

[72] Inventors **Richard D. Houk**  
**Stow;**  
**Dale F. Leuenberger, Cuyahoga Falls, both**  
**of, Ohio**  
 [21] Appl. No. **872,987**  
 [22] Filed **Oct. 31, 1969**  
 [45] Patented **Aug. 31, 1971**  
 [73] Assignee **North American Rockwell Corporation**  
**Pittsburgh, Pa.**

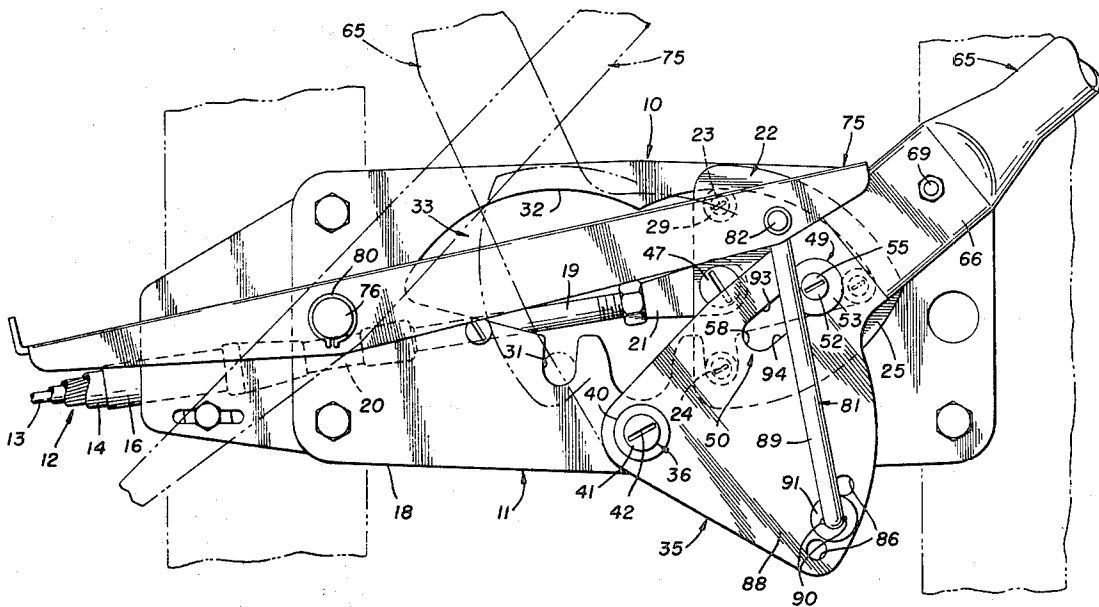
*Primary Examiner*—Martin P. Schwardron  
*Assistant Examiner*—R. H. Lazarus  
*Attorneys*—John R. Bronaugh, Floyd S. Levison and E. Dennis O'Connor

[54] **HAND AND/OR FOOT ACTUATING APPARATUS FOR A CONTROL DEVICE**  
**5 Claims, 4 Drawing Figs.**

[52] U.S. Cl. .... **74/481**  
 [51] Int. Cl. .... **G05g 11/00**  
 [50] Field of Search ..... **74/501,**  
**502, 481, 491, 516, 517, 518; 64/3**

[56] **References Cited**  
**UNITED STATES PATENTS**  
 3,505,896 4/1970 Phillips ..... **74/481**

**ABSTRACT:** An actuating apparatus selectively operable by a foot pedal or hand lever, each movable only about a single axis of rotation, to swing a throw member alternately about at least two spaced, pivotal axes. Such an actuating apparatus may be employed to advantage with a control for imparting movement to a motion transmitting device as a nonlinear function of the movement applied to the throw member thereof, the latter being movable about at least two, spaced, pivotal axes. The apparatus has a driving member that is mounted to rotate about a single drive axis located generally medially of the dual axes about which the throw arm swings but laterally of a reference line extending between said dual axes. A shuttle head on the throw member is received for reciprocating motion in an elongate race in the driving member. The race is also located laterally of said reference line, but oppositely of the single drive axis. The major axis of the elongate race preferably lies substantially perpendicular to the aforesaid reference line so that an extension thereof would intersect the single drive axis.



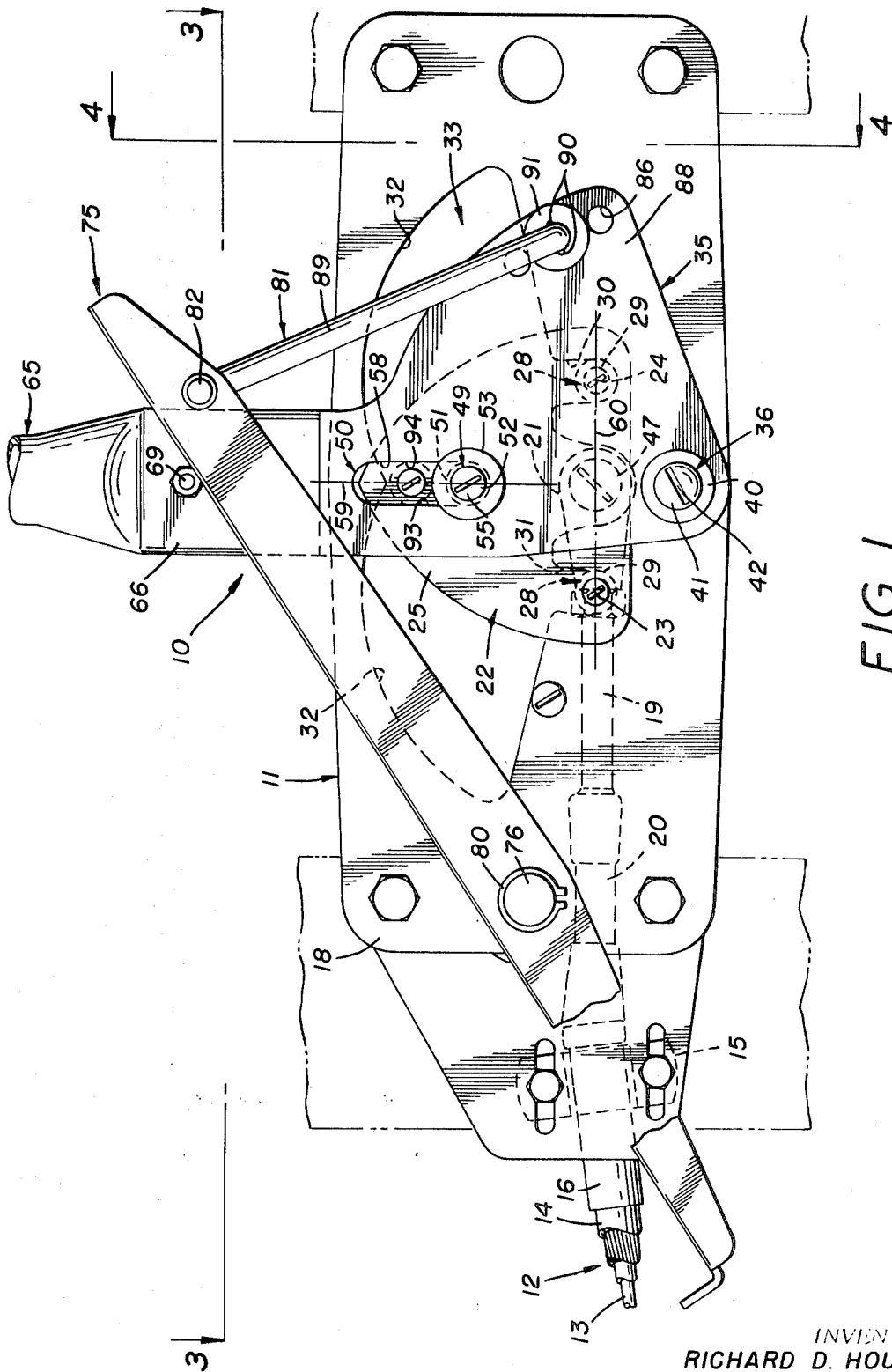


FIG. 1

INVENTORS  
RICHARD D. HOUK  
DALE F. LEUENBERGER  
BY *Hamilton, Cook,*  
*Renner & Kenner*  
ATTORNEYS

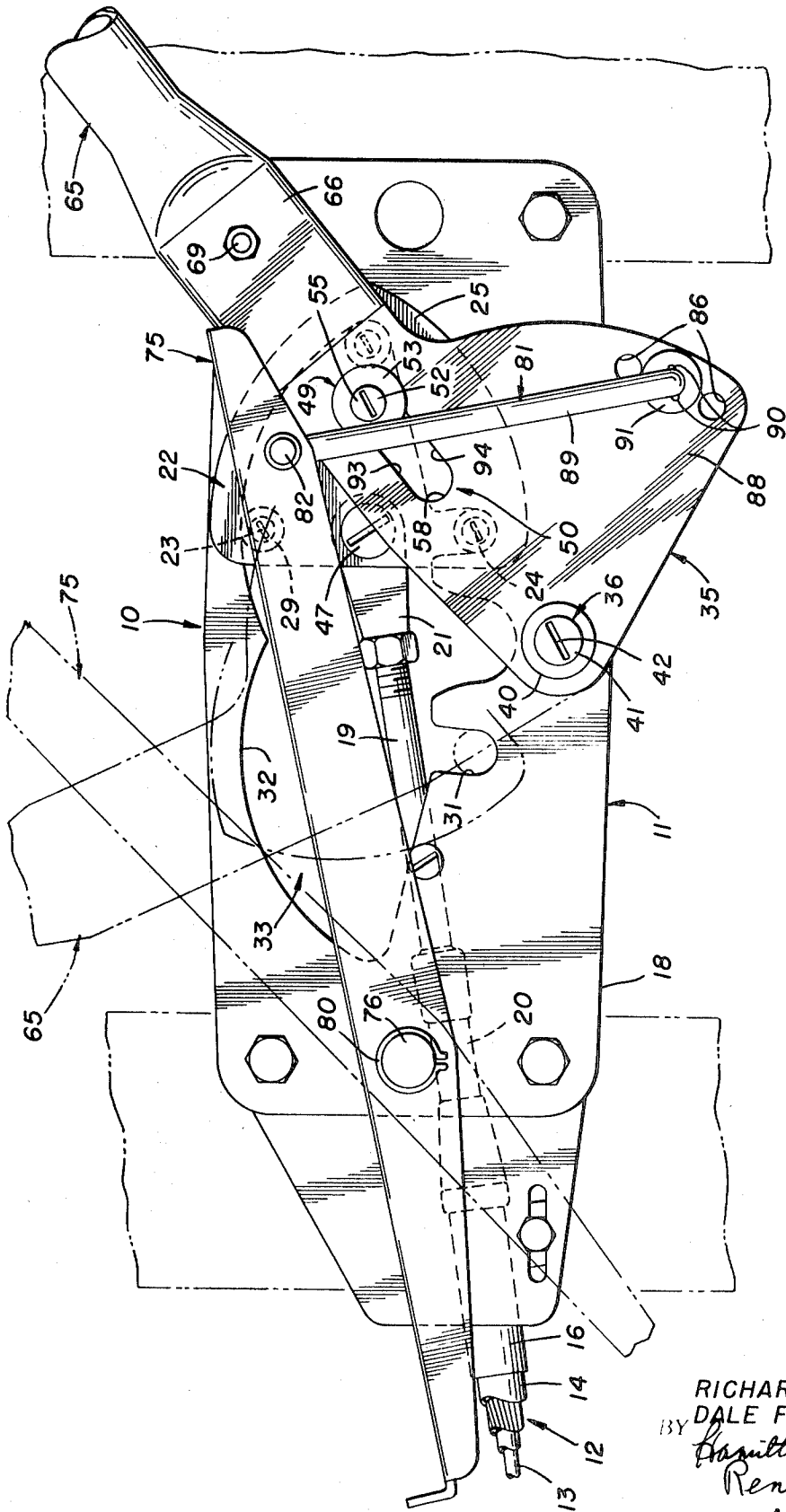


FIG. 2

INVENTORS  
RICHARD D. HOUK  
DALE F. LEUENBERGER  
BY *Hamilton, Cook,  
Rennie & Kenner*  
ATTORNEYS

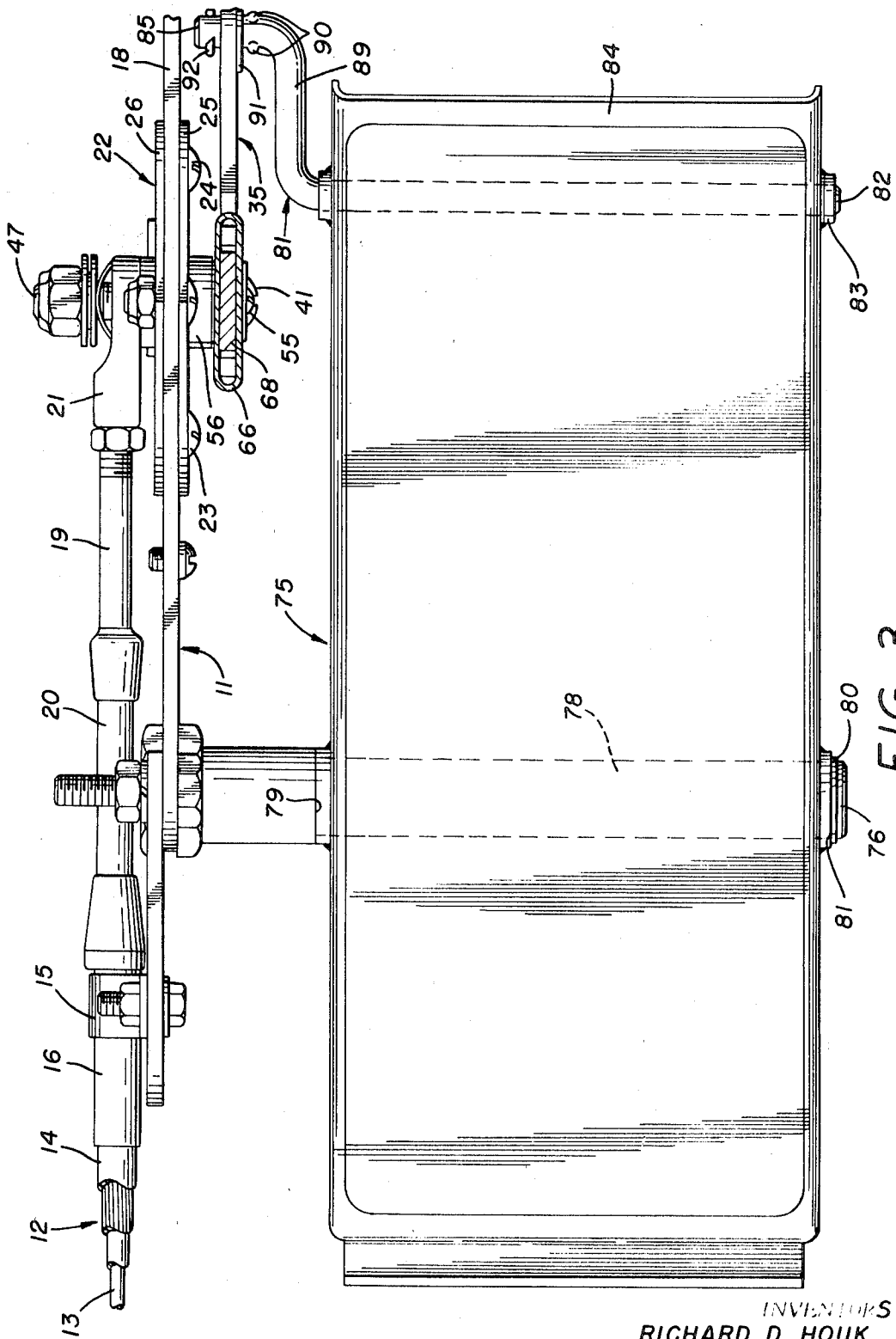


FIG. 3

INVENTORS  
RICHARD D. HOUK  
DALE F. LEUENBERGER  
BY *Hamilton, Cook,  
Rensler & Kenner*  
ATTORNEYS



## HAND AND/OR FOOT ACTUATING APPARATUS FOR A CONTROL DEVICE

### BACKGROUND OF THE INVENTION

The present invention relates generally to apparatus for actuating a control and more specifically to an actuating apparatus by which the regulating means—either a hand lever or foot pedal—may be rotated about their respective single axes to actuate a control in which the throw member is selectively required to swing about at least a pair of spaced axes.

Hydrostatic transmissions for vehicles are not new, and as was discussed in Richard D. Houk's copending patent application, Ser. No. 804,468, filed Mar. 5, 1969, it is often highly desirable to provide a control for hydrostatic transmission in which the movement imparted to the motion transmitting device operatively connecting the control to the swash plate, or plates, of the hydrostatic transmission is a nonlinear function of the movement imparted by the operator to the control lever. The nonlinear control taught in the aforesaid patent application, Ser. No. 804,468, effects just such a result. That control employs a throw arm that is selectively swingable about two, spaced pivotal axes, and the control lever is disclosed as being attached directly thereto. Such an arrangement is perfectly satisfactory for many installations, but there are also many situations in which it would be more desirable if the control lever, or other regulating device, itself were movable about only a single axis.

Single axis rotation is, for example, particularly desirable when the regulating device is a foot pedal. To rotate a foot pedal selectively about more than one axis requires a rather complicated coordination of movements involving the ankle, knee and hip. The complexity of the coordination required, and hence the difficulty in accomplishing assured facile operation, are greatly reduced by limiting the foot pedal to rotation about a single axis.

In addition, it is often desirable to operate a single control either by foot or hand, depending upon the particular environmental circumstances encountered.

### SUMMARY OF THE INVENTION

It is, therefore, a primary object of the present invention to provide an actuating apparatus having at least one regulating means rotatable about only a single axis to swing the throw member in a control device about multiple axes.

It is another object of the present invention to provide an actuating apparatus, as above, that is selectively operable by a foot pedal or a hand lever.

These and other objects, together with the advantages thereof over existing and prior art forms which will become apparent from the following specification, are accomplished by means hereinafter described and claimed.

In general, an actuating apparatus embodying the concept of the present invention employs a driving member mounted to rotate about a single axis. One or more regulating means are operatively connected to the driving member, and a further means operatively connects the driving member to the throw member of the control device. The throw member is swingable about at least two, spaced axes and the connecting means between the driving member and the throw member preferably comprises a head means secured to one of said members and reciprocatingly received in a race means provided in the other of the members.

The orientation of the race means with respect to the pivotal axis of the driving member and with respect to a reference line extending between the axes about which the throw member is selectively swingable allows rotation of the driving member about its single axis to effect a swinging movement of the throw member selectively about its pivotal axes.

The regulating means may well be either a hand lever with means for securing it to the driving member, or the regulating means may be a foot pedal mounted for rotation about a single

axis spaced from the axis about which said driving member rotates. A crank means interconnects the foot pedal with the driving member.

One preferred embodiment of an actuating apparatus according to the concept of the present invention is shown by way of example in the accompanying drawings without attempting to show all various forms and modifications in which the invention might be embodied; the invention being measured by the appended claims and not by the details of the specification.

### DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of an actuating apparatus embodying the concept of the present invention, the apparatus being operatively connected to a control having a throw member depicted in neutral position but swingable about two, spaced, pivotal axes and the apparatus being further depicted with both a hand lever and a foot pedal as the regulating means;

FIG. 2 is a view similar to FIG. 1 but depicting, in solid lines, the regulating means moved to their respective positions, the throw member having been swung about one of its two pivotal axes and further depicting, in chain lines, the regulating means moved to their respective positions, the throw member having been swung about the second of its two pivotal axes;

FIG. 3 is a top plan taken substantially on line 3—3 of FIG. 1; and,

FIG. 4 is an enlarged cross section taken substantially on line 4—4 of FIG. 1.

### DESCRIPTION OF A PREFERRED EMBODIMENT

An actuating apparatus embodying the concept of the present invention is indicated generally by the numeral 10 on the attached drawings and is shown operatively connected to a control 11 for imparting movement through a motion transmitting device 12.

The motion transmitting device 12 may well be of the push-pull cable variety having a conventional construction in which a core 13 is slidably received within a casing 14 to transmit mechanical motion by the application of either tensile or compressive forces to the core 13 when at least the ends of the casing 14 are clamped in a substantially fixed position with respect to the axis along which the core 13 slides.

In the environment with which the subject control 10 is disclosed, the core 13 and casing 14 are both secured to the control 11. Specifically, a clamp 15, which engages an end fitting 16 affixed to the end of the casing 14, is secured to the control frame 18 in order to assure the substantially fixed location required for the end of the cable casing.

The core 13 is secured to an end rod 19, in a well known fashion, and the end rod is closely received within an extension tube 20 mounted for gyrational movement on the end fitting 16. Outwardly of the extension tube 20 the end rod 19 joins a connector 21 rotatably mounted to the throw member 22 of the control 11.

A complete disclosure of the particular control 11 depicted environmentally herein is available in the aforementioned copending application of Richard D. Houk, Ser. No. 804,468. For purposes of the present invention it should suffice to relate that the throw member 22 is alternately swingable about two, spaced, pivotal axes 23 and 24 in order to impart movement to the core 13 as a nonlinear function of the movement applied to the throw member 22.

The throw member 22 itself comprises two plates 25 and 26 spaced to embrace a portion of the control frame 18, as best seen in FIGS. 3 and 4. The plates 25 and 26 are joined by securing means 28 provided with followers 29 for engaging the travel slots 30 and 31 and the lobated camming surface 32 of voided area 33.

The actuating apparatus 10 has a driving member 35 rotatably mounted from a base means which may well be the control frame 18, as shown. Specifically, the driving member 35 may be supported by a bolt 36 secured to, and extending

outwardly of, the control frame 18. An annular spacer 38 encircles the bolt 36 and is positioned between the control frame 18 and the driving member 35 in order to maintain the latter in spacially fixed relationship with respect to the control frame 18. A pair of bearing washers 39 and 40 embrace the driving member 35 and are interposed between it and the spacer 38 and the head 41 of the support bolt 36, respectively, to facilitate rotation of the driving member 35 about the axis 42 of bolt 36.

As best shown in FIG. 4, the nut 43, which tightens the bolt 36 to the frame 18, may also secure a J-shaped flange 44 by which one end of the deadman spring 45 is anchored in a fixed position with respect to the control frame 18. The other end of the spring 45 is secured to the throw member—as to a tab 46 mounted on the bolt 47 that carries connector 21—in order to assure that the throw member 22 will be continuously biased toward its neutral position.

The driving member 35, which is rotatable about the axis 42 of bolt 36, is operatively connected to the throw member 22 so that movement of the driving member 35 about its axis of rotation 42 causes swinging movement of the throw member 22 selectively about its pivotal axes 23 and 24. This operative connection may comprise a shuttle head 49 secured to the throw member 22 that is received for a reciprocating motion in a race means 50 provided in the driving member 35.

The shuttle head 49 may well comprise a roller 51 carried on a bolt 52 secured to the throw member 22, a pair of locating washers 53 and 54 embracing the driving member 35 to confine the roller 51 within the race means 50. Washer 53 is maintained against the driving member 35 by the head 55 of bolt 52, and washer 54 is maintained against the driving member 35 by an annular spacer 56 that embraces the bolt 52 and extends between the throw member 22 and the driving member 35.

The race means 50 comprises an elongate aperture 58 having a major axis 59 that is oriented generally transversely of a reference line 60 that extends between the location of the two pivotal axes 23 and 24, at least when the throw member 22 is in the neutral position depicted in FIG. 1. In the preferred embodiment an extension of the major axis 59 also intersects the axis 42 about which the driving member 35 rotates, at least when the throw member 22 is in the neutral position. Further, it will be readily observed from FIG. 1 that race means 50, and the single axis 42 about which the driving member 35 rotates, are on opposite sides of the reference line 60.

With these preferred geometric relationships the interaction of the shuttle head 49 with the race means 50 effects a swinging movement of the throw member 22 from its neutral position (FIG. 1) selectively about its two, spaced, pivotal axes 23 and 24 in response to rotation of the driving member 35 about a single axis 42 displaced from the two pivotal axes 23 and 24, as can be seen from FIG. 2 and as is more fully hereinafter described.

Other than to provide a means whereby a regulating means may be operatively connected to the driving member, the shape of the driving member 35 is not critical to its operation. As best seen in FIGS. 1 and 3, one regulating means in the form of a handle 65 having a socket portion 66 may be removably secured to the driving member 35 by fitting a shank 68 on the driving member 35 into a socket portion 66 on the handle 65 and inserting a lock bolt 69 through not only the opposed bores 70A and 70B in the sides of the socket portion 66 but also a bore 71 in the shank 68, the bore 71 being positionable in register with the bores 70A and 70B.

A second regulating means in the form of a pedal 75 may also be operatively connected to the driving member 35. The pedal 75 may be pivotally supported on an independent stanchion or may, as shown, be supported on a pintle 76 secured to, and extending laterally of, the control frame 18. A gudgeon 78 affixed to the pedal 75 rotatably receives the pintle 76, and the lateral position of the pedal 75 may be maintained by engagement of one end of the gudgeon 78 with a fixed shoulder 79 at one end of the pintle and by engagement

of the other end of the gudgeon with a spring clip 80 removably receivable within a groove 81 in the pintle 76.

The pedal 75 is operatively connected to the driving member 35 by a crank 81 swingingly secured between the pedal 75 and the driving member 35. Specifically, a first crankpin 82 is rotatably received within a journal 83 on the forward, or toe, portion 84 of the pedal 75, and the second crankpin 85 is rotatably received within one of a plurality of bores 86 that may be provided in the blade portion 88 of the driving member 35.

A plurality of bores 86 are provided arcuately about, and spaced radially of, the axis 42 in order to provide selective adjustment of the pedal 75 for the convenience of the operator and independently of either the remainder of the actuating apparatus and/or the control 11. The length of the web portion 89 of the crank is also a factor in the selective adjustment of the pedal orientation. To secure the crank 81 in operation position, only one of the crankpins need be anchored. As best seen in FIG. 3, a pair of ears 90 may be formed on the crankpin 85 to act as a limit stop for the retaining washer 91. On the opposite side of the driving member 35 with respect to the ears 90 and washer 91 the crank pin 85 is transversely bored to receive a cotter pin 92. By thus laterally securing the crankpin 85 with respect to the driving member 35, the crankpin 82 will also be retained laterally fixed with respect to the pedal 75.

From the neutral position of the control 11 depicted in FIG. 1 the application of toe pressure to pedal 75 or hand pressure—directed to the right as viewed in that Figure—to handle 65 will rotate the driving member 35 clockwise about bolt 36. This motion will translate the race means 50 through a corresponding degree of angular displacement so that the one side surface 93 of aperture 58 will apply a force against the roller 51 of shuttle head 49. The force so applied will act in a direction tangent to the arcuate path through which the race means 50 is being translated and will, therefore, tend to swing the throw member 22 about pivotal axis 24.

Because the throw member 22 must swing about an axis displaced from the axis about which the driving member 35 rotates, the arcuate path about which the shuttle head 49 and the race means 50 will rotate are not coincident. The differential of movement between these two elements can be accommodated by a component of radial displacement of the shuttle head 49 with respect to the race means 50, it having been found that by employing the particular geometric relationships between the race means 50, its orientation, and the various pivotal and rotational axes 23, 24 and 42, the relative displacement between the shuttle head 49 and the race means 50 will have substantially no effect by way of lost motion to the throw member 22 in response to motion of the driving member 35. Accordingly, the aforesaid rotation of the driving member 35 will swing the throw member 22 in control 11 through its forward range to the position depicted by solid lines in FIG. 2.

Conversely, the application of heel pressure to pedal 75 or hand pressure—directed to the left as viewed in FIG. 1—to handle 65 will rotate the driving member 35 counterclockwise about bolt 36.

This motion too, will translate the race means 50 through a corresponding degree of angular displacement and will cause the second side 94 of aperture 58 to apply a force against the roller 51 of shuttle head 49. For example, with the actuating apparatus 10 and control 11 disposed in the relative positions depicted by solid lines in FIG. 2, the aforesaid application of force by side 94 against collar 51 will swing the throw member 22 about axis 24 back to neutral (FIG. 1) and then about axis 23 as the throw member 22 continues to swing from the neutral position to the chain line position depicted in FIG. 2.

It should thus be apparent that an apparatus embodying the concept of the present invention will actuate a control having a throw arm swingable about multiple axes by one or more regulating means rotatable about their individual, single axes.

We claim:

1. Apparatus for actuating a control device having a throw member which is swingingly movable about at least two, spaced, pivotal axes from a neutral position, said apparatus comprising, a base means, a driving member mounted on said base means, for rotation about a single axis displaced from the axes about which the throw member may be selectively swung, a regulating means selectively movable by an operator of said apparatus, means connecting said regulator means to said driving member so that movement of said regulating means rotates said driving member, means operably connecting said driving member to the throw member so that movement of said driving member about its axis of rotation causes swinging movement of the throw member selectively about its pivotal axis, said means operably connecting said driving member to said throw member comprising a race means in one of said members and a head means secured to the other of said members, said head means being received for reciprocating motion in said race means, said regulating means comprising a pedal mounted for rotation about a single axis and in which a crank means interconnects said pedal with said driving member, the axis about which said pedal is rotatably mounted is located medially of said pedal so that application of toe pressure will pivot the driving member to swing the throw member in one

direction and the application of heel pressure will pivot the driving member to swing the throw member in the opposite direction.

2. Apparatus, as set forth in claim 1 in which said race means comprises an elongate aperture having a major axis, said major axis being oriented generally transversely of a reference line extending between the two pivotal axes about which the throw member is selectively swingable when the throw member is in the neutral position.

3. Apparatus, as in claim 2, in which the major axis of said race means intersects the axis about which said driving member rotates, at least when said throw member is in the neutral position.

4. Apparatus, as set forth in claim 3, in which the single axis about which said driving member rotates is on the opposite side, with respect to the race means, of a reference line extending between the pivotal axes about which the throw member is selectively swingable.

5. Apparatus, as set forth in claim 1, in which the regulating means comprises a hand lever and means for securing said hand lever to said driving member.

25

30

35

40

45

50

55

60

65

70

75