April 13, 1954 H. J. FRAMHEIN 2,675,435

PUSH ROD CONTROLLER

Filed Feb. 8, 1950

Fig. 1.

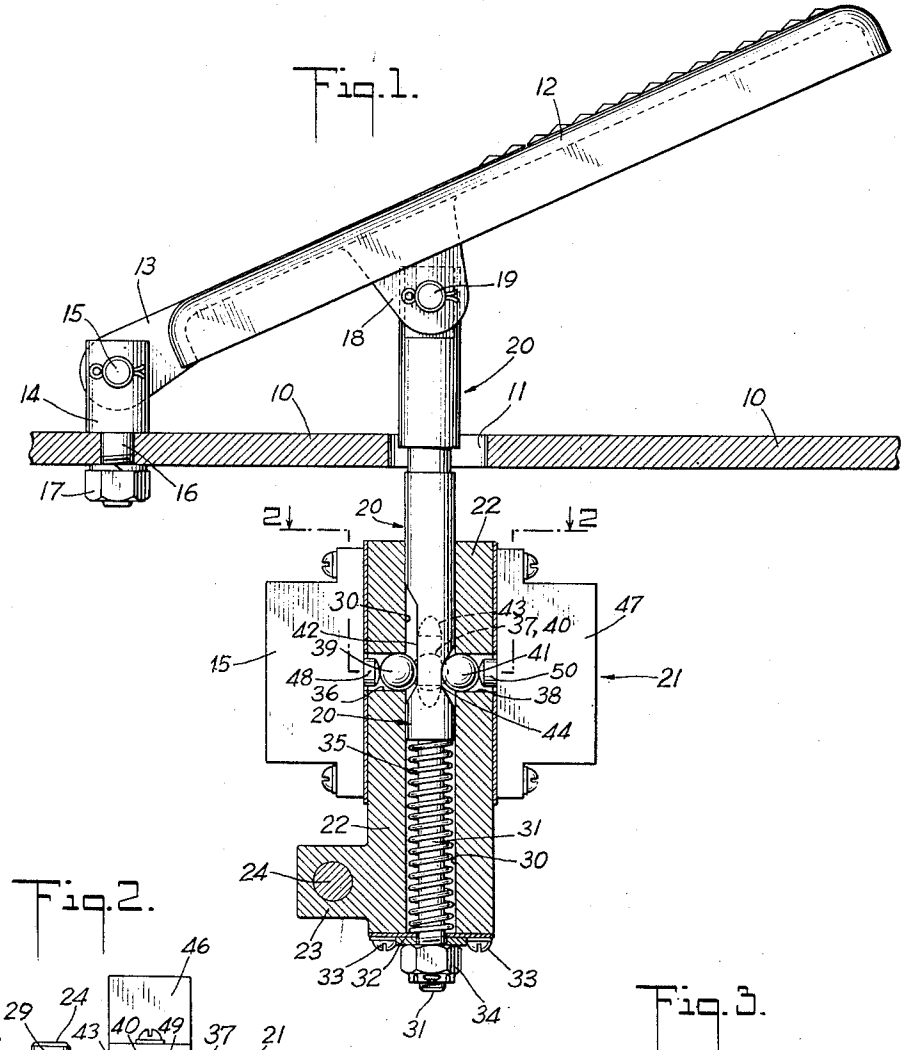



Fig. 2.

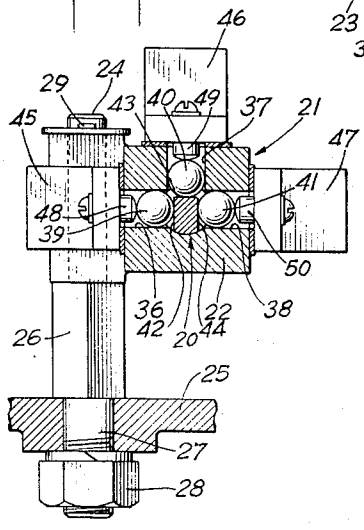
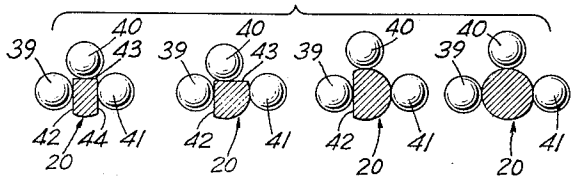



Fig. 3.




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## PUSH ROD CONTROLLER

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6 Claims. (Cl. 200—5)

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This invention relates generally to a controller for an electric truck.

The general object of the invention is to provide a novel control device for actuating a series of switches in a predetermined order, and, within the scope of the invention, such device may be modified so as to actuate the switches one at a time sequentially or in predetermined combinations. For example, and such example is specially illustrated herein, the device may be adapted to close a first switch, next to close a second switch while the first remains closed, and next to close a third switch while both the first and second remain closed, or even while one of the first two switches is restored to open position.

An exemplary use of the invention is that of controlling the motor of an electric industrial truck. Thus, a particular object of the invention is to provide a simple and preferably foot-operated controller for starting, stopping, and varying the performance of the motor of such a truck.

Herein, for the purpose of illustrating my invention I show one form thereof particularly adapted for use as the controller of the motor of such a truck. The controller is provided with a pedal, like the foot accelerator of an automobile, and which may be conveniently mounted on the floor board or other part of the truck within easy access of the foot of the driver. The controller normally throws the motor out of circuit, and may be utilized to start and to increase the torque of the motor by stages as the pedal is depressed. In short, the controller may be employed as a simple accelerator. But the controller may also be arranged as a safety starter for the motor where load conditions are such as to warrant this use.

A feature of the controller, whether used in connection with an electric industrial truck or otherwise, is that it provides simple means for cumulative actuation of a series of switches, preferably in response to a continued thrust. For example, the controller may be adapted to cut in or out of an electric circuit, one section of a resistance after another.

The gist of my invention resides in the provision of means for obtaining as an incident to a unidirectional movement, a cumulative effect in the actuation of a series of switches.

I have thus outlined rather broadly the more important features of my invention in order that the detailed description which follows may be better understood, and in order that my contribution to the art may be better appreciated.

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There are, of course, additional features of my invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of my invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of my invention, in order to prevent the appropriation of my invention by those skilled in the art.

The drawing illustrates the invention as embodied in a foot-operated motor controller suitable for an electric industrial truck.

Fig. 1 is a side elevational view; Fig. 2 is a plan view of the lower portion of the controller, partly in section as indicated by the lines 2—2 of Fig. 1; and Fig. 3 is a schematic view showing four operational stages of the controller.

The structure illustrated in the drawing, being assumed to be a foot-operated motor controller for an electric industrial truck, the reference numeral 10 indicates a floor board or similar part of the truck in section (see Fig. 1). The floor board is apertured at 11, and the controller is shown mounted partly above and partly below the floor board, a linkage connecting the parts of the controller, passing freely through the aperture at 11.

Fig. 1 clearly shows a pedal above the floor board and other parts of the controller beneath the same. While Fig. 1 shows only a means for mounting the pedal to the floor board, Fig. 2 shows a means of mounting the lower part of the controller to any available member of the truck chassis beneath the floor board, such as part of the main frame of the truck or a bracket secured in any suitable manner to the underside of the floor board.

The pedal shown only in Fig. 1 is designated 12. At the heel of the pedal a rigid lug 13 is pivotally attached to a stud 14 by means of a pin 15. The stud is suitably fixed to the floor board, as by means of a threaded shank 16 passed through the floor board and secured beneath by a nut 17.

Beneath the pedal is another rigid lug 18 pivotally secured at 19 to a rod 20. The rod 20 serves not only as a linkage between the pedal and the parts of the controller beneath the floor board but also as the prime moving part of the controller, as will be presently shown.

As a convenience that assembly of parts of the

controller beneath the floor board, and linked to the pedal by means of rod 20, is designated in its entirety 21.

The rod 20 is generally of circular cross section. In the drawing the rod is shown to be of stepped thickness, indicating that the upper part, which attaches to lug 18, may be a superimposed headpiece specially adapted to engage the lug at 19. But for practical purposes the rod 20 may be regarded as a cylinder.

The assembly of parts 21 of the controller beneath the floor board is pivotally mounted on any suitable part of the main frame of the truck or upon a bracket secured to the under side of the floor board. The pivot axis permits the assembly 21 to rock back and forth to compensate for the pivotal movement of the pedal 12. See below.

The assembly 21 comprises a block 22 having an integral lug 23 which is bored to receive with some tolerance a horizontally disposed stub shaft 24 on which the assembly may rock.

The stub shaft 24 is shown, in Fig. 2, to be the shank of a post 26 which is rigidly secured to any suitable part of the main frame of the truck or to a bracket fixed to the under side of the floor board, such part or bracket being shown in fragmentary section and being designated 25. A threaded shank 27 of post 26 is passed through the part or bracket 25 and is secured by a nut 28. A cotter key 29 is provided near the outer end of the stub shaft 24 to prevent displacement of assembly 21.

The block 22 is here shown to be generally of square cross section and of length considerably in excess of its thickness. See Figs. 1 and 2. The block is provided with a longitudinal bore 30 in which the rod 20 is slidably received. A shank 31 at the lower end of rod 20 is passed through a bored plate 32 secured to the lower end of the block by cap screws 33. The lower end of the shank is threaded, and beneath the plate 32 a nut 34 is mounted and locked on said shank.

Within the bore 30 and mounted upon the shank 31 of rod 20 is a compression spring 35. The ends of spring 35 respectively bear against the shoulder of rod 20 at the upper end of shank 31 (see Fig. 1) and the plate 32 at the lower end of block 22 so that normally the rod 20 is maintained in the relative position shown in Fig. 1.

At a common level of the block 22 intermediate the top thereof and the lug 23 are three lateral bores, spaced at angular intervals of 90°, the axis of each such lateral bore being normal to a side of the block, and intersecting the axis of bore 30, and each such lateral bore leading from a side of the block to bore 30. The lateral bores are best illustrated in Fig. 2 which, in part, is a horizontal section taken on the said common level, and are designated 36, 37, and 38.

Within each bore a ball is freely fitted; each such ball is in contact with rod 20. These balls are designated 39, 40 and 41 and relate respectively to bores 36, 37, and 38. See Fig. 2 particularly.

It will be apparent from Fig. 1 that the rod 20 is prevented by the pivotal attachment at lug 18 from rotating on its own axis.

The lower portion of the rod 20 within the bore 30 of block 22 is provided with three cam surfaces 42, 43, and 44 angularly spaced at 90° intervals to register with the lateral bores 36, 37 and 38. Balls 39, 40 and 41 normally engage the keyways as shown in Figs. 1 and 2. These cam surfaces are here shown to be depressions in the cylindrical surface of rod 20 such as might be made by longitudinally milling the sides thereof at 90° intervals. It will be apparent that the cam surfaces may be variously formed, but it is preferable, of course, that they be tapered at their ends as shown so that the balls may easily accommodate themselves to the surfaces of the rod 20 as the latter is moved axially. See Figs. 1 and 2.



It will be noted in Fig. 1 that the lower ends of the three cam surfaces are at a common level, but that surface 42 is of greater length than the others, that surface 43 is of intermediate length, and surface 44 is the shortest. The surfaces 42 and 43 are preferably, but not necessarily, of lengths which are multiples of the length of the smallest surface 44.

Suitably mounted to the sides of the block 22, as best shown in Fig. 2, are switches 45, 46 and 47, corresponding to lateral bores 36, 37, and 38. Each switch is provided in the usual manner with a button or other control element assumed to be urged outwardly from the switch by means of a spring. The buttons or control elements of the three switches 45, 46, and 47 are respectively designated 48, 49 and 50, and each button or element bears against one of the three balls 39, 40, and 41. See Fig. 2.

The normal relationship of parts of the controller is illustrated in Figs. 1 and 2 and, schematically, with respect to the rod 20, and the three balls 39, 40 and 41, in the left hand element of Fig. 3.

It will be obvious that as the rod 20 is depressed, as by means of the pedal 12, the upper taper of cam surface 44 will presently engage ball 41 and force the ball against the control element 50 to effect operation of its related switch 47. Thereafter, of course, if the movement of rod 20 is continued, the ball 41 will engage the cylindrical surface of rod 20 and maintain control element 50 in operative position. Next, if the downward movement of rod 20 is continued, the upper taper of cam surface 43 will in like manner engage and move ball 40 and control element 49 of switch 46, and thereafter the upper taper of cam surface 42 will engage and move ball 39 and control element 48 of switch 45.

Thus, a continued downward movement of pedal 12 not only effects operation of switches 45, 46, and 47 in seriatim, but maintains in operative position each switch that is actuated. When pressure on pedal 12 is withdrawn the rod 20, under tension of the spring 35, is restored to the normal or inoperative position of Fig. 1; the cam surfaces 42, 43, and 44 are realigned with their respective balls 39, 40 and 41, and the control elements of the switches return to normal positions. It will be understood that, within limits, the movement of rod 20 may operate the switches in a cumulative manner, either positively or negatively to effect desired variations in an electrical circuit.

The means by which the three switches may be arranged to govern an electric circuit are so diverse and so well understood that no description is here given.

I now claim:

1. In a controller of the class described, a housing, a series of switches on said housing, a member mounted for movement relatively to said housing in a predetermined axis, control elements for actuating said switches mounted about said member on the housing in angularly spaced relation to said predetermined axis, surface portions on said member angularly spaced about the

periphery thereof relatively to said predetermined axis and coextending relatively to one another in an axial direction to move simultaneously by each of said control elements in operating relation thereto as the member moves in said axis, each surface portion formed as a cam for controlling one of said elements, and means holding said member against rotation relatively to said housing with each surface portion aligned with its control element whereby to control each of the switches independently during the entire movement of the member in said axis.

2. In a controller of the class described, a housing, a series of switches on said housing, a rod mounted for axial movement in said housing, control elements for actuating said switches mounted in said housing in a plane transverse to the rod, surface portions coextending relatively to one another in an axial direction on the periphery of said rod in position to move simultaneously by each of said control elements in operating relation thereto as the rod moves in said housing, each surface portion formed as a cam for moving one of said elements, and means holding said rod against rotation in said housing with each surface portion aligned with its control element whereby to control each of the switches independently during the entire movement of the rod in the housing.

3. In a controller of the class described, a housing, a series of switches on said housing, a rod mounted for predetermined movement in an axial direction in said housing, control elements for actuating said switches mounted in the housing in angularly spaced relation in a plane transverse to the rod, surface portions angularly spaced about the periphery of said rod relatively to said predetermined axis and coextending relatively to one another in an axial direction in position to move simultaneously by all said control elements in operating relation thereto during the predetermined axial movement of the rod in said housing, each surface portion formed as a cam for moving one of said elements, and means coacting with said rod to hold each surface portion aligned with its control element whereby to effect independent control of each switch throughout the predetermined axial movement of the rod.

4. In a controller of the class described, a housing, a series of switches on said housing, a member mounted for movement relatively to said housing in a predetermined axis, control elements for actuating said switches mounted in the housing in angularly spaced relation about said member in a plane transverse to the member, surface portions coextending relatively to one another in an axial direction on said member and coacting with said control elements throughout the movement of the member in said axis, each



surface portion formed as a cam for moving one of said elements, and means coacting with said member to hold each surface portion aligned with its control element whereby to control each of the switches independently as the member moves in said axis.

5. In a controller of the class described, a housing having a bore, a push rod mounted for axial movement in said bore, said housing having a series of further bores intersecting the first bore in angularly spaced relation about said push rod, a series of switches on said housing, control elements for actuating said switches positioned in said further bores, surface portions on said push rod coextending relatively to one another lengthwise of the rod and moving simultaneously past said control elements as the push rod moves in its bore, each surface portion formed as a cam for moving one of said control elements, and means holding said push rod against rotation in its bore with each surface portion aligned with its control element whereby to control each switch independently throughout the movement of the push rod.

6. In a controller of the class described, a housing having a bore, a push rod mounted for movement through a predetermined distance in said bore, said housing having in a single plane transverse to said bore a series of further bores intersecting the first bore, a series of switches on said housing, a control element for actuating each switch positioned in each of said further bores, surface portions on the periphery of said push rod coextending relatively to one another lengthwise of the push rod and moving simultaneously past said further bores during the predetermined movement of the push rod, each surface portion formed as a cam for moving one of said control elements, and means acting through said rod to hold each surface portion aligned with a particular control element whereby to effect independent control of each switch throughout the predetermined movement of the push rod.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 626,919 | Medary | June 13, 1899 |
| 802,945 | Waterman | Oct. 24, 1905 |
| 1,091,465 | Adam et al. | Mar. 24, 1914 |
| 1,926,419 | Apple | Sept. 12, 1933 |
| 2,122,678 | Bruce | July 5, 1938 |
| 2,391,881 | Clay | Jan. 1, 1946 |
| 2,579,172 | Bordelon | Dec. 18, 1951 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 274,258 | Great Britain | July 21, 1927 |