

- [54] **FORCE RELEASE DEVICE**
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- [51] Int. Cl. .... F15b 13/16
- [58] Field of Search ..... 92/30; 91/358 A, 91/378, 337; 137/624.27

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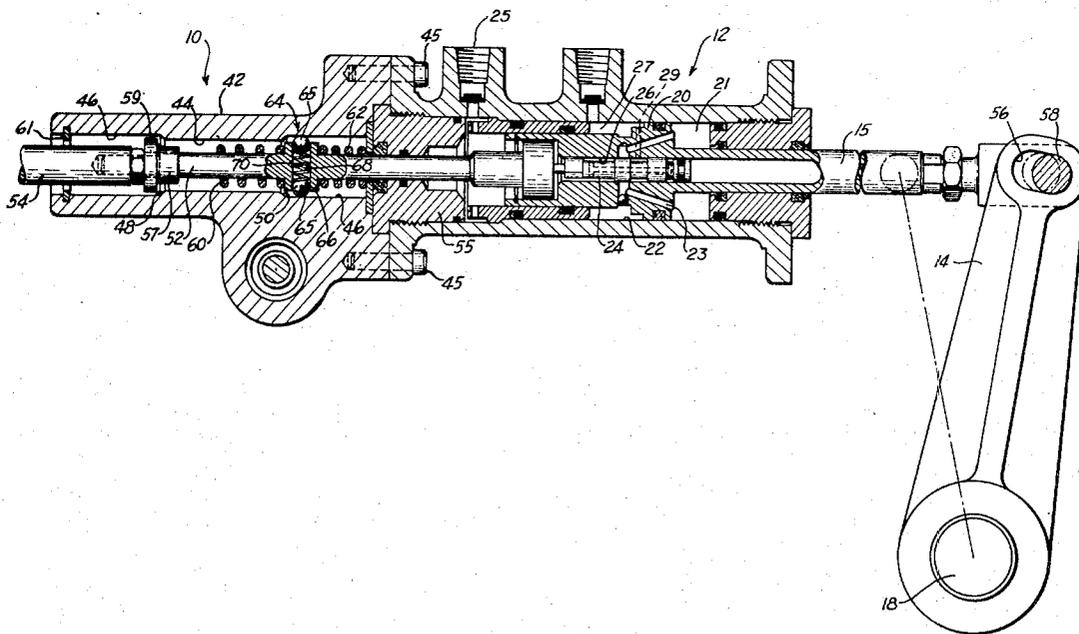
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[57] **ABSTRACT**

A force release device for relieving the force imparted to a lever actuated mechanism by a proportional force amplifier, the device including a manually controlled actuating member connected to the amplifier, a pair of detent stops spaced a distance apart less than the stroke of the amplifier, a detent assembly mounted on the actuating member in a position to engage said detent stops and a spring on each side of the assembly to bias the actuating member in direction opposite to the direction of manual operation.

7 Claims, 3 Drawing Figures



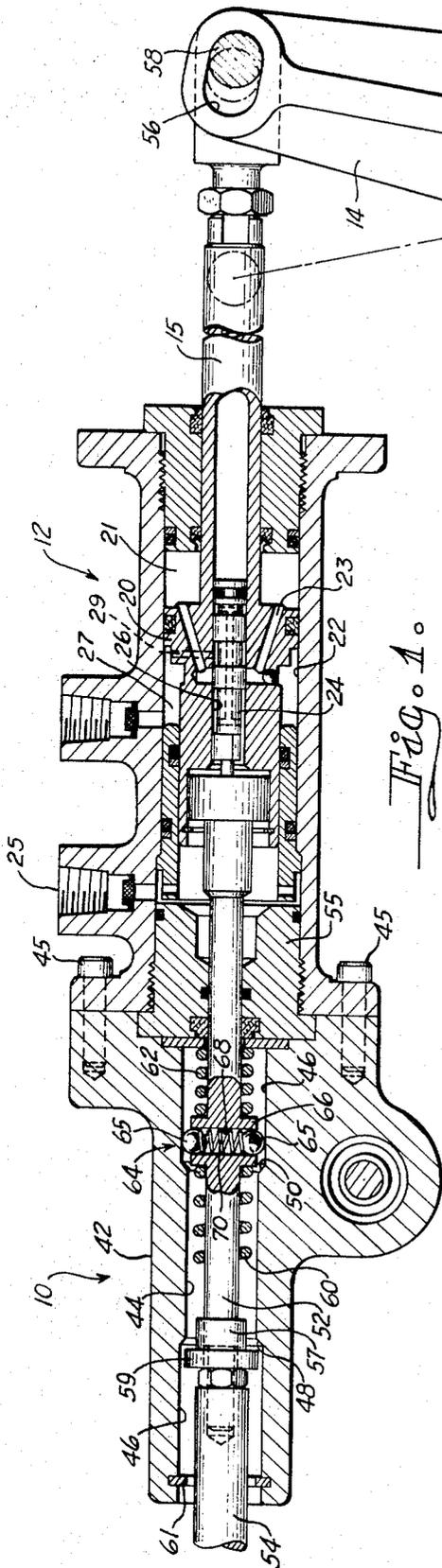


Fig. 1.

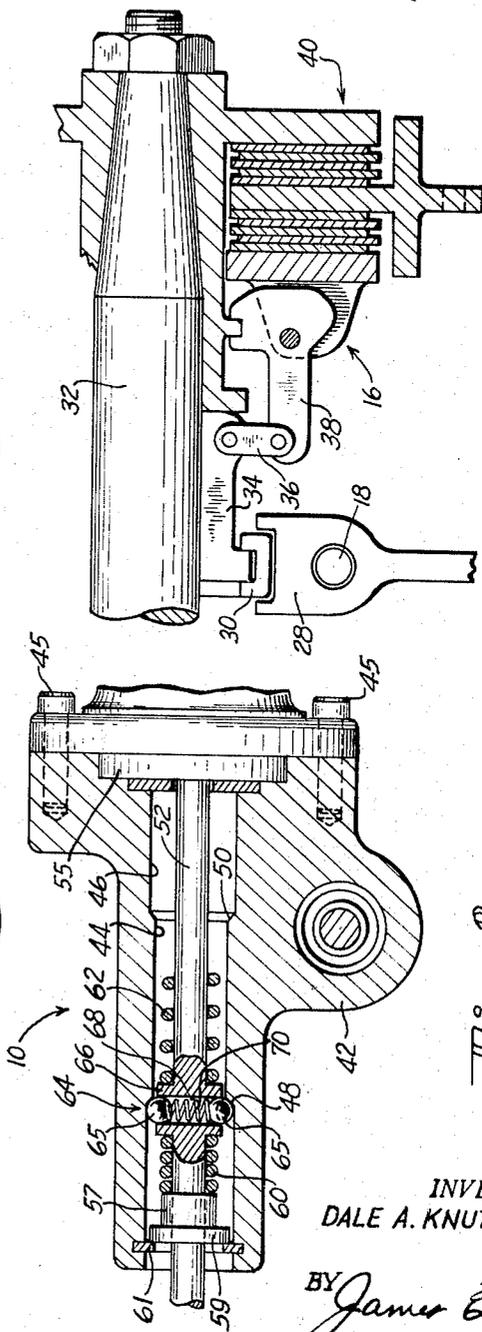


Fig. 3.

Fig. 2.

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## FORCE RELEASE DEVICE

### BACKGROUND OF THE INVENTION

Where a proportional force amplifier is used to move a lever actuated mechanism to an operative position it is often undesirable to leave the application of hydraulic force on the mechanism. This is particularly true in the case of a disc type clutch which is moved between engaged and disengaged positions by means of an over-center linkage. Once the clutch has been engaged, there is no longer any necessity to apply hydraulic force to the linkage system. Where there is continued motion between parts of the linkage or lever system, excessive friction or wear can occur which reduces the life of the system.

### SUMMARY OF THE INVENTION

The force release device of this invention provides for the automatic release of force on a linkage or lever actuated system on release of the actuating or input force. This is achieved by providing a small return motion to the actuating rod on release of the input force. The actuating rod is biased by the springs provided on the rod on each side of a detent assembly. Detent stops are provided to limit the amount of return motion of the detent assembly as well as the actuating rod so that the amount of return motion is not applied to the linkage system.

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

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view in elevation of the force release device mounted on a proportional force amplifier which is connected to an actuating lever;

FIG. 2 is a view of the actuating rod in the disengaged position with the detent assembly seated in a detent stop; and

FIG. 3 is a schematic showing of an over-center linkage assembly for a disc clutch which is actuated by the proportional force amplifier.

### DESCRIPTION OF THE INVENTION

The force release device 10 of the invention is seen in FIG. 1 of the drawing is shown mounted on a proportional force amplifier or hydraulic booster 12 of the type shown in my co-pending United States Pat. application Ser. No. 196,495, filed Nov. 8, 1971, and entitled "Proportional Force Amplifier." The proportional force amplifier 12 is connected by means of an output shaft 15 to a lever arm 14 for a lever actuated clutch mechanism 16 (FIG. 3). The lever arm 14 is connected to a common shaft 18 for the clutch mechanism to engage and disengage a clutch as more particularly described below.

The proportional force amplifier 12 is used to increase the input force from the force release device 10 and to transmit the increased force through a piston assembly 20 to the lever arm 14. The piston assembly 20 is mounted for reciprocal motion within a chamber or bore 22 in the proportional force amplifier 12 and is controlled by means of a spool valve 24 positioned within an axial passage 26 in the piston assembly 20. Movement of the spool valve 24 to the right in FIG. 1 produces a corresponding movement in the piston assembly 20 by connecting chamber 21 to the tank

through passages 23, bore 26 and outlet 25. The drop in pressure in chamber 21 will allow the piston assembly 20 to move a corresponding distance to the right due to the inlet pressure in inlet chamber 27. Movement of the spool valve 24 to the left will connect the chamber 21 to inlet pump pressure through passages 23, 29 and chamber 27. The increase in pressure in chamber 21 will allow the piston assembly 20 to move a corresponding distance to the left. The operation of the proportional force amplifier 12 of this type is more completely described in my co-pending United States Pat. application Ser. No. 196,495.

The clutch mechanism 16 as seen in FIG. 3 is representative of the type of mechanism with which the force release device 10 of this invention can be used. In this regard, the clutch mechanism 16 includes an actuator arm 28 which is mounted on the shaft 18 and is positioned to engage an annular ring 30 which is mounted to rotate with a drive shaft 32. Axial movement of the annular ring 30 with respect to the shaft 32 is used to impart axial motion to a sleeve 34 which is connected by means of an over-center link 36 to a bellcrank 38. Pivotal movement of the bellcrank 38 engages or disengages a disc clutch generally shown at 40. In the position shown in FIG. 3, the clutch 40 is in the engaged position and since the link 36 has been moved over center, there is no longer any necessity to maintain a hydraulic force on the lever arm 14. It should be noted that the annular ring 30 rotates continually with the shaft 32 and the continued application of force produces an undesirable amount of wear between the ring 30 and the actuator 28 as well as binding forces within the linkage assembly.

### FORCE RELEASE DEVICE

In accordance with the invention, the force release device 10 is used to automatically retract the proportional force amplifier 12 a short distance, without disengaging the clutch to relieve the force on the lever arm 14. The force release device 10 generally includes a housing 42 having an axially extending bore 44 and a counterbore 46 on each end. Each of the counterbores 46 terminates at a shoulder or detent stop 48 and 50 at each end of the bore 44. The housing 42 is mounted on the proportional force amplifier 12 by means of bolts 45.

An actuating rod or member 52 is mounted for axial movement within the bore 44 of the housing 42 and is connected at one end to the spool valve 24 of the proportional force amplifier 12 and at the other end to a flexible input cable 54. A detent assembly 64 is provided in the actuating rod 52 for movement through the bore 44. A sleeve 57 having a flange 59 is mounted for axial movement on the rod 52 and is retained in counterbore 46 by a retainer ring 61.

In an arrangement as described herein, the stroke of the proportional force amplifier 12 and the actuating rod 52 has to be sufficient to move the lever arm far enough to engage and disengage the clutch 40. For example, in a clutch mechanism as shown in FIG. 3, a predetermined stroke of two inches is necessary to move the sleeve 34 far enough to move the link 36 over center. In order to relieve the hydraulic force of the proportional force amplifier 12 from the lever arm 58, the actuating rod 52 should be retracted approximately 0.200 inches.

In this regard, it should be noted that the lever arm 14 is provided with an elliptical opening 56 which is connected to the output shaft 15 by a pin 58. Retraction of the actuating rod 52 and the proportional force amplifier 12 will retract the pin 58 without moving the lever arm 14, since the length of the stroke required to actuate the clutch mechanism is known, the amount of retraction required to relieve the force acting on the lever arm is determined by the length of the bore 44 or the distance between stops 48 and 50.

Retraction of the actuating rod 52 is achieved by means of the springs 60 and 62 mounted on the actuating rod 52. The spring 62 is positioned between the detent assembly 64 provided in the actuating rod 52 and the end cap 55 of the proportional force amplifier 12. As shown in FIG. 1, the spring 62 is compressed between the detent assembly 64 and the end cap 55. On release of the cable 54, the spring 62 will bias the detent assembly 64 into engagement with the detent stop 50. The movement of the detent assembly 64 to the left in the drawing into engagement with detent stop 50 will also move the spool valve 24 the same distance to the left. The piston assembly 20 will follow the spool valve 24 moving the pin 58 toward the center of slot 56.

Referring to FIG. 2, the spring 60 is shown positioned between the detent assembly 64 and the sleeve 57. When the actuating rod is moved to the left, the flange 59 on sleeve 57 will engage the retainer ring 61 and the spring 60 will be compressed between the sleeve 57 and the detent assembly 64. On release of the cable 54, the spring 60 will bias the detent assembly 64 into engagement with detent stop 48. The small movement of the detent assembly 64 into engagement with detent stop 48 will also move spool valve 24 to the right the same distance. The piston assembly 20 will follow the spool valve 24 moving the pin 58 toward the center of slot 56.

#### DETENT ASSEMBLY

The detent assembly 64 which is provided in the actuating rod 52 includes a flange 66 which extends radially outward from the actuating rod 52. A cross bore 68 is provided in the flange 66. A pair of detent balls 65 are positioned in the cross bore 68 and are biased outwardly by means of a spring 70 so that the balls 65 ride on the surface of the counterbore 46 and the bore 44. The amount of reverse motion of the actuating rod 52 to relieve the force of lever arm 14 must be sufficient merely to move the pin 58 part way back in the opening 56 in the lever arm 14. As indicated above, a reverse motion of 0.200 inches is sufficient for the clutch mechanism shown in the drawing.

I claim:

1. A device for relieving the force imparted to a lever actuated mechanism by a hydraulically actuated proportional force amplifier being movable through a predetermined stroke, fluid control means including a spool valve controlling flow of pressurized fluid to the amplifier.

said device comprising an actuating member connected to the spool valve and adapted to be manually moved through a predetermined stroke to actuate the spool valve,

first and second detent stops located a distance apart less than said predetermined stroke of the actuating member,

a detent assembly connected to said actuating mem-

ber and being positioned to engage said detent stops and first and second means for biasing said actuating member toward said detent stops on release of said actuating member whereby the force of said amplifier acting on said lever actuated mechanism is released.

2. The device according to claim 1 wherein said first and second biasing means comprise a pair of springs mounted on said actuating member, one of said springs being located on each side of said detent assembly.

3. A force release device for a hydraulically actuated proportional force said amplifier having a predetermined stroke;

said amplifier including fluid control means.

said device comprising a housing having a bore;

an actuating member positioned in said bore and being connected to said amplifier, said member being adapted to be manually actuated to move the amplifier through the predetermined stroke;

a pair of fixed stops in said housing spaced a distance apart less than the predetermined stroke of said amplifier;

a detent assembly mounted on said actuating member in a position to engage one or the other of said detent stops and means for biasing said actuating member in a direction counter to the direction of actuation, whereby on release of said actuating member said detent assembly will be moved into engagement with one of the detent stops and withdraw said actuating member to relieve the force acting on said amplifier.

4. The device according to claim 3 wherein said biasing means comprises a pair of springs; one spring being located at each end of the actuating member.

5. The device according to claim 3 wherein said detent assembly comprises a cross-bore in said actuating member,

a pair of detent balls in said cross-bore,

and a spring in said cross-bore biasing said detent balls outwardly.

6. A force release device for relieving the force imparted by a hydraulically actuated proportional force amplifier to a lever actuated mechanism movable between engaged and disengaged positions,

said amplifier including fluid control means;

the amplifier being movable through a predetermined stroke to engage and disengage the mechanism;

said device comprising a housing mounted on the amplifier and having an axially extending bore;

a pair of annular detent stops located in said bore;

an actuating rod in said bore connected to the amplifier and being adapted to be manually actuated to move the amplifier through the predetermined stroke;

a detent assembly movable with said actuating rod to a position beyond one of said detent stops on actuation of said amplifier and a spring on each end of said rod to bias said rod and said detent assembly into engagement with one of the detent stops on release of said actuating rod.

7. The device according to claim 6 wherein detent stops are spaced apart a distance less than the stroke required to engage or disengage the mechanism.

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