

[54] **UNIVERSALLY MOVABLE CONTROL LEVER ASSEMBLY**

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[58] Field of Search 214/138, 140; 180/6.48, 180/6.2, 6.7

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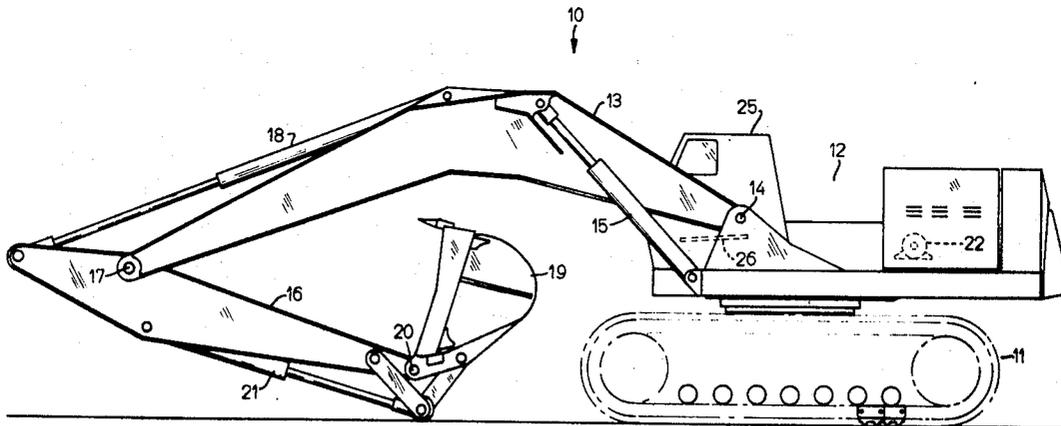
[57] **ABSTRACT**

A backhoe comprises a horizontally rotatable and vertically pivotable boom, a vertically pivotable stick mounted on the boom and a vertically pivotable dipper mounted on the stick, all of which components are movable by hydraulic actuators in response to operation of four control valves. The four control valves are independently operated by four generally parallel control rods which are axially movable by two separate universally movable operator's manual control levers located on a control platform on the backhoe, along with other operator controls. Each of the two universally movable manual control levers is pivotably movable in a first plane to move one backhoe component; in a second plane (normal to the first) to move a second backhoe component; and in other planes transverse to the first and second planes to effect simultaneous but proportional movement of the two backhoe components.

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14 Claims, 9 Drawing Figures



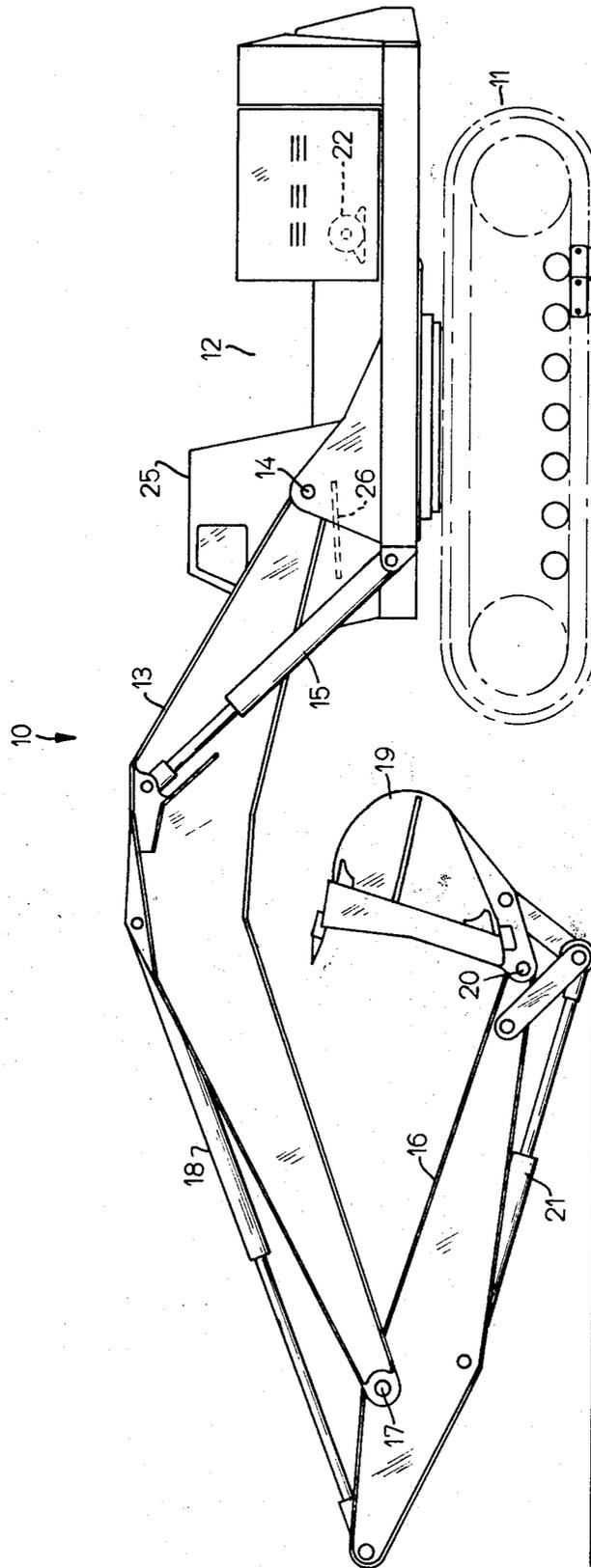


FIG. 1

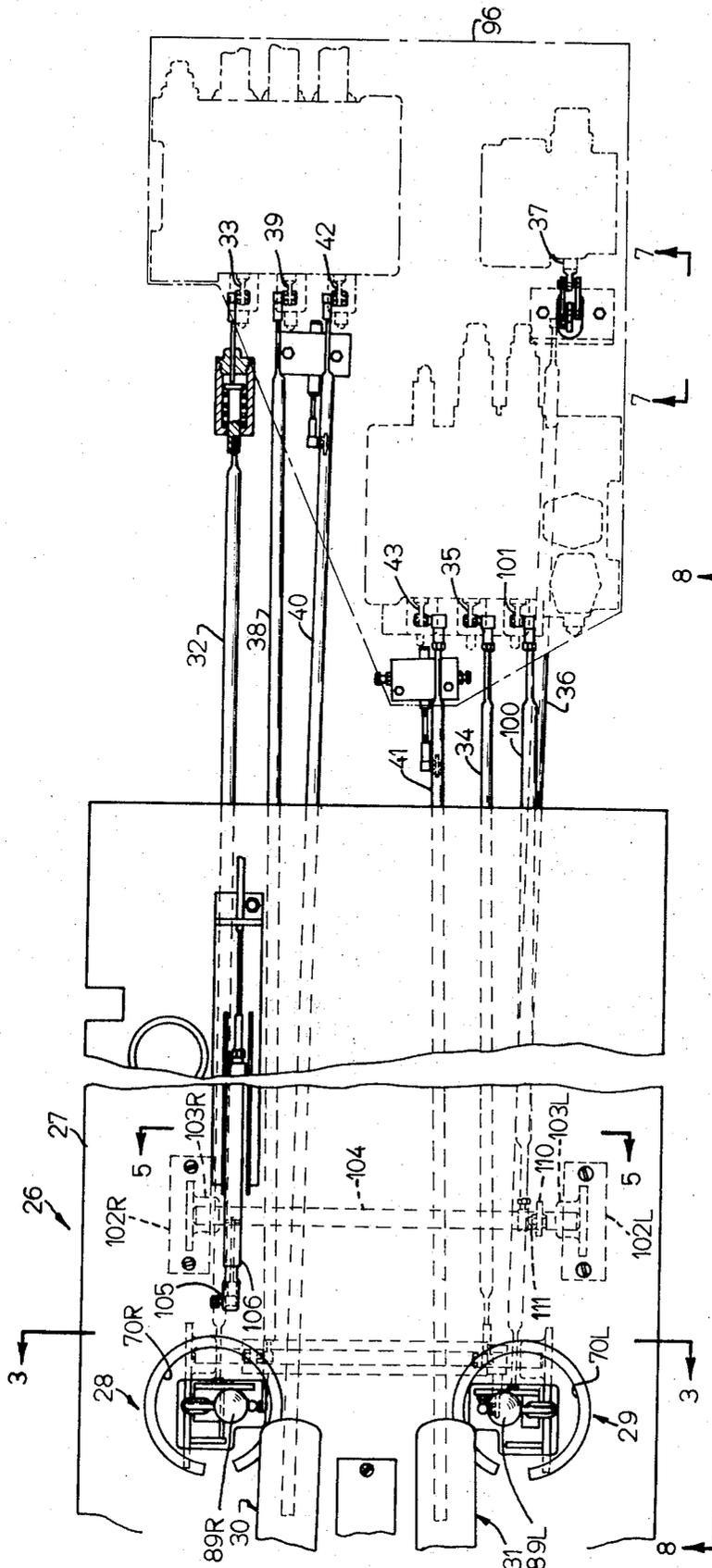


FIG. 2

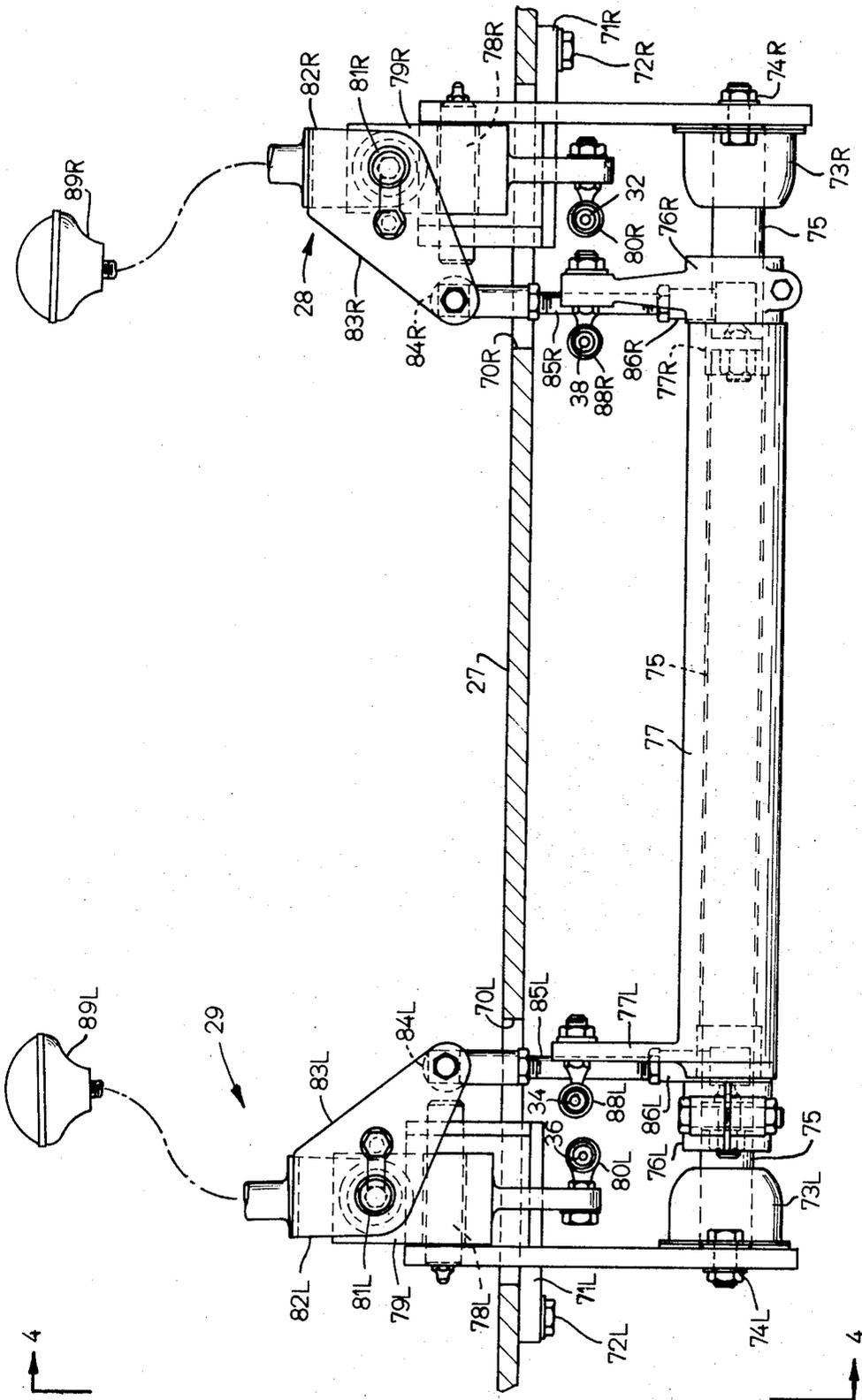


FIG. 3

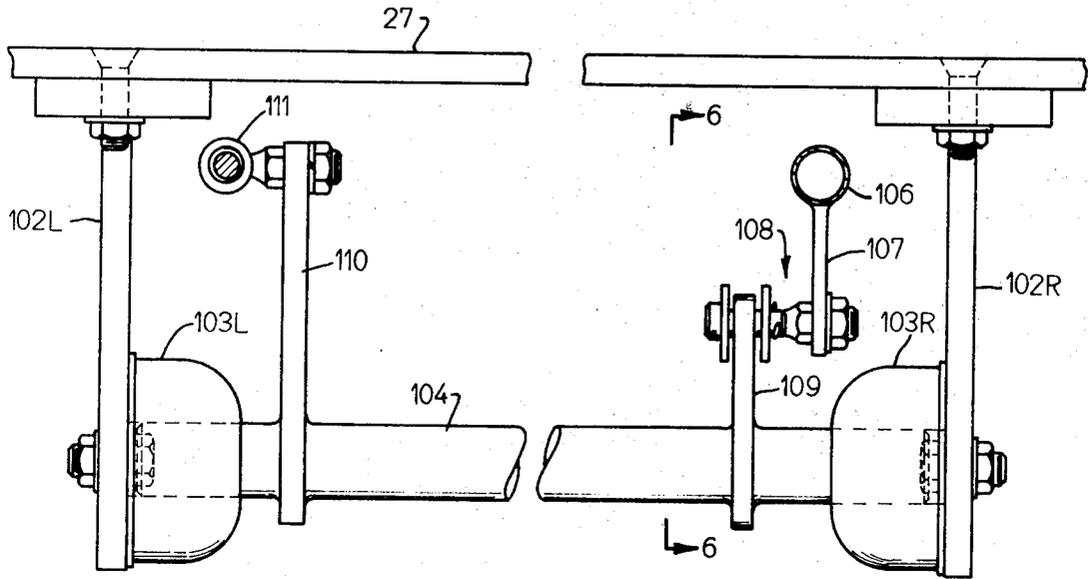


FIG. 5

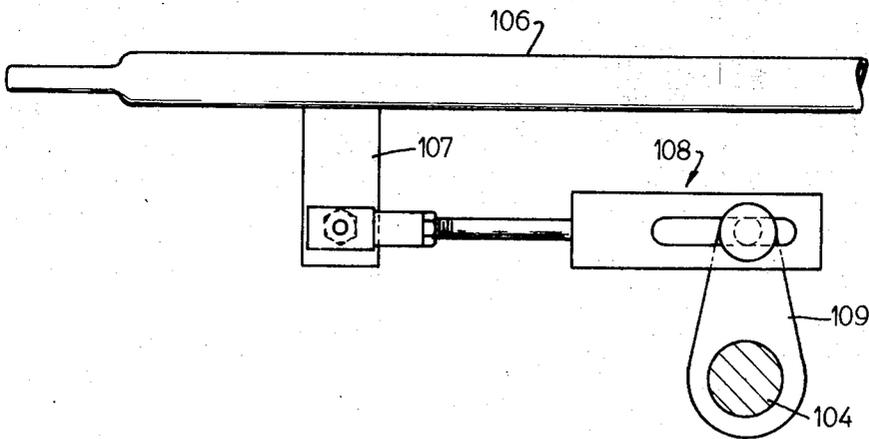


FIG. 6

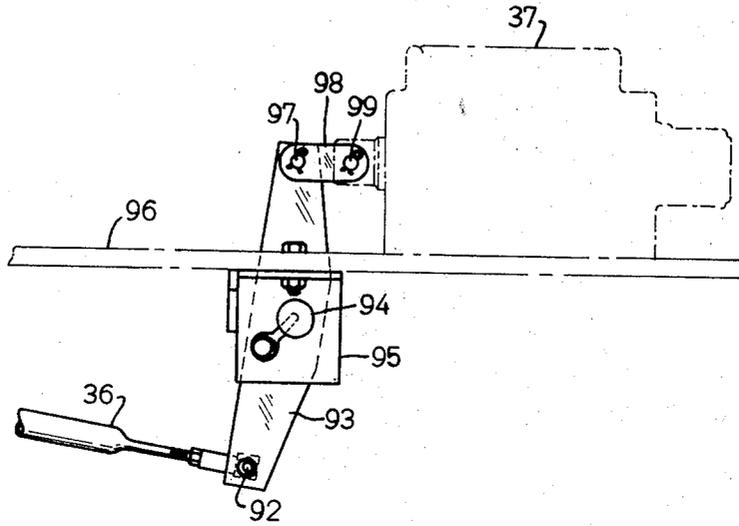


FIG. 7

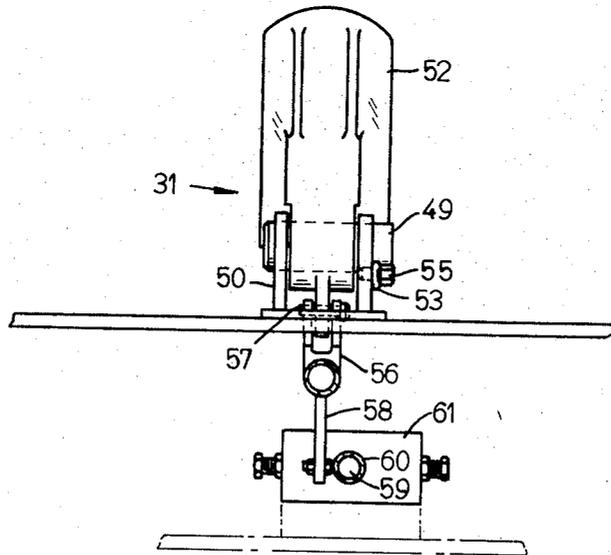


FIG. 9

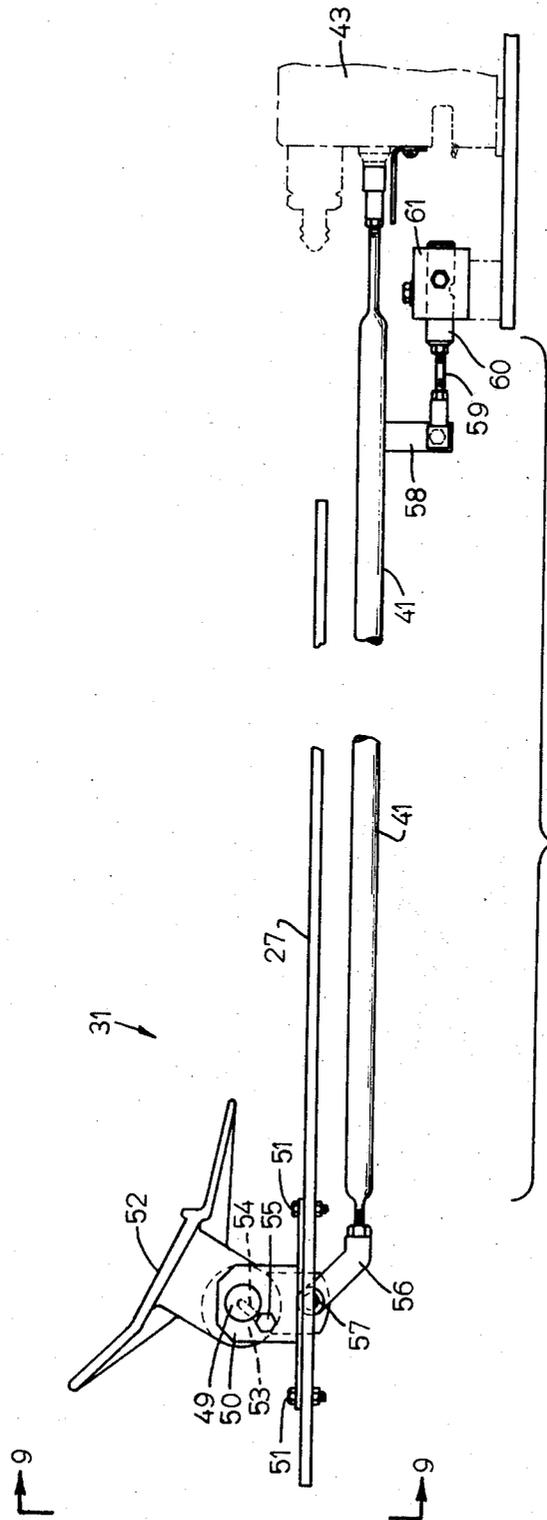


FIG. 8

UNIVERSALLY MOVABLE CONTROL LEVER ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of Use

This invention relates generally to manually operable control levers for operating control valves for hydraulic cylinders or the like.

2. Description of the Prior Art

Machines, such as backhoes, usually comprise a mobile lower section and a horizontally rotatable upper section on which vertically pivotable boom is mounted. A stick is mounted for vertical pivotable movement on the boom and a dipper is mounted for vertical pivotable movement on the stick. In hydraulically operated machines, rotation of the machine upper and pivotal movement of the boom, stick and dipper are effected by individual hydraulic actuators and the extend and retract movements of each cylinder are controlled by a conventional three-position valve. Each such valve has a linear movable valve spool which has extend, neutral and retract positions. Each valve spool is operated by a control rod which is connected to a manually operable control lever located on an operator's control platform on the machine. Heretofore, an individual control lever was provided for each control rod and valve and each control lever was movable, for example, from a centered neutral position either forward or backward to effect appropriate movements of the single backhoe component (upper, boom, stick or dipper) which it controlled. Such an arrangement required one control lever for each component and when more than two control levers were provided, required the machine operator to neutralize and release his grasp on one control lever while he operated another. Therefore, in machines where numerous control functions were required, such an arrangement necessitated numerous control levers crowded together within reach of the operator. Thus, greater operator skill was required, the possibility of operator-error was increased, operator fatigue resulted and smooth and coordinated use of the control levers was inhibited.

SUMMARY OF THE PRESENT INVENTION

The present invention contemplates a machine, such as a backhoe, comprising components, such as a machine upper, a boom, a stick and a dipper, which are to be moved by means of individual actuators, such as hydraulic motor or cylinders. Each actuator is controlled by a multiposition main control valve, such as a three-position valve having extend, retract and neutral positions. Each main control valve comprises a linear movable valve spool which is connected to and operated by a control rod. The control rods, which are in generally parallel arrangement, extend to a control platform assembly on the machine where they are connected to control lever assemblies in accordance with the invention.

Each control lever assembly is adapted to be connected to move or operate two control rods (and, therefore, two valves) either independently of each other or simultaneously in proportional movement. In the embodiment shown, there is a left hand control lever assembly for operating the swing control rod and the dipper control rod and there is a right hand lever

assembly for operating the stick control rod and the boom hoist control rod.

Each control lever assembly comprises a support bracket mounted on the control platform and a first pin carried by the bracket. A pivot link is pivotably mounted on the first pin and is pivotably connected to one of the control rods. A second pin is carried by the pivot link and is spaced from and at right angles to the first pin. A manual control lever is pivotably mounted on the second pin and includes an arm on which a ball joint is mounted. The arm of the manual control lever is pivotably connected through this ball joint and through suitable linkage to the other control rod. The center of rotation of this ball joint lies on the axis of the first pin. Consequently, pivotal movement of the manual control lever in a first plane about the first pin effects axial movement of the said one control rod. Pivotal movement of the manual control lever in a second plane about the second pin effects axial movement of the said other control rod. Pivotal movement of the manual control lever in any other plane transverse to both the said first and second planes effects simultaneous and proportional movement of both control rods. In a preferred embodiment, the aforesaid linkage comprises a shaft rotatably mounted between the support brackets of the right hand and left hand control lever assemblies. Lever arms secured to and rotatable with the shaft connect one manual control lever and one of the control rods therefor. A bell crank rotatably mounted on the shaft connects the other manual control lever and one of the control rods therefor.

Control lever assemblies in accordance with the invention reduce the number of individual control levers needed to perform specified control functions, simplify operation of the control levers, reduce operator fatigue, reduce the chance of operator error in lever selection, enable smoother control application and have other objects and advantages as will hereinafter appear.

DRAWINGS

FIG. 1 is a side view of a backhoe of the type wherein the invention is advantageously employed;

FIG. 2 is an enlarged top plan view of an operator's control platform assembly and associated control valves of the backhoe shown in FIG. 1;

FIG. 3 is a view of the control platform assembly taken on line 3—3 of FIG. 2;

FIG. 4 is an enlarged side view of one control lever assembly of the platform assembly taken on line 4—4 of FIG. 3;

FIG. 5 is a view of a sub-assembly on the control platform assembly taken on line 5—5 of FIG. 2;

FIG. 6 is a detail view taken on line 6—6 of FIG. 5;

FIG. 7 is a side view of the control valves taken on line 7—7 of FIG. 2;

FIG. 8 is a detail view taken on line 8—8 of FIG. 2;

and
FIG. 9 is an end view taken on line 9—9 of FIG. 8.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 is a side view of a machine such as a backhoe 10 comprising a mobile crawler tractor type lower section 11 having right and left tracks on which a horizon-

tally rotatable upper section 12 is mounted. A boom 13 is mounted for vertical pivotal movement on upper section 12 by a pin 14 and is operated by a hydraulic boom hoist cylinder 15. A stick 16 is mounted for vertical pivotal movement on boom 13 by a pin 17 and is operated by a hydraulic dig cylinder 18. A dipper 19 is mounted for vertical pivotal movement on stick 16 by a pin 20 and is operated by a hydraulic dipper cylinder 21. Upper section 12 of backhoe 10 is rotated by operation of a hydraulic motor 22. Backhoe 10 has an operator's cab 25 wherein a control platform assembly 26 is located on which certain manual and pedal operated controls are mounted.

FIG. 2 is a top plan view of control platform assembly 26 which comprises a rigid metal platform 27, a right hand control lever assembly 28 for operating boom 13 and stick 16, a left hand control lever assembly 29 for operating swing movement of upper section 12 and dipper 19, a right pedal assembly 30 for operating the right track of the backhoe, and a left pedal assembly 31 for operating the left track of the backhoe.

Right hand control lever assembly 28 is connected to and operates a boom hoist control rod 32 (connected to the axially movable valve spool of a boom control valve 33) and a stick control rod 34 (connected to the axially movable valve spool of a stick control valve 35).

Left hand control lever assembly 29 is connected to and operates a swing control rod 36 (connected to the axially movable valve spool of a swing control valve 37) and a dipper control rod 38 (connected to the axially movable valve spool of a dipper control valve 39).

The right and left pedal assemblies 30 and 31 are connected to and operate right and left propel control rods 40 and 41 which are connected to the axially movable valve spools of the right and left propel control valves 42 and 43, respectively. As FIGS. 8 and 9 show, left pedal assembly 31, its control rod 41 and valve 43 are connected as follows. A bracket 50 is secured to platform 27 by bolts 51 and carries a pin 49 which is secured thereto by a fastener 53 which extends into a hole 54 in pin 49 and is attached to bracket 50 by a bolt 55. A treadle 52 is pivotably mounted on pin 49 and an offset clevis 56 is attached to a projection on the treadle by a pin 57. Clevis 56 is secured to one end of rod 41 and the other end of the rod is connected to the axially movable valve stem of valve 43. Rod 41 is provided with a downwardly depending projection 58 which is connected by an adjustable rod 59 to a detent member 60 which extends into a detent mechanism 61 which includes an adjustable spring-load ball (not shown). The detent mechanism prevents movement of rod 41 to operate valve 43 until a predetermined force is applied to treadle 52. It is to be understood that right pedal assembly 30, its control rod 40 and valve 42 are similarly arranged as FIG. 2 shows.

As FIG. 2 shows, the various control valves are arranged or grouped in banks and are located some distance to the rear of the platform 27 and the various control rods therefor are in a generally parallel arrangement beneath the platform.

As FIGS. 2, 3 and 4 show, the right and left hand control lever assemblies 28 and 29 are similar in construction and mode of operation but are reverse-images of each other. To facilitate description, identical components in each assembly are designated herein by the same reference numerals followed by the suffix letter

R or L, depending on whether it is part of the right or left hand assembly.

Platform 27 has holes 70R and 70L for accommodating the assemblies 28 and 29 and the assemblies comprise a support bracket 71R and 71L which are secured to the platform by bolts 72R and 72L. The brackets 71R and 71L have bushings 73R and 73L secured thereto by bolts 74R and 74L and the bushings rotatably support a control lever shaft 75 therebetween. Two levers 76R and 76L, one vertical and the other horizontal are clamped near the ends of shaft 75 and are rotatable therewith. A bell crank 77 is rotatably mounted on shaft 75 and comprises two arms 77L, and 77R, one vertical and the other horizontal.

The brackets 71R and 71L also support first pins 78R and 78L which are parallel to shaft 75. Pivot links 79R and 79L are pivotably mounted on the pins 78R and 78L and have depending portions which are pivotably connected by ball joints 80R and 80L to the boom control rod 32 and the swing control rod 36, respectively. The pivot links 79R and 79L support second pins 81R and 81L, which are disposed above and at right angles to the first pins. Control levers 82R and 82L are pivotably mounted on the second pins 81R and 81L and have arms or extensions 83R and 83L on which a ball joint assemblies 84R and 84L are mounted. The centers of rotation of the ball joint assemblies 84R and 84L lie on the axes of rotation of the first pins 78R and 78L, respectively. The ball joint assemblies 84R and 84L are connected by vertical rods 85R and 85L to ball joints 86R and 86L. Ball joint 86R is pivotably connected to horizontal bellcrank arm 77R and ball joint 86L is pivotably connected to horizontal lever 76L. Vertical lever arm 76R is connected by a ball joint 88R to dipper control rod 38.

The control levers 81R and 82L are provided with offset manually operable handles 89R and 89L and flexible rubber boots, such as 90 shown in FIG. 4, are secured to platform 27 to protect the assemblies 28 and 29.

Referring to FIG. 2, the following motions of the handles 89R and 89L effect the following control functions.

Right hand lever 89R:

Forward (toward left in FIG. 2)—boom lower
Rearward (toward right in FIG. 2)—boom hoist
Right (toward top in FIG. 2)—stick open
Left (toward bottom in FIG. 2)—stick dig.

Left hand lever 89L:

Forward (toward left in FIG. 2)—swing right
Rearward (toward right in FIG. 2)—swing left
Right (toward top in FIG. 2)—dipper dig
Left (toward bottom in FIG. 2)—dipper open

The forward-rearward movements of each control handle 89R or 89L take place in a first plane, while the right-left movements take place in a second plane which is normal to the said first plane. Such independent motion is possible in each control lever assembly 28 and 29 because the center of rotation of the ball joint assemblies 84R and 84L lie on the axes of the pins 78R and 78L, respectively. If a control handle is moved in any plane transverse to the first and second planes, however, two appropriate control functions will result with proportional movement of each, depending on the degree of transverseness.

As FIGS. 2 and 7 show, swing control rod 36 is pivotably connected by a bolt 92 to the lower end of a lever

arm 93 which is, in turn, mounted on a pivot pin 94 on a bracket 95 secured to a platform 96. Platform 96 affords support for the valves 43, 35, 33, 39, 42, and 37. The upper end of lever arm 93 is pivotably connected by a pin 97 to a link 98 which, in turn, is connected by a pin 99 to the linearly movable valve stem of swing control valve 37.

FIGS. 2, 5 and 6 show an arrangement whereby operation of boom hoist control rod 32 for hoist valve 33 also effects operation of another boom rod 100 and its boom valve 101 to accomplish certain control functions which are necessarily involved in the embodiment of the invention shown. Thus, platform 27 carries brackets 102R and 102L which have bushings 103R and 13L that support a cross shaft 104. As FIG. 2 shows, boom hoist control rod 32 is connected by a linkage 105 to a rod 106. Rod 106 includes a depending bracket 107 which is pivotably connected by an adjustable linkage 108 to an arm 109 on cross shaft 103. Cross shaft 104 also carries an arm 110 which is connected by a ball joint 111 to rod 100.

Resume

A backhoe 10 comprises components, such as a machine upper 12, a boom 13, a stick 16, and a dipper 19, which are moved by means of individual actuators, such as a pump 22 and hydraulic cylinders 15, 18, and 21, respectively. Each actuator is controlled by a multi-position main control valve, such as three-position valves 37, 33, 35 and 39 having extend, retract and neutral positions. Each main control valve 37, 33, 35 and 39 comprises a linear movable valve spool which is connected to and operated by a control rod 36, 32, 34 and 38, respectively. The control rods, which are in generally parallel arrangement, extend to a control platform assembly 26 on the machine where they are connected to right and left control lever assemblies 28 and 29, respectively, in accordance with the invention.

Each control lever assembly 28 and 29 is adapted to be connected to move or operate two control rods (and, therefore, two valves) either independently of each other or simultaneously in proportional movement. In the embodiment shown, left hand control lever assembly 29 operates the swing control rod 36 and the dipper control rod 38 and right hand lever assembly 28 operates the stick control rod 34 and the boom hoist control rod 32.

The control lever assemblies 28 and 29 comprise support brackets 71R and 71L mounted on a control platform 27 and first pins 78R and 78L are carried by the brackets. Pivot links 79R and 79L are pivotably mounted on the first pins 78R and 78L and are pivotably connected to the control rods 32 and 36, respectively. Second pins 81R and 81L are carried by the pivot links 79R and 79L and are spaced from and at right angles to the first pins 78R and 78L. Manual control levers 82R and 82L are pivotably mounted on the second pins 81R and 81L and include arms 83R and 83L on which ball joint assemblies 84R and 84L are mounted. The arms of the manual control levers 82R and 82L are pivotably connected through these ball joint assemblies 84R and 84L and through suitable linkage to the other control rods 38 and 34, respectively. The center of rotation of these ball joint assemblies lie on the axes of the first pins 78R and 78L. Consequently, pivotal movement of a manual control lever

in a first plane about its first pin effects axial movement of one of its control rods. Pivotal movement of the same manual control lever in a second plane about its second pin effects axial movement of the other of its control rods. Pivotal movement of the manual control lever in any other plane transverse to both the said first and second planes effects simultaneous and proportional movement of both control rods. In a preferred embodiment, the aforesaid linkage comprises a shaft 75 rotatably mounted between the support brackets 71R and 71L of the right hand and left hand control lever assemblies 28 and 29. Lever arms 76L and 76R secured to and rotatable with shaft 75 connect manual control lever 82L and control rod 38. A bell crank 77 rotatably mounted on shaft 75 connects the other manual control lever 82R and control rod 34.

I claim:

1. In a mobile material handling machine: at least two components which are movable either individually or simultaneously; at least two actuators operable to effect movement of said components, one actuator being provided for each component; and a control lever assembly including a control lever movable to affect operation of said actuators either individually or simultaneously for moving two components either individually or simultaneously, said control lever assembly comprising:
 - a first member mounted on said machine for pivotal movement about a first axis and operatively connected to one of said actuators,
 - a second member to which said control lever is connected mounted on said first member for pivotable movement about a second axis,
 - and ball joint means operatively connecting said second member and the other of said actuators and having its center of rotation on said first axis and spaced from said second axis, whereby an actuator is operated only when the member connected thereto is pivoted about its axis in response to movement of said control lever.
2. A machine according to claim 1 wherein said ball joint means comprises a ball, a link rigidly connected to said ball and operatively connected to said other actuator, and wherein said ball is supported on a ball holding structure which is rigidly connected to and movable with said second member.
3. A machine according to claim 2 wherein said control lever assembly comprises at least a pair of movable control rods, one rod for effecting operation of each actuator, wherein said first member is pivotably connected to a control rod for said one actuator and wherein said link is pivotably connected to a control rod for said other actuator.
4. A machine according to claim 3 wherein said control rods are movable parallel to each other and including a bell crank pivotably connected to said link and to said control rod for said other actuator.
5. A machine according to claim 1 wherein only one actuator is operated when said lever is moved in a first plane, wherein only the other actuator is operated when said lever is moved in a second plane transverse to said first plane, and wherein both actuators are operated proportionately and simultaneously when said lever is moved in a third plane which is transverse to both said first and second planes.

6. A machine according to claim 5 wherein said first and second axes are normal to each other and wherein said first and second planes are normal to each other.

7. A machine according to claim 6 including at least two control rods for said actuators, each control rod being operatively connected between a member and an actuator, and wherein said two control rods are parallel to each other.

8. In a mobile material handling machine:

at least two components which are movable either individually or simultaneously; at least two actuators operable to effect movement of said components, one actuator being provided for each component;

and a control lever assembly comprising:

a support on said machine,

first and second axially movable parallel control rods extending in one direction, each control rod being operatively connected to one actuator,

a first pin on said support and spaced from and transverse to said rods,

a first member pivotably mounted on said first pin and pivotably connected to said first rod,

a second pin on said first member and spaced from and transverse to said first pin,

a second member pivotably mounted on said second pin,

a bell crank on said support and pivotably about an axis transverse to said rods,

one arm of said bell crank pivotably connected to said second rod,

a link pivotably connected to the other arm of said bell crank,

ball joint means connecting said second member to said link,

said ball joint means lying on the same axis of said first pin,

and an opening handle on said second member for pivotally moving said second member on said second pin to move said second rod axially, and for pivotably moving said first member on said first pin to move said first rod axially without effecting axial movement of said second rod.

9. In a mobile material handling machine:

at least four components which are movable either individually or simultaneously; at least four actuators operable to effect movement of said components, one actuator being provided for each component;

first and second control lever assemblies,

each assembly including a control lever adapted to be moved to effect operation of two actuators to thereby move two components either individually or simultaneously, each assembly comprising:

a first member mounted on said machine for pivotal movement about a first axis and operatively connected to one of said actuators,

a second member to which the control lever of the assembly is connected,

said second member mounted on said first member and pivotable about a second axis,

and ball joint means connected to said second member, said ball joint means having its center of rotation on said first axis and spaced from said second axis.

a bell crank connected to the ball joint means of the first assembly and to another of said actuators, and

lever means connected to the ball joint means of the second assembly and to still another of said actuators.

10. A machine according to claim 9 wherein said bell crank and said lever means pivot about the same axis of rotation.

11. In a mobile material handling machine:

at least four components which are movable either individually or simultaneously; at least four actuators operable to effect movement of said components, one actuator being provided for each component;

first and second control lever assemblies, each assembly including a support bracket on said machine,

a pair of control rods, one for each actuator, and a control lever adapted to move said two control rods either individually or simultaneously, each assembly further comprising:

a first pivot pin mounted on the support bracket,

a pivot link pivotably mounted on said first pivot pin and pivotably connected to a control rod,

a second pivot pin mounted on said pivot link, said second pivot pin being disposed at right angles to said first pivot pin,

said control lever of said assembly being pivotably mounted on said second pivot pin,

and ball joint means connected to said control lever,

said ball joint means having its center of rotation on the axis of rotation of said first pivot pin,

a rotatable shaft mounted between the support brackets of said first and second assemblies,

first and second lever arms connected to and movable with said shaft,

one lever arm being pivotably connected to the ball joint means of one control lever assembly and the other lever arm being pivotably connected to a control rod,

and a bell crank pivotably mounted on said shaft, one arm of said bell crank being pivotably connected to the ball joint means of the other control lever assembly and the other arm of said bell crank being pivotably connected to a control rod.

12. A machine according to claim 11 including four control rods arranged in generally parallel relationship to each other and at generally right angles to said shaft.

13. A machine according to claim 12 wherein the axes of the first pivot pins for the first and second control assemblies are generally parallel to the axis of said shaft.

14. A backhoe comprising:

a horizontally rotatable upper section, a boom mounted for vertical pivotal movement on said upper section, a stick mounted for vertical pivotal movement on said boom, and a dipper mounted for vertical pivotal movement on said stick; a swing control valve, a boom control valve, a stick control valve, and a dipper control valve operable to move said upper section, said boom, said stick and said dipper, respectively;

control rods connected to each of said control valves;

a first control lever assembly for operating the control rods for said swing control valve and said dipper control valve;
 and a second control lever assembly for operating the control rods for said stick control valve and said boom control valve;
 each control level assembly comprising a manually operable control lever movable in a first plane to operate one control rod and the valve therefor and movable in a second plane to operate another control rod and the valve therefor, said control lever being further movable in any plane transverse to said first and second planes to effect simultaneous and proportional operation of the two valves associated therewith, each control lever assembly fur-

ther comprising
 a first member mounted on said backhoe for pivotal movement about a first axis and operatively connected to one of said control rods,
 a second member to which said control lever is connected mounted on said first member for pivotable movement about a second axis,
 and ball joint means operatively connecting said second member and another one of said control rods and having its center of rotation on said first axis and spaced from said second axis, whereby a control rod is moved only when the member connected thereto is pivoted about its axis in response to movement of said control lever.

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