

[54] AUTOMATIC RELEASE AND CENTERING DEVICE

[75] Inventor: Dale A. Knutson, Oconomowoc, Wis.

[73] Assignee: Applied Power Inc., Milwaukee, Wis.

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[58] Field of Search 91/358 A, 358 R, 91/360, 426, 337, 425, 378, 43; 137/624.27

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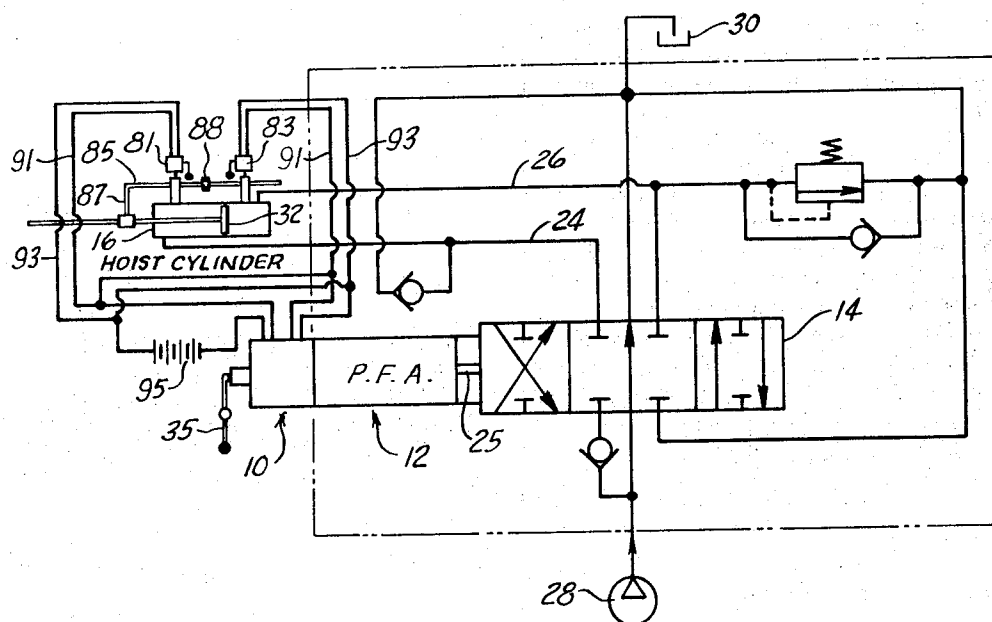
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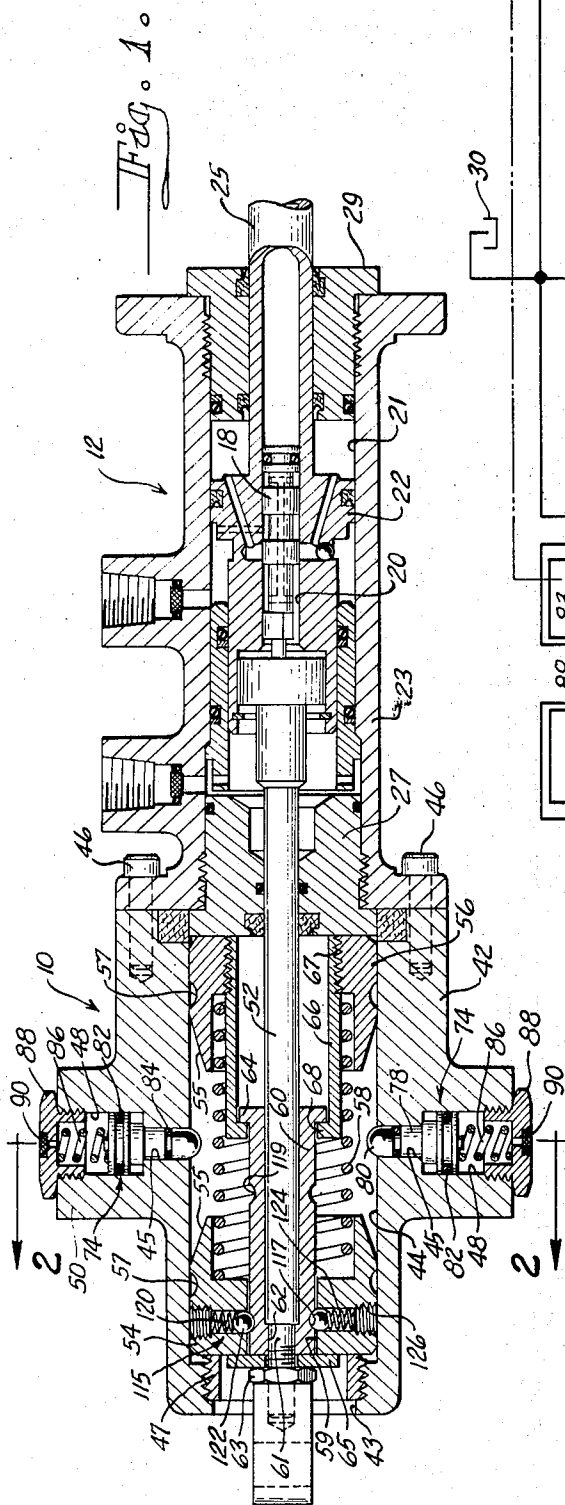
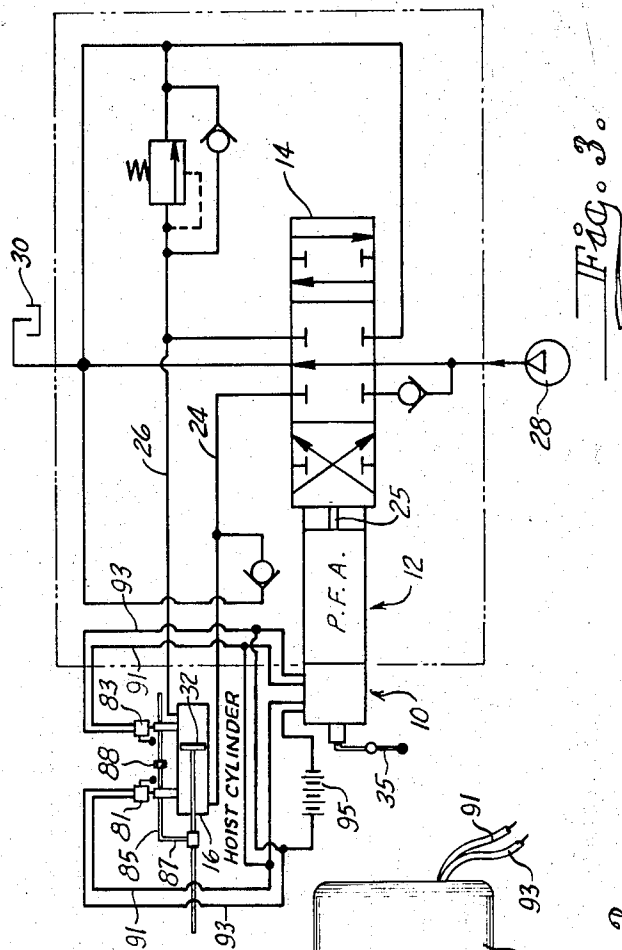
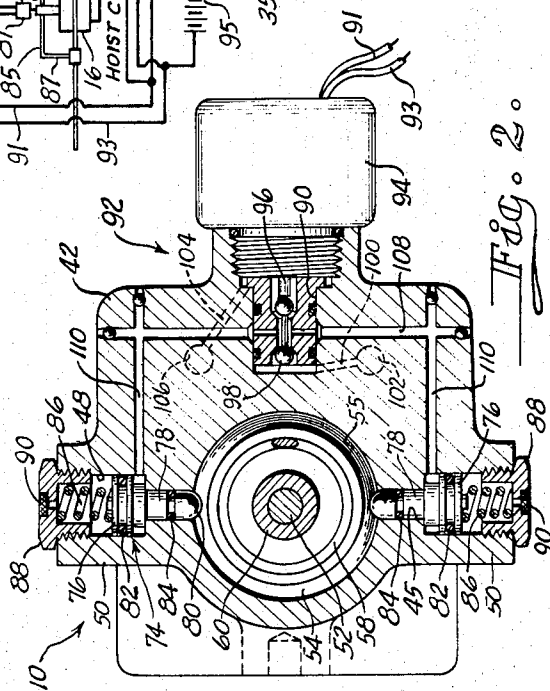
Primary Examiner—Paul E. Maslousky
Attorney—James E. Nilles

[57] ABSTRACT

An automatic release and centering device for a double acting hydraulic cylinder, the device includes a housing, an actuating rod mounted for axial motion within the housing and being connected to the control valve for the hydraulic cylinder, the actuating rod being movable in either direction from a neutral position to an actuated position, a pair of detent members mounted on the rod, each detent member being connected to move in one direction with the rod, a detent assembly positioned to engage and hold a detent member in an actuated position, a spring positioned to bias the detent members and the rod to the neutral position and a pressure actuated release system to release the detent assembly from the detent member.

8 Claims, 5 Drawing Figures



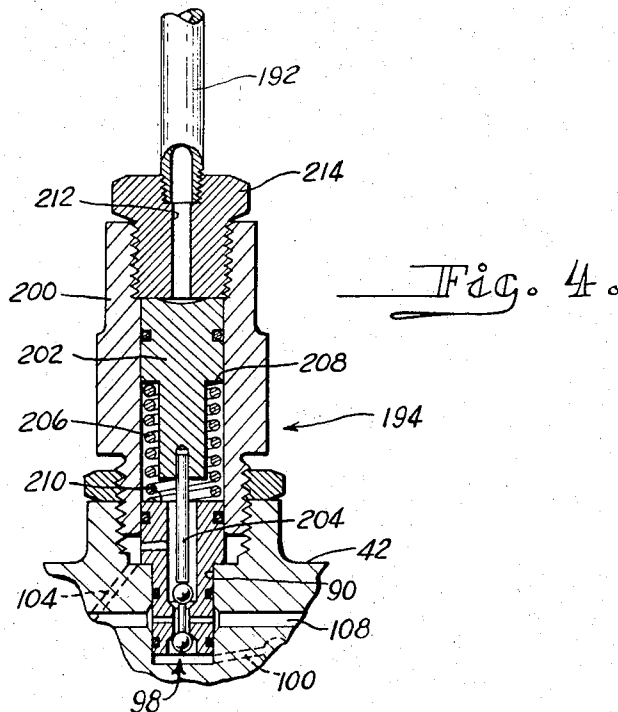
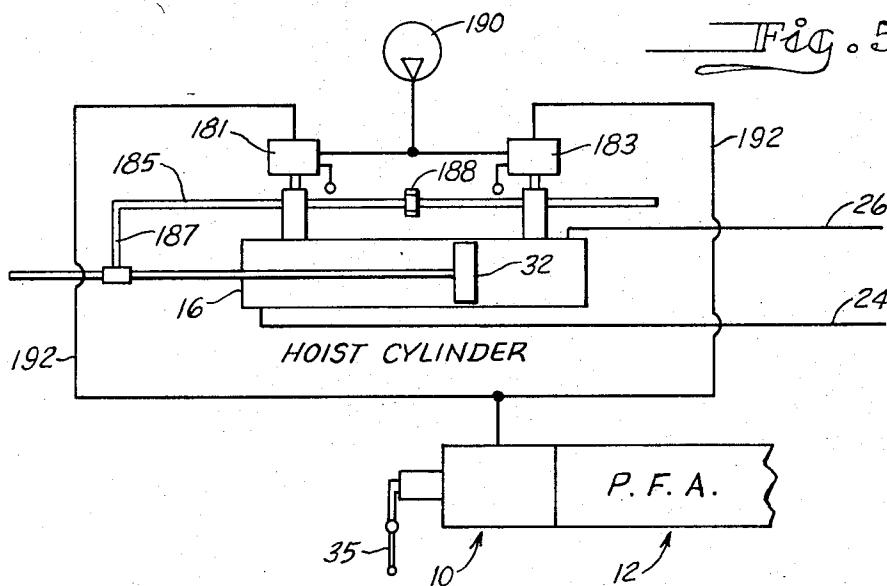


INVENTOR:

DALE A. KNUTSON

BY:

James E. Miller
ATTORNEY



INVENTOR.
DALE A. KNUTSON

BY *James E. Miller*
ATTORNEY

AUTOMATIC RELEASE AND CENTERING DEVICE

BACKGROUND OF THE INVENTION

In hydraulically actuated articulated vehicles such as front end loaders, a number of double acting hydraulic cylinders are used to control the movements of the bucket and boom. These movements are controlled by control levers provided in the cab which are actuated by the operator to initiate the movement of the pistons in the cylinders. The pistons normally will continue to move until the operator returns the levers back to the neutral position. It is not uncommon for the operator, once he has initiated the operation of one of the cylinders, to become pre-occupied with the operation of the loader and to forget to return the lever to the neutral position. As a consequence, excessive hydraulic forces can build up in the cylinder which can adversely affect the hydraulic system.

SUMMARY OF THE INVENTION

The automatic release and centering device of the present invention provides an automatic limit control for the movement of the various hydraulic cylinders in an articulated vehicle. The control valves for the hydraulic cylinders can be automatically returned to neutral when the operator releases the lever or when the piston reaches a preset limit. The operator of the machine can then continue the operation of the loader without damaging or over-loading the hydraulic system. This device can be combined with a proportional force amplifier to provide an increased operating force if the control valve for the hydraulic cylinder requires a greater operating force.

Other objects will become apparent from the following description when read in connection with the following drawings.

THE DRAWINGS

FIG. 1 is a side view in section elevation of the automatic detent release and centering device of the present invention mounted on a proportional force hydraulic booster;

FIG. 2 is a view taken on line 2—2 of FIG. 1 showing a fluid release system for the detent assembly of this invention;

FIG. 3 is a schematic showing of a hydraulic circuit showing the centering device and proportional force amplifier connected to control a three-position four-way control valve for a double acting hydraulic cylinder;

FIG. 4 is an alternate embodiment of the pressure release actuating assembly; and

FIG. 5 is a schematic showing of the pneumatic system for the assembly shown in FIG. 4.

DESCRIPTION OF THE INVENTION

The automatic release and centering device 10 of this invention as seen in FIG. 3 of the drawing is shown mounted on a proportional force amplifier or hydraulic booster 12 which is connected to operate a three-position four-way control valve 14 for a double acting hydraulic cylinder 16. The proportional force amplifier 12 is used to increase the input force of the device 10 to actuate the control valve 14 and can be omitted where small forces are required to operate the control valve 14.

In this regard, the proportional force amplifier 12 is controlled by means of a spool valve 18 (FIG. 1) positioned within an axial bore 20 in a piston assembly 22 which is connected to the control valve 14 by a rod 25. The piston assembly 22 is movable within the central bore 21 in the housing 23 of the amplifier. End caps 27 and 29 are provided at each end of the bore 21. The operation of the proportional force amplifier 12 is more fully described in my copending application entitled "Proportional Force Amplifier," Ser. No. 196,495, filed on Nov. 8, 1971. However, it should be noted that the amplifier provides movement between the spool valve 18 and the piston assembly 22 on a one-to-one ratio.

In order to fully understand the function of the device 10 of this invention, the device 10 is shown in FIG. 3 connected to the control valve 14 for a hydraulic system of the type contemplated herein. In this regard, the control valve 14 is shown connected to the double acting cylinder 16 by hydraulic lines 24 and 26. In the position shown, the control valve 14 is in a null position and hydraulic fluid from a pump 28 passes through the control valve 14 directly into the reservoir or tank 30. On movement of the control valve 14 to either the right or the left, the cylinder 16 will be connected to the pump 28 and will move the piston 32 in response to the increase in fluid pressure in the cylinder 16 as is generally understood. The device 10 can be used to return the control valve 14 to the null position when the control lever 35 is released or when the piston 32 reaches an upper or lower limit.

FIGS. 1 AND 2

The device 10 includes a housing 42 having a central bore or chamber 44 and a radially inwardly extending flange 43 at one end. The housing 42 is shown mounted on the end of the proportional force amplifier 12 by bolts 46 with the other end of the chamber 44 closed by the end cap 27. Radially extending bores 48 are provided in bosses 50 on the outside periphery of the housing and are connected to the chamber 44 by ports 45.

The spool valve 18 of the proportional force amplifier 12 is controlled by means of an actuating rod 52 mounted for axial movement within the chamber 44. The rod 52 is connected to the spool valve 18 at one end and to a manual type actuating lever or push-pull cable generally shown at 35 at the other end. Movement of the actuating rod 52 to the right or left will produce a corresponding movement in the amplifier 12 and in the control valve 14.

Means are provided for centering the actuating rod 52 in a neutral position within the chamber 44. Movement of the actuating rod 52 in a neutral position will also move the control valve 14 to the neutral position. Such means includes a pair of floating detent members 54 and 56 which are mounted on the rod 52 and a spring 58 which biases the detent member 54 outwardly into engagement with an adjustable nut 47 threadedly received within the flange 43 and the detent member 56 outwardly into engagement with end cap 27. The detent members 54 and 56 are mounted for axial movement with respect to the chamber 44 and are connected to move with the actuating rod 52 in one direction and to allow for the free movement of the actuating rod in the other direction.

More particularly, detent member 54 is provided with an outwardly tapered cam surface 55 which termi-

nates at an annular groove 57 and a center bore 59. The member 54 is mounted on a tubular member 60 which is secured to the actuating rod 52. In this regard, the member 60 is provided with an inwardly extending flange 62 at one end and a radially outwardly extending flange 64 at the other end. The rod 52 is drawn up tight against the flange 62 by means of a threaded nut 63 threadedly received on the threaded end 61 of rod 52. A washer 65 is provided between the nut 63 and the end of the member 60 to engage the detent member 54 when the rod 52 is moved in one direction or to the right in FIG. 1. The member 60 is free to move through bore 59 when the rod 52 is moved in the other direction or to the left in FIG. 1.

The detent member 56 is provided with a threaded opening 67 and is threadedly mounted on a tubular member 66 which is also mounted on the actuating rod 52. The member 66 is connected to the member 60 by means of an inwardly extending flange 68 at one end in a position to engage the flange 64 on the member 60. The tubular member 60 is free to move in one direction in member 66 but the flange 64 will engage flange 68 on movement of the tubular member 60 in the other direction. The nut 47 is turned into engagement with the end of detent member 54 after flange 64 engages flange 68 to prevent backlash.

DETENT ASSEMBLY

The actuating rod 52 is held in the actuated position by means of detent assemblies 74 provided in the radially extending bores 48 in the housing 42. Each of the detent assemblies 74 includes a piston 76 having piston rod 78 with a rounded end 80. The piston 76 is sealed within the bore 48 by means of an O-ring seal 82 and the piston rod 78 is sealed in the port 45 by an O-ring seal 84. The pistons 76 are biased inwardly by means of compression springs 86 held in the bore 48 by caps 88. Vents 90 are provided in the caps 88 to vent the bores 48 to atmosphere.

When the actuating rod 52 is moved to the right in FIG. 1, the cam surface 55 on detent member 54 will cam the piston rod 78 outwardly in the bores 48 until the end 80 of the piston rod 78 engages the annular groove 57 in the detent member 54. The actuating rod 52 will then be in an actuated position. The proportional force amplifier 12 will move the control valve 14 to one of its operative positions pressurizing the cylinder 16. The piston 32 will move outwardly from the cylinder 16 as seen in FIG. 3.

Means are provided on the cylinder 16 to sense the position of the piston 32. Such means includes a pair of micro switches 81 and 83 and a rod 85 connected to the piston 32 by a link 87. The rod 85 is mounted to slide past the micro switches 81 and 83 and a nut 88 on the rod will engage one or the other of the switches 81 and 83 when the piston reaches the end of its stroke. The electric signal from the micro switch 81 or 83 is transmitted through lines 91 or 93 to actuate a release mechanism 92 provided in the housing 42. A battery 95 is provided in the line 93 to provide current for the release mechanism provided in the housing 42.

FLUID PRESSURE RELEASE

Referring to FIG. 2, the release mechanism 92 includes a solenoid valve 94 having a plunger pin 96 mounted on the side of the housing 42. The plunger pin 96 is positioned to engage a ball valve 98 mounted in

a bore 90 in the housing 42. The ball valve 98 is used to control the fluid pressure to the detent assemblies 74. The fluid for actuating the detent assemblies can be either pneumatic or hydraulic.

The hydraulic or pneumatic pressure is applied to the detent assemblies 74 through an inlet passage 100 connected to a source of fluid pressure through a port 102 and an outlet passage 104 connected to a reservoir through a port 106. The bore 90 is connected to the bore 48 for the piston assemblies 74 through passages 108 and 110. In the normal position as shown in FIG. 2, the passages 108 are vented to tank through the valve 98, passage 104 and port 106. On actuation of the solenoid valve 94, the position of the ball valve 98 will be reversed connecting the fluid inlet passage 100 to the passages 108 and 110. The pressure of the fluid will move the pistons 76 radially outward in bore 48 against the bias of springs 86 releasing the detent member 54 or 56. The spring 58 will return the detent member 54 or 56 to the initial position. The movement of the detent member will center the actuating rod 52 in housing 42 and will move the control valve 14 to the neutral position through the power amplifier.

FIGS. 4 AND 5

In the embodiment of the sensing mechanism shown in FIGS. 4 and 5, sensing of the cylinder is accomplished by means of a fluid system either hydraulic or pneumatic rather than electric as shown in FIGS. 2 and 3. Referring to FIGS. 4 and 5, such means includes a pair of air or hydraulic valves 181 and 183 mounted on the cylinder 16 and a rod 185 connected to the piston by a link 187. The rod 185 is mounted to slide past the valves 181 and 183 and an adjustable nut 188 on the rod engages one or the other of the valves 181 or 183 when the piston reaches the end of its stroke.

On actuation of one of the valves, fluid from a pressure source 190 will flow through lines 192 to a fluid actuated piston and plunger assembly 194. In this regard the piston and plunger assembly 194 is used in place of the solenoid 94 in FIG. 2 to actuate the ball valve 98. The piston and plunger assembly 194 includes a hollow cylindrical housing 200 having a piston 202 mounted for reciprocal movement therein. The piston 202 includes a plunger 204 which extends outward for engagement with the ball valve 98. The piston 202 is biased outward by a spring 206 positioned between a flange 208 on the piston and a shoulder 210 on the end of the cylinder. Fluid is admitted to the cylinder through a port 212 in a cap 214 which is connected to line 192.

When the nut 188 engages one of the valves 181 or 183, fluid under pressure will be admitted into cylinder 200. The piston 202 and pin 204 will move downward into engagement with ball valve 98 to pressurize the detent assemblies 74. When the piston 32 is moved again, the valve 181 or 183 will close dropping pressure in the cylinder 200. The piston 202 will move away from the ball valve 98 due to the spring force of spring 206 and depressurize the detent assemblies 74.

In the event of unusual vibrations in the control lever 35, the actuating rod 52 can move independently of the detent member 54 and thereby move the control valve to the mid-position. This can be minimized by means of a second detent assembly 115 provided in the detent member 54 and grooves 117 and 119 provided in the tubular member 60. Each detent assembly 115 includes

a spring 120 and a ball 122 positioned in a port 124 in the detent member 54 and held therein by a cap 126. The ball 122 is positioned to ride on the surface of the member 60 into and out of engagement with the grooves 117 and 119. When the detent member 54 is in the actuated position, the rod 52 will be retained in position by the engagement of ball 122 with groove 117. When the detent member 56 is in the actuated position, the actuating rod 52 will be retained in position by the engagement of the ball 122 with the groove.

RESUME

The automatic release and centering device assures an immediate stop in the movement of the piston in a hydraulic cylinder by the automatic return of the control valve for the cylinder to a null or neutral position. When used in conjunction with the operation of the hydraulic cylinders for an articulated vehicle, it allows the operator to predetermine the limits of motion of the piston and to rely on the automatic release and centering device to stop the motion of the piston when it reaches the predetermined limit. The automatic release device can be either hydraulic or pneumatic and in either case provides immediate release of the detent member to allow the actuating member to return to neutral. A proportional force amplifier can be interposed between the device and the control valve if an increased force is necessary to operate the control valve.

I claim:

1. An automatic release and centering device for automatically returning a control valve for a hydraulic cylinder to a null position;

said device comprising a housing having a chamber; an actuating rod mounted for reciprocal motion in said chamber and being connected to the valve; a first detent member connected to move in one direction with said rod;

a second detent member connected to move in the other direction with said rod;

a spring biasing said detent members to an initial position;

means for engaging one of said detent members on movement of said actuating rod in either direction to an actuated position and means for releasing said engaging means from said detent members whereby said engaged detent member is returned to the initial position by the bias of the spring, said engaging means including a piston mounted for radial movement in said housing and a spring for biasing said piston to a position to engage said one of said detent members.

2. The device according to claim 1 wherein said releasing means includes a fluid pressure passage in said housing communicating with said piston and a valve in said passage connected to respond to a signal to pressurize said passage and move said piston radially outwardly to release said piston from the detent member.

3. The device according to claim 1 including a second detent assembly in one of said detent members and a tubular member connected to said actuating rod, said tubular member having a pair of spaced annular grooves positioned to engage said detent assembly and being movable through said one of said detent members.

4. In a hydraulically actuated mechanism having a hydraulic piston and cylinder assembly controlled by a

three position control valve, an automatic centering device connected to return said control valve to neutral when the piston reaches a predetermined limit, said device comprising:

a housing having a chamber,

an actuating member and extending through said chamber, means for connecting said actuating member to said valve,

means in said chamber for biasing said member to a neutral position with respect to said valve; said biasing means including a floating detent member mounted on said actuating member at each end of the chamber, means for connecting each of said detent members in one direction with said actuating member, and a spring positioned to bias said detent members to a neutral position at each end of the chamber;

means mounted in said housing for holding said actuating member in an actuated position in said chamber; said holding means including a bore in said housing, a piston mounted for movement in said bore radially toward said actuating member, a piston rod connected to said piston and positioned in the path of motion of said detent members and a spring positioned to bias said piston toward said detent members;

and means responsive to a signal from the piston and cylinder assembly for releasing said holding means, whereby said actuating member automatically returns to neutral.

5. The device according to claim 4 wherein said releasing means comprises a fluid passage in said housing connected to said bore, a source of fluid pressure connected to said passage and a valve in said passage to control the flow of fluid through said passage to said bore in response to the position of the piston in the cylinder.

6. In a hydraulically actuated mechanism having a hydraulic piston and cylinder assembly controlled by a three position control valve, an automatic centering device connected to return said control valve to neutral when the piston reaches a predetermined limit, said device comprising:

a housing mounted on the amplifier and having a chamber,

an actuating member operatively connected to said amplifier and extending through said chamber,

means in said chamber for biasing said member to a neutral position with respect to said amplifier,

means mounted in said housing for holding said actuating member in an actuating position in said chamber,

means responsive to a signal from the piston and cylinder assembly for releasing said holding means, whereby said actuating member automatically returns to neutral,

and means connected to said piston and cylinder assembly for providing a signal indicating the preset limits of travel of said piston and cylinder assembly to said releasing means, said providing means including a pair of fluid valves and a fluid actuator connected to respond to fluid pressure in said valves.

7. In a hydraulically actuated mechanism having a hydraulic piston and cylinder assembly controlled by a three position control valve, an automatic centering device connected to return said control valve to neutral

when the piston reaches a predetermined limit, said device comprising:

- a housing mounted on the amplifier and having a chamber,
- an actuating member operatively connected to said amplifier and extending through said chamber, means in said chamber for biasing said member to a neutral position with respect to said amplifier,
- means mounted in said housing for holding said actuating member in an actuated position in said chamber,
- means responsive to a signal from the piston and cylinder assembly for releasing said holding means, whereby said actuating member automatically returns to neutral, and
- means connected to said piston and cylinder assembly for providing a signal indicating the present limits of travel of said piston and cylinder assembly to said releasing means, said providing means including a pair of micro switches and a hydraulic solenoid valve connected to said switches for hydraulically releasing said releasing means.

8. In a hydraulically actuated mechanism having a hydraulic piston and cylinder assembly controlled by a

three position control valve, an automatic centering device connected to return said control valve to neutral when the piston reaches a predetermined limit, said device comprising:

- a housing and having a chamber,
- an actuating member and extending through said chamber, means for connecting said actuating member to said valve,
- means in said chamber for biasing said member to a neutral position with respect to said valve,
- means mounted in said housing for holding said actuating member in an actuated position in said chamber,
- means responsive to a signal from the piston and cylinder assembly for releasing said holding means, whereby said actuating member automatically returns to neutral,
- means connected to said piston and cylinder assembly for providing a signal indicating the preset limits of travel of said piston and cylinder assembly to said releasing means, said providing means including a pair of fluid valves, and a fluid actuator connected to respond to fluid pressure said said valves.

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