Dec. 6, 1966 R. R. ERICKSON 3,289,546

HYDRAULIC ACTUATING MECHANISM

Filed Aug. 11, 1964 2 Sheets-Sheet 1

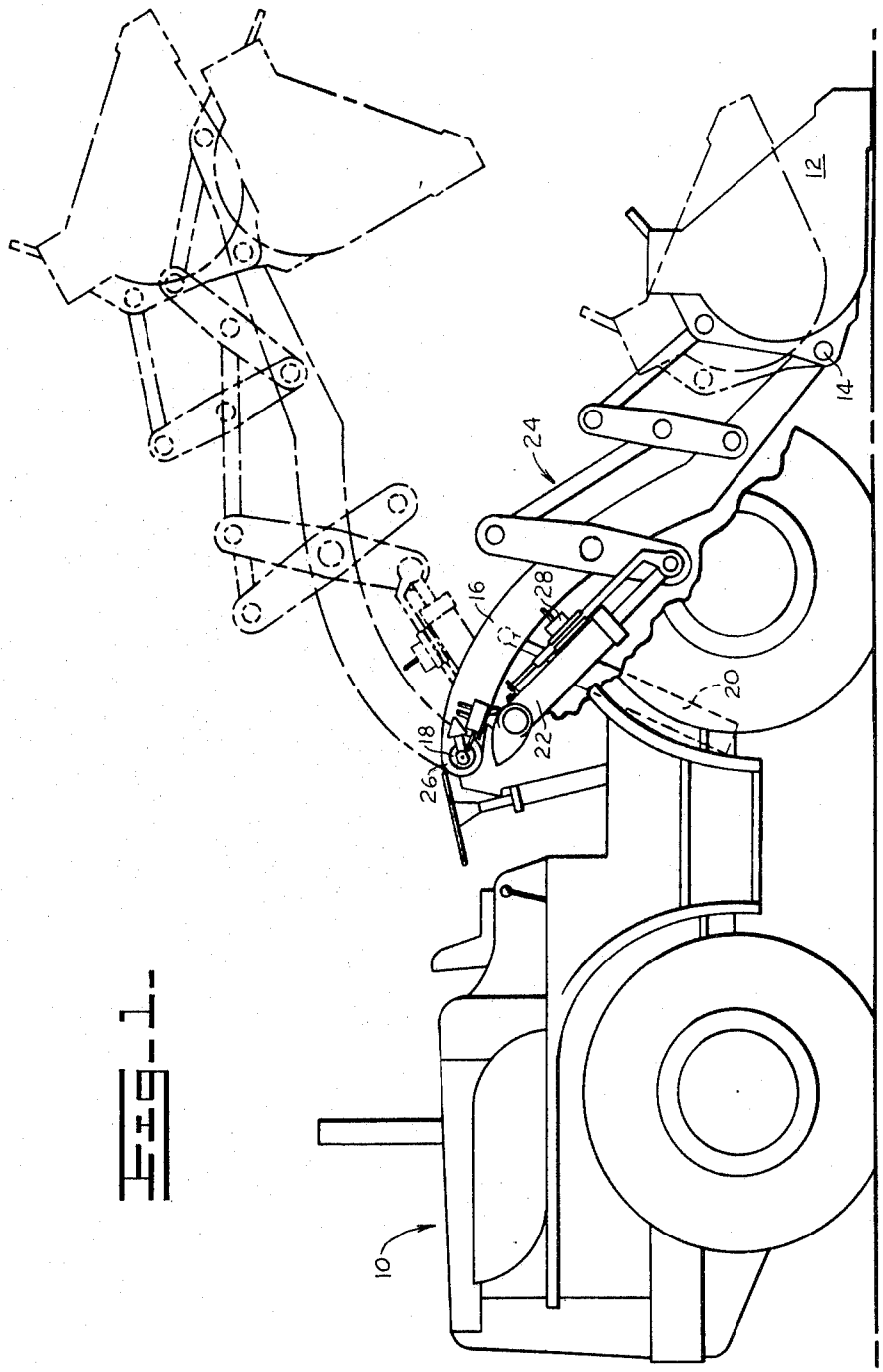


Fig. 1

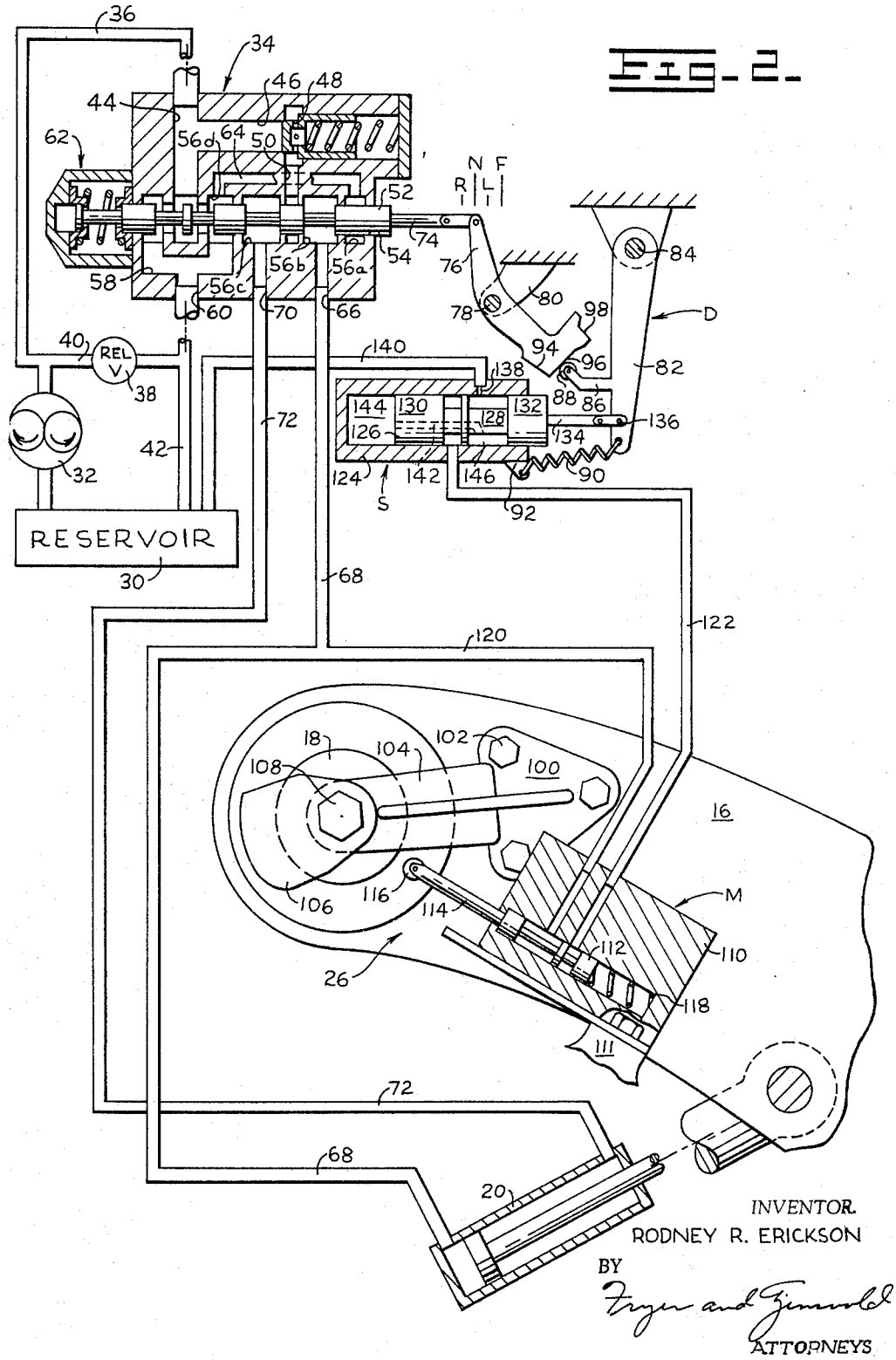
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FIG. 2



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HYDRAULIC ACTUATING MECHANISM

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This invention relates to a hydraulic control device and more particularly to a device for venting the hydraulic circuit during each cycle of operation and for conditioning the hydraulic circuit to interrupt operation of a hydraulic motor.

This invention can be employed to control the flow of actuating pressure fluid to hydraulic motors, particularly linear actuators, in order to interrupt operation of the motor at a desired time, thus positioning an element, whether it be a linkage mechanism, a turntable, or a boom, which is actuated by the motor, at any particular location.

Controls of this general type are the subject of Patent No. 3,122,247 and U.S. application Nos. 208,303 and 286,320, now respectively Patents Nos. 3,211,310 and 3,155,252, all of which are assigned to the assignee of the present invention. Although the controls disclosed by the referred to patents and applications have been largely successful in providing automatic positioning of a loader bucket, problems have arisen relating to the entrainment of air in the hydraulic system causing erratic operation and at times rendering the automatic positioning mechanisms inoperative until such time that the air is purged from the system. This invention provides a hydraulic circuit which includes a cyclically operable valve which is effective, during each cycle of operation of the positioning mechanism, to vent the hydraulic circuit to the atmosphere and thereby maintain the hydraulic circuit free of entrapped air.

In contrast to the separate pilot pressure fluid circuit of the referenced patents and applications which is provided for shifting the main control to arrest operation of the hydraulic motor, this invention employs the working pressure fluid to achieve the same result thus giving rise to a simpler and more trouble-free system.

Accordingly it is an object of this invention to provide a new and improved control device.

Another object of this invention is to provide a hydraulically actuated positioning mechanism wherein the hydraulic circuit is cyclically vented to the atmosphere.

Another object of this invention is to provide a shiftable hydraulic motor valve to vent a portion of the working fluid to a zone of reduced pressure in order to purge and thus maintain the working fluid free of entrapped air.

Another object of this invention is to employ the pressure fluid of the main hydraulic circuit to operate a control device which arrests movement of a positioning mechanism at a desired point.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings.

In the drawings:

FIG. 1 shows a wheeled vehicle having a bucket positioning mechanism incorporating the control device of this invention.

FIG. 2 is a diagrammatic of the hydraulic circuit showing the hydraulic valves in section.

Referring to FIG. 1, a loading apparatus generally indicated by the numeral **10** includes a bucket **12** pivotally connected at **14** to a pair of arms **16**. The arms **16** are pivotally connected at **18** to the frame of the loading apparatus with pivotal movement of the arms **16** about the pivot connection **18** being effected by a hydraulic motor **20**, preferably a jack. The bucket **12** is interconnected to a tilt motor **22** by a linkage system **24** which

operates to hold or retain the bucket **12** in a fixed position relative to the horizontal as it is raised. Retraction of the motor **22** causes the linkage mechanism **24** to effect pivotal movement of the bucket **12** about the pivot **14** thus dumping the contents from the bucket.

The hydraulic circuit for operating the hydraulic motors **20** and **22** includes a lift kick-out mechanism **26** operating to interrupt flow of hydraulic fluid to the motor **20** when the arms **16** have been raised to a predetermined position and a cam kick-out mechanism **28** operating to control the action of motor **22** in order to effect tilting of the bucket **12** about the pivot connection **14** when the arms **16** are in their raised position.

As shown in FIG. 2, the portion of the hydraulic circuit for actuating the motor **20** comprises a reservoir **30** which contains hydraulic fluid that is distributed to the circuit by a pump **32** having the discharge port thereof connected to the inlet port of a control valve **34** by a conduit **36**. A conventional relief valve **38**, located in a branch conduit **40**, maintains the pump discharge pressure at a predetermined value by operating to return a portion of the pressure fluid to the reservoir through the conduit **40** and a conduit **42** open to the reservoir **30**.

Pressure fluid from the conduit **36** is discharged to communicating passageways **44** and **46** formed in the body of the control valve **34**. A check valve **48** operates in response to the value of pressure in the passageway **46** to establish communication between the passageway **46** and another passageway **50** which communicates pressure fluid to a bore **54** containing a reciprocable control spool **52**. The bore **54** is formed with a plurality of longitudinally spaced annular recesses **56***a*, **56***b*, **56***c*, **56***d*, which in conjunction with the lands of the spool control the flow of pressure fluid through the valve **34**. The passageway **44** distributes pressure fluid to a generally U-shaped cavity **58** and a port **60** to which is connected the conduit **42** to thereby return the pressure fluid to the reservoir **30**. A conventional spring centering mechanism **62** is provided for restraining or biasing the spool **52** in a neutral position, which is the position illustrated in the drawing. While in the neutral position, it will be noted that the passageway **44** is in communication with the cavity **58** so that fluid discharged by the pump **32** is immediately returned to reservoir **30** by the conduit **42**.

The spool **54** is adapted to assume various adjusted positions indicated by the letters R, N, L, and F being respectively, the raise position wherein pressure fluid is communicated to the motor **20** effecting extension thereof, a neutral position wherein fluid is returned directly to the reservoir **30**, the lower position wherein fluid is communicated to the motor **20** in order to effect retraction thereof, and a float position wherein fluid is communicated to the rod end and head end of the fluid motor **20** permitting the bucket to be lowered by gravity and to be able to freely follow the terrain over which it is being moved. The annular recesses **56***a* and **56***d* have extending therebetween an internal passageway **64** defining a fluid flow path for returning fluid exhausted from the head end of the hydraulic motor **20** to the recess **56***d*, through the cavity **58** and to the reservoir **30** by the conduit **42**. The recess **56***b* communicates pressure fluid from the passageway **50** to the head end of the motor **20** by a port **66** and a conduit **68** whereas pressure fluid communicated to the recess **56***c* by the passageway **50** is communicated, by a port **70** and a conduit **72**, to the rod end of the motor **20**.

In operation assuming that it is desired to extend the fluid motor **20**, the operator positions the spool **52** adjacent the position indicated by the letter R, blocking communication between the passageway **44** and the U-shaped cavity **58** and establishing communication between the passageway **50** and the discharge port **66**. Under these circumstances the pressure fluid from the pump in-

creases the pressure in the passageway 46 to a sufficient value to cause opening of the check valve 48 and allowing the pressure fluid to flow through the passageway 50 into the annular recess 56*b* and through the discharge port 66 and the conduit 68 to the head end of the hydraulic motor 20 thus causing extension thereof. Retraction of the hydraulic motor 20 is accomplished by moving the spool 52 in the position indicated by the letter L establishing communication between the passageway 50 and the conduit 70 and between the conduit 68 and the passageway 64. With the check valve 48 open, pressure fluid is distributed to the hydraulic motor 20 by the conduit 72 causing retraction of the motor 20. The fluid exhausted from the head end of the hydraulic motor 20 flows through the conduit 68 to the annular recess 56*b*, to the annular recess 56*a*, through the passageway 64 and to the annular recess 56*d* which is in communication with the discharge port 60 thus returning the exhausted fluid to the reservoir 30 by the conduit 42.

The lift kick-out mechanism 26 includes a valve operating in response to the pivotal movement of the arm 16 for communicating pressure fluid derived from the control valve 34 to a slave valve S being effective to release a detent mechanism D thereby conditioning the control valve 34 to interrupt the flow of pressure fluid to the motor 20 and thus halt pivotal movement of the arms 16.

In accordance with the basic features of this invention the hydraulic system illustrated in FIG. 2 is arranged to employ the high pressure fluid for releasing the detent mechanism D and means are incorporated in the slave valve S for venting the hydraulic circuit in order to purge air which may be entrained in the hydraulic system.

As shown, the spool 52 has an extension 74 pivotally connected to an actuating lever 76 mounted for rotation with a shaft 78 which is rotatably mounted in a bracket 80 secured to the frame of the machine. Shifting of the spool to any of the indicated positions is accomplished when the operator rotates the shaft 78 in turn rotating the lever 76 thus effecting reciprocation of the spool 52. In addition to the lever 76 the detent mechanism D comprises another lever 82 pivotally connected to the frame of the machine at 84 and formed with a laterally projecting support arm 86 on the end of which is rotatably mounted a roller 88. The lever 82 is urged in a clockwise direction by a spring 90 having one end attached to the lower end of the lever 82 and the remaining end attached to a small bracket 92 secured to the body of the valve S.

The lower end of the actuating lever 76 is formed with cam surfaces 94, 96, and 98 against which the roller 74 is held in engagement by the spring 90. These cam surfaces are effective in conjunction with the force of the spring 90 to retain the lever 76 and the spool 52 in a desired adjusted position.

It can be seen that rotation of the lever 76 in order to position the spool 52 of the valve 34 in the raised position rotates the lower end of the lever 76 in a counterclockwise direction permitting the roller 88 to come in rolling contact with the cam surface 94 and thus cause, by virtue of the spring 90, clockwise rotation of the lever 82. When the roller 88 is in contact with the cam surface 94, the spool 52 is held in the raised position.

One of the principal features of this invention pertains to the slave valve S which is constructed and arranged in accordance with the operation of the detent mechanism D to vent the hydraulic circuit when the arms 16 have been raised to their predetermined position.

Another important feature of this invention pertains to a high pressure kick-out mechanism operating to communicate pressure fluid discharged through the conduit 68 to the slave valve S in order to rotate the lever 82 of the detent mechanism in a counterclockwise direction thereby returning the spool 52 to its neutral position interrupting movement of the arms 16 at a desired raised position.

As shown in FIG. 2, the kick-out mechanism comprises a base plate 100 rigidly mounted on the arms 16 by plurality of bolts 102. A bracket 104, secured to the plate 100 has a cam 106 secured thereon in any suitable maner and preferably as shown by means of a bolt 108. A valve 110 is rigidly supported on a boss 111, forming part of the frame of the loading apparatus. This valve includes a spool 112 having an outward extension 114 on the end of which is rotatably mounted a roller 116. The spool 112 is normally held in the illustrated position by a spring 118 located within the bore of the spool. The valve 110 is connected by means of a conduit 120 to the conduit 68 and by means of a conduit 122 to the valve S. During such times that the control valve 34 is adjusted to discharge pressure fluid from the pump 32 to the conduit 68 in order to pressurize the head end of the motor 20, the cam 106 engages the roller 116 moving the spool 112 to the right (as viewed in FIG. 2) thereby establishing communication between the conduit 120 and 122 thus communicating presure fluid to the slave valve S.

When the spool 52 is shifted leftwardly in order to admit pressure fluid to the conduit 68 causing extension of the motor 20, the actuating lever 76 is rotated in a counterclockwise direction and the lever 82 by virtue of the spring 90 is rotated in a clockwise direction establishing rolling engagement between the roller 88 and the cam surface 94.

The slave valve S is hydraulically arranged with the valve 110 and mechanically arranged with the detent mechanism D to vent the fluid in the conduit 122 and to permit the spring centering mechanism 62 to return the spool 52 to its neutral position when the arms 16 have reached a predetermined raised position. The valve S comprises a tubular body 124 having a spool 126 reciprocably mounted therein. The spool has a reduced diameter portion 128 extending between inner and outer lands 130 and 132 respectively. An elongated rod portion 134 extending from the land 132 is pivotally connected at 136 to the lower portion of the lever 82. An orifice 138 is provided in the wall of the body 124, located between the lands 130 and 132, and is connected by means of a conduit 140 to the reservoir 30. As shown, the conduit 122 establishes communication between the valve 110 and the valve S in order to communicate pressure fluid from the conduit 120 to the valve S when the spool 112 is moved inwardly by the cam 106. A passageway 142 (shown in dotted outline) establishes communication between a chamber 144 and an annular cavity 146. The passageway 142 is provided for communicating pressure fluid, communicated to the cavity 146 by the conduit 122, to the cavity 144 in order to cause shifting of the spool 126 to the right. By virtue of the pivotal connection 136 it will be apparent that shifting of the spool 126 to the right causes consequent counterclockwise rotation of the lever 82.

In describing the operation it will be assumed that the hydraulic motor 20 is to be extended raising the arms 16 and the detent mechanism D is adjusted so that the roller 88 is in contact with the cam surface 94 and the spool 126 of the slave valve S is accordingly shifted to the left a sufficient distance establishing communication between the conduit 122 and the orfice 138. As the arms 16 reach their predetermined raised position, the spool 112 of the valve 110 is shifted by the cam 106 to establish communication between the conduits 120 and 122 thereby communicating pressure fluid to the cavity 146. A part of the fluid communicated to the slave valve S is exhausted through the orifice 138 to the reservoir 30 by the conduit 140. The remaining portion of the fluid is communicated to the chamber 144 by the passageway 142 increasing the pressure in this chamber a sufficient amount to overcome the bias of the spring 90 and shift the spool 126 to the right. Such shifting in turn causes counterclockwise rotation of the lever 82 and consequent disengagement of the roller 88

from the cam surface 94. Thus spring centering mechanism 62 of the control valve 34 is made effective to position the spool 52 in a neutral position blocking flow of pressure fluid to the conduit 68 to arrest further extention of motor 20. It is seen that the slave valve S is effective to constitute a release mechanism for the detent D and at the same time purge any air that may be entrapped in the hydraulic system every time the arms 16 are actuated to their raised position.

Although the slave valve S has been shown and described with a loader mechanism or loading apparatus, it is to be appreciated that it may be incorporated in any hydraulic circuit where cyclic automatic purging is desired.

What is claimed is:

1. A control device for a fluid circuit comprising a moveable support, a fluid motor being arranged to impart movement to said support, a valve mechanism for communicating pressure fluid to said motor to cause operation thereof, means including a pressure operated device connected to the circuit for maintaining said valve mechanism in a position communicating pressure fluid to said motor, and means actuated in response to the position of said support and being operable to communicate pressure fluid to said pressure operated device for disconnecting said motor from a source of pressure fluid in order to arrest movement of said moveable support.

2. A control device for automatically venting a hydraulic control circuit comprising a moveable support, a hydraulic motor being arranged to impart movement to said support, a valve mechanism for communicating pressure fluid to said motor to cause operation thereof, means including a pressure operated device connected to the circuit for maintaining said valve mechanism in a position communicating pressure fluid to said motor, means actuated in response to the position of said support and being operable to communicate line pressure fluid to said pressure operated device for disconnecting said motor from a source of pressure fluid in order to arrest movement of said moveable support, said pressure operated device being formed to define a chambered portion communicating with the source of fluid by a conduit, and means for throttling the flow of the fluid flowing between said chamber and the source of fluid.

3. A control device for automatically venting a hydraulic control circuit comprising a double acting linear actuator; a control valve including a reciprocable spool for controlling the flow of pressure fluid to said actuator to thus effect extension or retraction thereof; a support arranged to be moved by said actuator; means for biasing said spool to a neutral position blocking communication of pressure fluid to said actuator; a detent mechanism for holding said spool in an adjusted position against the bias of said biasing means in order to communicate pressure fluid to said actuator and thereby effect movement of said support; a detent release valve operated by the pressure fluid derived from said control valve and in response to the movement of said support for rendering said biasing means effective

to move said spool to the neutral position and thus arrest movement of said support; and means associated with said detent release valve for venting the fluid communicated thereto to a zone of reduced pressure.

4. A control device for venting a hydraulic circuit comprising a fluid control valve having a spool reciprocably mounted therein, a double acting linear actuator connected to said control valve, said spool being adjustable to communicate pressure fluid to said actuator to effect extension and retraction thereof, a detent mechanism rendered operative when said spool is adjusted to effect extension of said actuator and maintain said spool in its adjusted position, a fluid operated detent release mechanism including a housing having a reciprocable valve element formed with land portions and a rod portion, means effective upon the extension of said actuator for communicating pressure fluid from said control valve to an annular chamber of said detent release defined by said rod and land portions, throttling means for exhausting a part of the fluid communicated to said annular chamber to a zone of reduced pressure and thereby purging entrapped air from the circuit, and a passageway in said valve element communicating fluid from said annular chamber to a second chamber defined by one of said lands and said housing in order to effect shifting of said valve element, said valve element being connected to said detent mechanism so that upon shifting thereof as aforesaid release of said detent is effected.

5. In combination, a hydraulic motor, a selectively operable control valve for controlling the flow of pressure fluid from a source to said motor, a reciprocable spool in said control valve formed with an elongated extension located outwardly of the valve body, a first link having one end pivotally connected to said extension and the other end formed to define a cam surface, a second link supporting a cam follower in contact with siliently biased to bring said follower in contact with said cam surface, valve means having a reciprocable spool connected to said second link, said last mentioned spool being moved in one direction by the bias imparted to said second link and in the other direction by pressure fluid communicated to said valve means, a valve operable in response to the operation of said motor communicating pressure fluid to said valve means for moving said spool thereof in said other direction against the bias of said second link to permit disengagement of said cam and follower and allow said first mentioned spool to interrupt flow of pressure fluid to said motor.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,289,546 December 6, 1966

Rodney R. Erickson

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 4, for "maner" read -- manner --; column 6, lines 36 and 37, strike out "in contact with siliently" and insert instead -- and being resiliently --.

Signed and sealed this 19th day of September 1967.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents