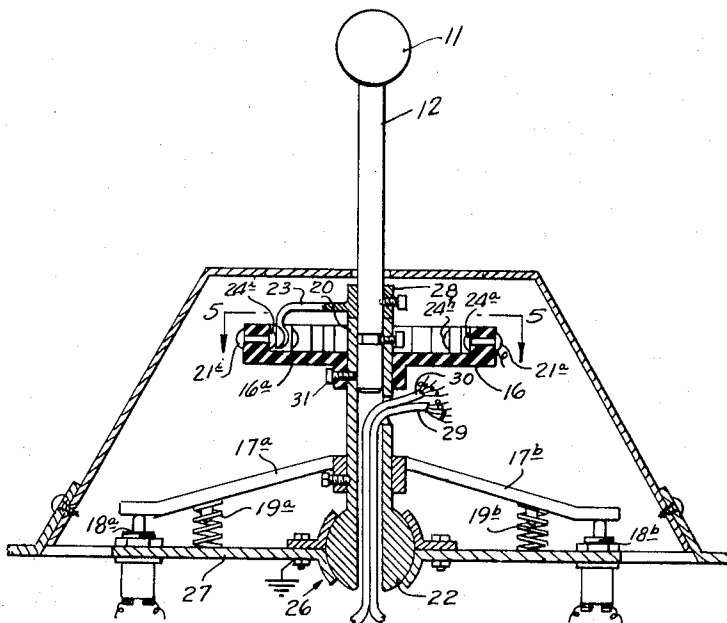


FIG. 1.

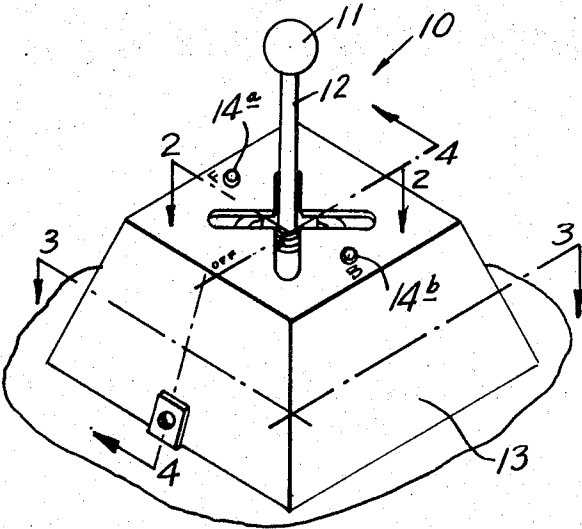


FIG. 2.

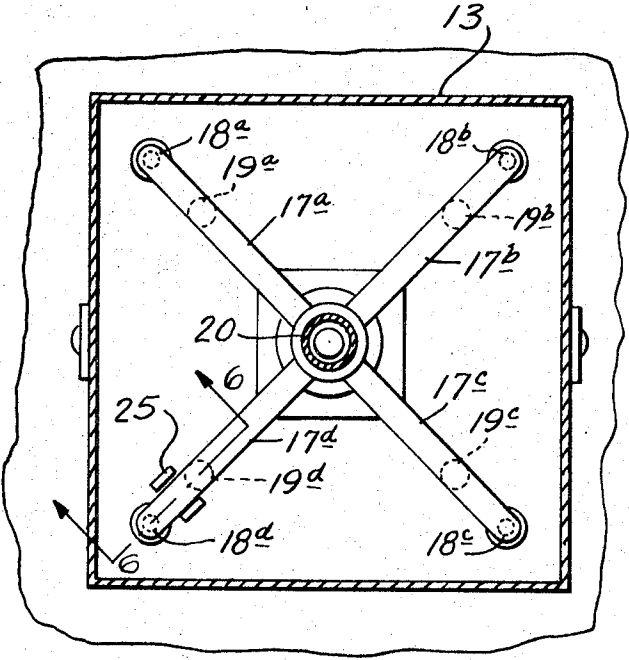
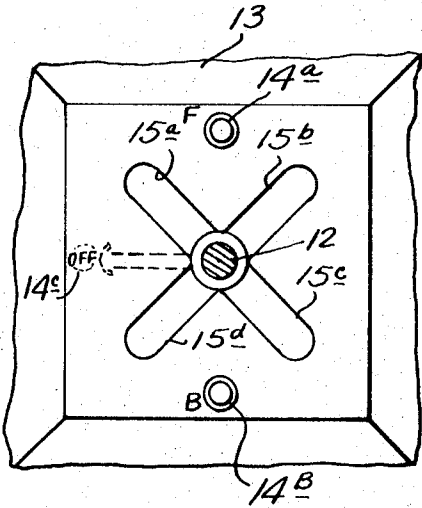


FIG. 3.

FIG. 4.

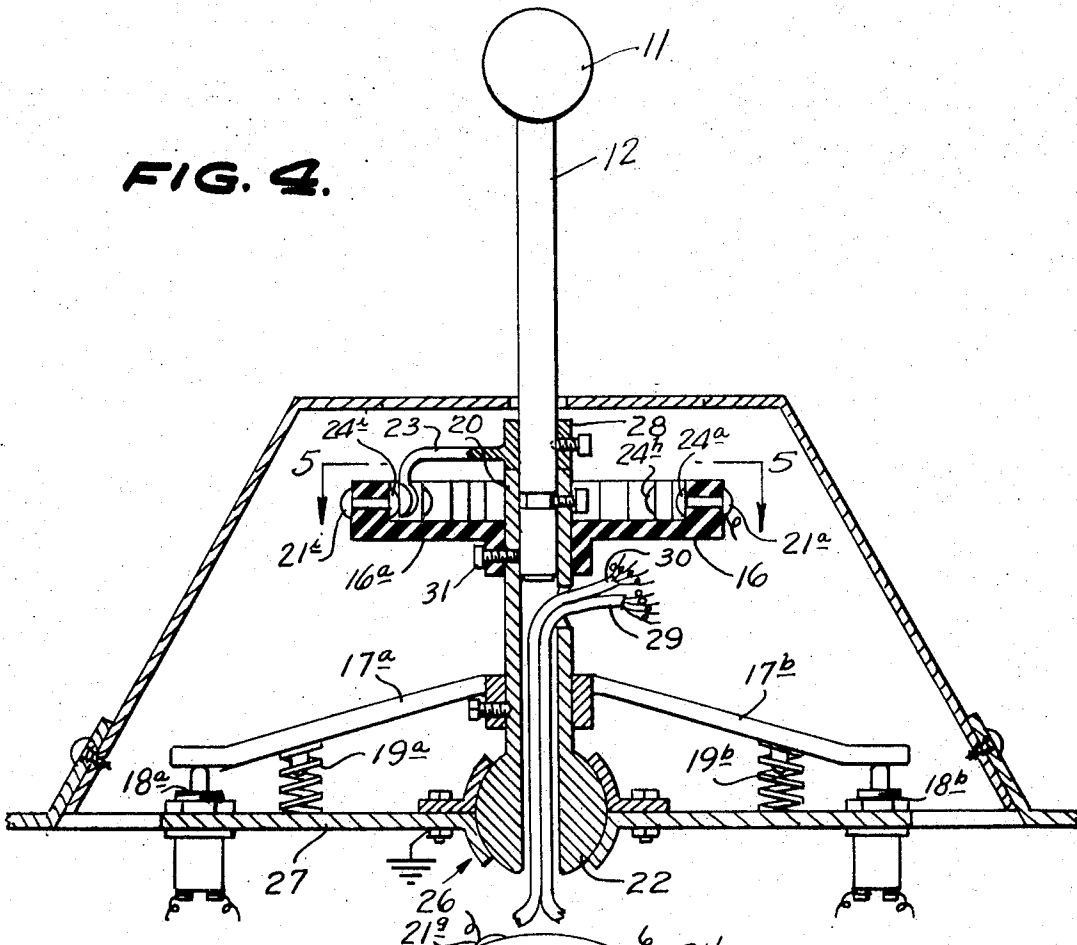


FIG. 5.

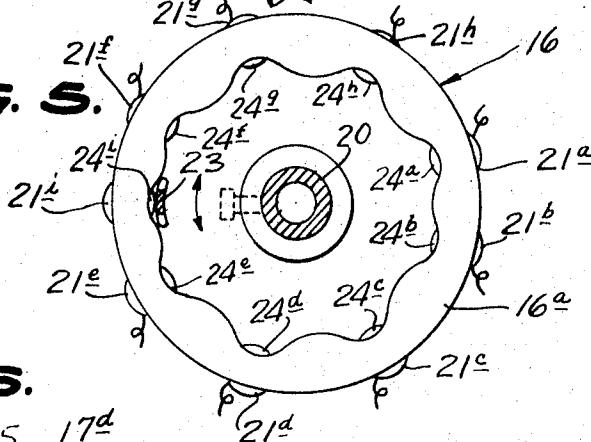
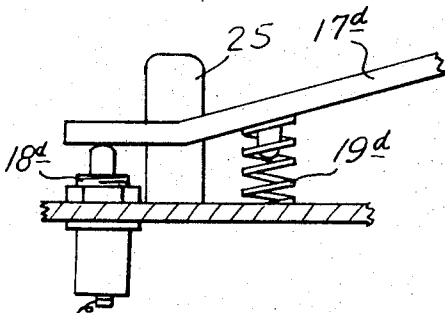


FIG. 6.



25/6/72

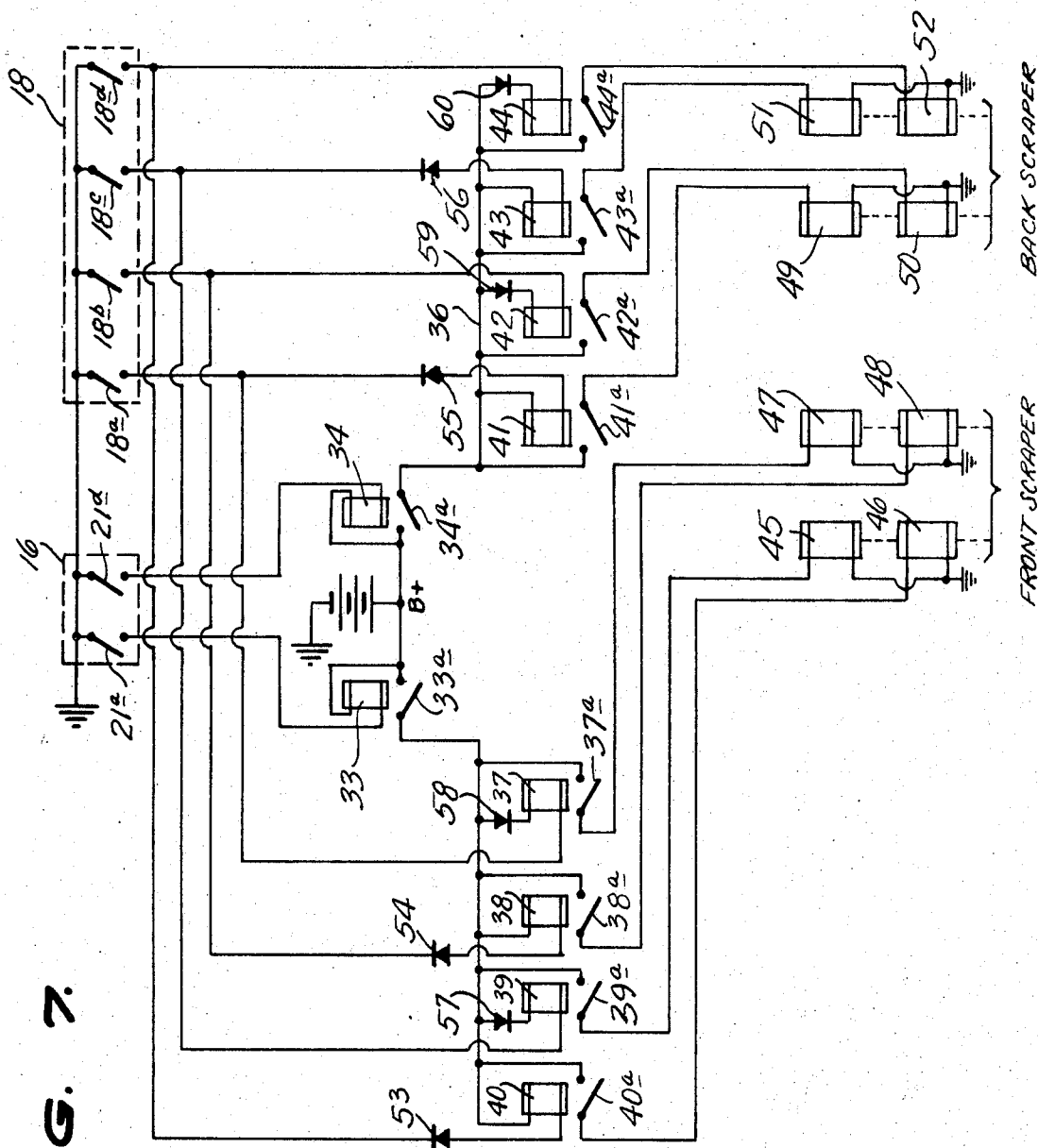


FIG. 8.

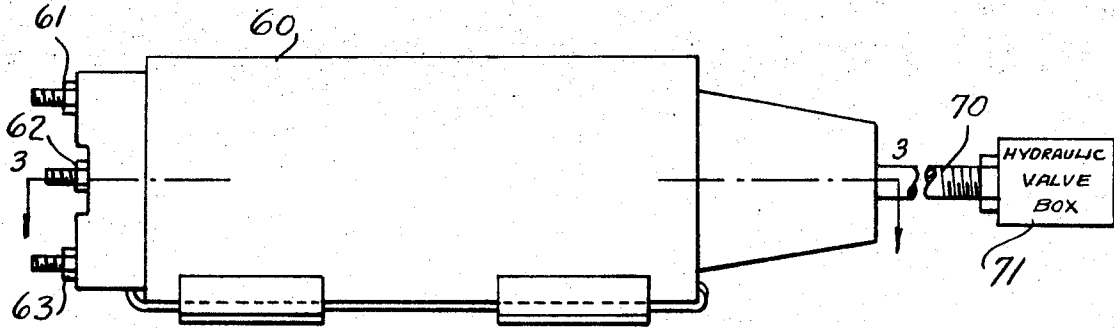


FIG. 9.

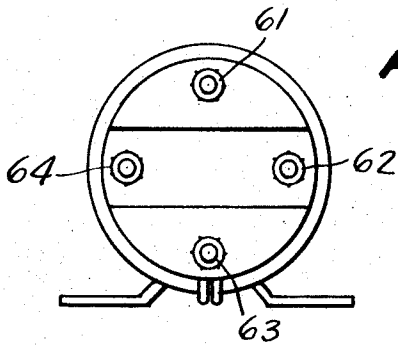
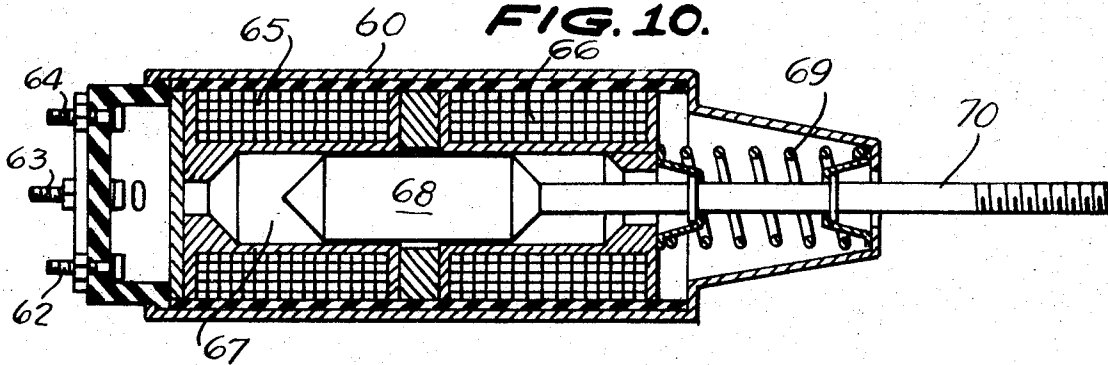


FIG. 10.



SWITCH CONTROL MEANS

This invention relates to a switch control unit, and in particular to a switch control unit employing in combination, a rotary selector switch and a plurality of selectively actuated push-button switches. This arrangement provides great flexibility and adaptability in selectively controlling a number of operating modes of a single machine, or in selectively controlling the operation of a number of separate apparatuses.

In many situations it is highly desirable to utilize a control unit which can be readily manipulated by a single hand of the operator and at the same time provide all the control functions which a plurality of separately actuatable switches would provide. A need for this type of control unit has been particularly felt where heavy machinery is involved and one hand of the operator is continually engaged in driving the apparatus, leaving only one hand free for performing the manipulative steps required to effect the control function. An example of such machinery, is the heavy earth moving rig, commonly used in large scale farming operations. Not only must the operator drive this heavy piece of equipment, but he must also be able to selectively actuate the component parts of the earth mover, commonly known as the scrapers. In one known form of earth moving rig, three separate scrapers are utilized, although in larger varieties of this machine many more scrapers may be employed. Since each scraper requires two separate hydraulic valve banks for its operation, each of which is controlled by two separate windings, it can be seen that in order to select the particular scraper to be actuated and then select the valve bank and coil of the scraper, a great many separate switches would be required. Similar problems are encountered in other types of heavy machinery or in any other area where complex switching control functions are required.

Accordingly, it is an object of this invention to provide a new and improved switching control unit which can be easily manipulated by the user to effect a plurality of switching functions.

Another object of this invention is to provide a switching control unit which is compact and capable of performing complex switching functions without requiring a plurality of separate switches.

Still another object of the present invention is to provide a switching control unit particularly adapted for use in heavy machinery such as earth moving equipment.

An additional object of this invention is to provide a new and improved switch control unit which can be readily adapted for use in conjunction with hydraulic valve box actuators.

These and other objects and features of the present invention will be more readily appreciated from a consideration of the following specification, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of the switch control unit of the present invention;

FIG. 2 is a partially broken away top view of the switch control unit of the present invention as viewed in the direction of the arrows 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the lines 3—3 in FIG. 1 as viewed in the direction of the arrows thereon;

FIG. 4 is a sectional view taken on the lines 4—4 in FIG. 1 as viewed in the direction of the arrows thereon;

FIG. 5 is a view of the rotary switch of the present invention as viewed in the direction of arrows 5—5 in FIG. 4;

FIG. 6 is a broken away detail taken on the line 6—6 in FIG. 3 as viewed in the direction of the arrows thereon;

FIG. 7 is a wiring diagram for a typical application of the switch control unit of the present invention;

FIG. 8 is a plan view of an hydraulic valve box actuator used in connection with the wiring diagram in FIG. 7;

FIG. 9 is an end view as viewed from the left of FIG. 8; and

FIG. 10 is a cross-sectional view of the hydraulic valve box actuator taken along lines 3—3 in FIG. 8, as viewed in the direction of the arrows thereon.

Referring now to FIGS. 1, 2, 3 and 4, there is shown the preferred embodiment of the switch control unit 10 of the present invention. As shown best in FIGS. 1 and 4, a "joy stick" control comprises knob 11 and shaft 12, which is free to rotate within hollow stem 20. Hollow stem 20 is fixedly secured to ball 22 of ball and socket joint 26. Secured to shaft 12 for rotation therewith is contact arm 23 for contacting one of a plurality of switch positions 24a through h of rotary switch 16 disposed within outer casing 13. Shaft 12 is constrained from moving upward or downward with respect to hollow stem 20 by collar arrangement 28.

As shown in FIG. 2, the upper surface of casing 13 is provided with display means, 14a, 14b and 14c for indicating the position of contact arm 23 on rotary switch 16. While only three positions are indicated in the particular embodiment described, it should be realized that any number of positions could be so indicated. In the embodiment described, position 14a indicates that contact arm 23 is in contact with the position of rotary switch 16 for activating the front scraper of associated earth moving equipment, 14b similarly indicates energization of the back scraper and 14c indicates the neutral or off position. Indicating means 14a, b and c may comprise signal lamps or other conventional means for providing a visual indication of the position of contact arm 23. If electrical indicating means are utilized, it should be realized that an electrical interconnection between indicating means 14a, b and c would be provided with the corresponding contact positions on rotary switch 16, which will be more fully described hereinbelow.

Also provided in the cover portion of casing 13 are orthogonally disposed slots 15a, 15b, 15c and 15d which constrain the movement of the joy stick assembly in conjunction with ball and socket joint 26, in one of four directions, corresponding to the location of four push-button switches mounted at the corners of bottom plate 27 of casing 13.

As shown best in FIGS. 3 and 4, push-button switches 18a, 18b, 18c and 18d are mounted at the four corners of bottom plate 27 of casing 13. Mounted on hollow stem 20 and disposed over and in operating relationship to each of the aforesaid push-button switches 18a, 18b, 18c and 18d are corresponding contact arms 17a, 17b, 17c and 17d. Thus, when the joy stick assembly is pivoted in ball and socket joint 26, through manipulation of knob 11 into one of the slots 15a, 15b, 15c or 15d, the contact arm 17 in alignment with the corresponding slot 15 will be forced against its

associated push-button switch 18, closing the switch. Spring-loaded constraining members 19a, 19b, 19c and 19d are attached to corresponding contact arms 17a, b, c and d to retain the contact arms in a neutral position when the joy stick assembly is out of engagement with any of the slots 15a, b, c or d. As shown in FIG. 3, up-standing flanges 25 are provided on either side of contact arm 17d to prevent the contact arm assembly from rotating out of its aligned position with push-button switches 18a, b, c and d. This relationship, among the contact arm 17d, push-button switch 18d, spring-loaded keeper 19d and flange 25 is shown in detail in FIG. 6.

Rotary switch 16 comprises an insulating base 16a having disposed thereon a plurality of contact points 24a through 24i for engagement with contact arm 23. Electrically connected to each of contact points 24a to 24i are electrical terminals 21a through 21i which are utilized to complete the electrical connections to the associated circuitry. As shown in FIG. 4, electrical terminal 21i is unconnected, corresponding to the neutral or off position 14c in FIG. 2 while the terminal 21a, as well as one other terminal (not shown) is electrically connected to the circuitry, as will more fully be explained hereinbelow. Insulating base plate 16a of rotary switch 16 is attached to hollow stem 20 by conventional means such as set screw 31.

FIG. 5 shows in detail the above-described relationship between contact points 24a through i and terminals 21a through i. While eight terminals and one neutral or off position are shown, as explained above, in the particular embodiment described, only two contact points and terminals and the off or neutral position are utilized. As shown in FIG. 4, metallic base plate 27 of casing 13 is electrically grounded. Since contact arm 23 is in electrical contact with the base plate through stem 20 and ball and socket joint 26, it too will be at ground potential. Of course, some other means might also be used to ground contact arm 23. Thus, when shaft 12 is rotated within hollow stem 20, contact arm 23 will be rotated along with it due to the connection between these two parts and ground will be successively applied to each of contact points 24 and electrical terminals 21. As will be more fully explained below, in connection with the electrical wiring diagram of FIG. 7, the application of ground to electrical terminals 21 serves to select either the front or back scraper, in the particular example chosen, while the application of ground through the closure of one of the push-button switches 18a, 18b, 18c or 18d serves to apply current to one of the four solenoid windings associated with each scraper. As shown in FIG. 4, electrical conductors 29 and 30 are provided for completing the circuit between electrical terminals 21 and the associated circuitry shown in FIG. 7. In the interest of clarity, conductors 29 and 30 are shown as unconnected in FIG. 4, but eight separate leads are illustrated. As stated above, only two of these leads, in the particular embodiment described, are actually connected. Terminal 21a is connected to the front scraper actuating relay while terminal 21d is connected to the back scraper actuating relay.

Before proceeding to a description of the electrical wiring diagram of FIG. 7, the operation of the switching control unit described above in connection with FIGS.

1 through 6 will be set forth. Assuming the operator of the earth moving rig wishes to actuate the front scraper, he places his hand on knob 11 of the switch control unit which is conveniently mounted in the operator's cab, and rotates shaft 12 until indicating means 14a shows that rotary switch arm 23 has made contact with contact 24a of rotary switch 16. The operator will then pivot the joy stick assembly into engagement with slot 15a, 15b, 15c or 15d, depending on the operation he wishes to perform with the front scraper. Assume that the operator wishes to perform the function controlled by the solenoid winding associated with push-button switch 18a. He will then pivot the joy stick assembly into engagement with slot 15a, causing contact arm 17a to close push-button switch 18a. This will then cause current to be applied to the selected solenoid winding of the front scraper. In a similar manner, any of the other solenoid windings of the front scraper may be selected and by rotating shaft 12 so that contact arm 23 engages contact 21d, the same series of operations may be performed with the back scraper. It should be realized, however, that the earth moving rig and front and back scraper description is given as merely exemplary and that the switch control unit of the present invention may be applied wherever a first switching selection followed by a second switching selection is desired.

Turning now to the wiring diagram of FIG. 7, it can be seen that rotary switch 16 is schematically illustrated as comprising two on-off switches 21a and 21d. These represent respectively, contact arm 23 applying ground to contacts 21a and 21d of rotary switch 16, as illustrated in FIGS. 4 and 5. Push-button switches 18a, b, c and d are also represented as on-off switches.

Associated with switch 21a is relay winding 33 and its associated contact 33a which serves to apply B plus voltage via line 35 to the winding of relay 37, 38, 39 or 40 in order to close one of the respective relay contacts 37a, 38a, 39a or 40a. The closure of switch contact 37a while contact 33a is closed, serves to apply B plus voltage to the other end of solenoid winding 47, causing current to flow therethrough. Similarly, closure of contact 38a will cause current to flow through solenoid winding 48, closure of contact 39a will cause current to flow through solenoid winding 45 and closure of contact 40a will cause current to flow through solenoid winding 46.

The aforescribed connections to the solenoid coils of the front scraper are duplicated with respect to the back scraper. Thus, closing switch 21d applies ground to the winding of relay 34, causing its associated contact 34a to close. This in turn applies B plus voltage via line 36 to one side of the coils of relays 41, 42, 43 and 44. Depending upon which of push-button switches 18a, 18b, 18c or 18d is actuated, ground will be applied to the other side of one of relay coils 41, 42, 43 or 44, causing the associated contacts 41a, 42a, 43a or 44a to close. The closure of contact 41a causes current to flow through back scraper solenoid winding 49, the closure of contact 42a causes current to flow through solenoid winding 50, the closure of contact 43a causes current to flow through solenoid winding 51 and the closure of contact 44a causes current to flow through solenoid winding 52. Diodes 53 through 60 are provided in the relay circuits in order to prevent feedback.

Assume then that the operator of the earth moving rig wishes to perform an operation with the front scraper initiated by current flow through solenoid winding 47. Joy stick assembly 11 and 12 is rotated until indicator 14a provides an indication that contact arm 23 has made contact with the position on rotary switch 16 controlling the front scraper. The operator then pivots the joy stick assembly into engagement with slot 15a, causing contact arm 17a to depress push-button switch 18a. This sequence of operations will first cause switch 21a in FIG. 7 to close, in turn activating relay 33 and causing its associated switch control 33a to close. This will place B plus voltage across relay winding 37, causing its associated contact 37a to close when ground is connected to its other side through the closure of push-button switch 18a. When contact 37a closes, this will cause current to flow through solenoid 47, since its other end is grounded and the function controlled by that solenoid winding will be initiated. When the operator allows the joy stick assembly to once more assume its neutral vertical position, current will no longer flow through solenoid winding 47 since push-button switch 18a will open. This results in the termination of the function controlled by solenoid winding 47.

Referring now to FIGS. 8, 9 and 10, there is illustrated an hydraulic valve box actuator, controlled by two solenoid windings such as 47 and 48 in FIG. 7, particularly suited for use in conjunction with the switch control unit of the present invention.

Disposed within outer cylindrical casing 60 is plunger 68 connected to shaft 70. Shaft 70 is connected to an hydraulic valve box which, for example, may control the flow of an hydraulic fluid for performing two different functions, depending upon the direction in which shaft 70 is moved. If, for example, shaft 70 is moved toward the right, as viewed in FIGS. 8 and 10, hydraulic valve box 71 may cause oil to be admitted through a first set of ports to cause the front scraper to be raised. Similarly, when shaft 70 is moved toward the left, as viewed in FIGS. 8 and 10, hydraulic valve box 71 may cause oil to flow through a second set of ports and lower the front scraper.

Plunger 68 is retained in a normally neutral position within cavity 67 by spring 69 and is surrounded by solenoid windings 65 and 66 for creating a magnetic field to move the plunger either to the left or to the right. The flow of current through solenoid winding 65 will cause plunger 68 to move to the left against the force of spring biasing means 69 while the flow of current through solenoid winding 66 will similarly cause plunger 68 to move to the right. Appropriate electrical terminals 61, 62, 63, and 64 are provided for connecting solenoid windings 65 and 66 to an appropriate source of current. For example, terminals 61, 62, 63 and 64 may be interconnected with the circuitry of FIG. 7, in the manner shown therein with respect to solenoid windings 47 and 48.

Thus, if solenoid winding 65 corresponded to solenoid winding 47 in FIG. 7, and solenoid winding 66 corresponded with solenoid winding 48 in FIG. 7, the above-described sequence of operations in FIG. 7, wherein switch 21a is closed followed by the closure of push-button switch 18a, would result in the flow of current through solenoid winding 65 and raise the front

scraper. The release of push-button switch 18a would then cause plunger 68 to return to its neutral position and if the operator wishes to lower the front scraper, he would then move the joy stick assembly into engagement with slot 15b to cause push-button switch 18b to close. Current will then flow through solenoid winding 66, causing plunger 68 to move toward the right against the force of spring-biasing means 69 and shaft 70 will actuate hydraulic valve box 71 in such a way as to lower the front scraper of the earth moving rig. Upon release of push-button switch 18b, the force of spring-biasing means 69 will cause plunger 68 to once again assume its neutral position in cavity 67.

In the particular embodiment described, solenoid windings 47 and 48 control the up and down movement of the front scraper. Similarly, solenoid windings 45 and 46, if embodied in an hydraulic valve box actuator such as shown in FIGS. 8, 9 and 10, could control two other functions of the front scraper. Of course, the above description applies equally well to the solenoid windings 49, 50, 51 and 52 of the back scraper.

While this invention has been described with particular reference to an earth moving rig incorporating a front and back scraper for purposes of illustration, it should be realized that the switch control unit is readily adaptable to any multifunction application wherein consecutive discrete controllable switching functions are required. Thus, while the manual ease of performing the switching functions with the switch control unit of the present invention makes it particularly suitable for use in heavy machinery where only a single arm of the operator may be available, it should be appreciated that general applications are contemplated within the scope of the present invention. Moreover, it is to be understood that the present invention is not limited to the specific embodiment described and illustrated herein, but that various modifications and alternative arrangements may be employed without departing from the scope of the invention as defined in the hereto appended claims.

I claim:

1. A multiple switch operating unit comprising in combination:

- a. a joy stick control having a shaft free to rotate within a hollow stem and said stem being pivotally mounted;
- b. rotary switch means insulatedly secured to said hollow stem;
- c. said rotary switch means being provided with a continuous substantially planar array of contact points;
- d. contact arm means secured to said shaft for selectively contacting one of said contact points as said shaft is rotated;
- e. a plurality of individually actuatable push-button switch means, actuated in response to a predetermined pivotal movement of said stem;
- f. said push-button switches being selectively interconnectable with each of said contact points.

2. The combination set forth in claim 1, further including a plurality of groups of output devices and circuit means for interconnecting said multiple switch operating unit with said groups of output devices, so that said rotary switch means can select one of said groups and said push button switch means can select one output device within said selected group.

7

3. The combination set forth in claim 2, further including a plurality of contact arms mounted on said stem, equal in number to said push-button switches, for selectively actuating one of said push-button switches when said sleeve is pivotally moved in a predetermined direction. 5

4. The combination set forth in claim 3, wherein said means for pivotally mounting said sleeve comprises a ball and socket joint.

5. The combination set forth in claim 4, further including means for constraining the pivotal movement of said sleeve to one of a plurality of predetermined directions corresponding to the location of said push-button switches. 10

6. The combination set forth in claim 2, wherein said output devices comprise solenoid windings. 15

7. The combination set forth in claim 6, wherein said solenoid windings comprise the actuating coils of at least one hydraulic valve box actuator.

8. The combination set forth in claim 7, wherein said hydraulic valve box actuator comprises: 20

- a. a plunger normally in a neutral position;
- b. a first and a second solenoid winding surrounding said plunger; and
- c. a reciprocable output shaft; so that current flow 25

8

through said first solenoid winding causes said output shaft to be actuated in a first direction and current flow through said second solenoid winding causes said output shaft to be actuated in a second direction diametrically opposite to said first direction.

9. The combination set forth in claim 5, wherein said output devices comprise solenoid windings.

10. The combination set forth in claim 9, wherein said solenoid windings comprise the actuating coils of at least one hydraulic valve box actuator.

11. The combination set forth in claim 10, wherein said hydraulic valve box actuator comprises:

- a. a plunger normally in a neutral position;
- b. a first and a second solenoid winding surrounding said plunger; and
- c. a reciprocable output shaft; so that current flow through said first solenoid winding causes said output shaft to be actuated in a first direction and current flow through said second solenoid winding causes said output shaft to be actuated in a second direction diametrically opposite to said first direction.

* * * * *

30

35

40

45

50

55

60

65