Dec. 17, 1968 R. B. McCREERY 3,416,406

HYDRAULIC RAM WITH MOVEMENT DECELERATING LIMIT STOP

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Fig. 1

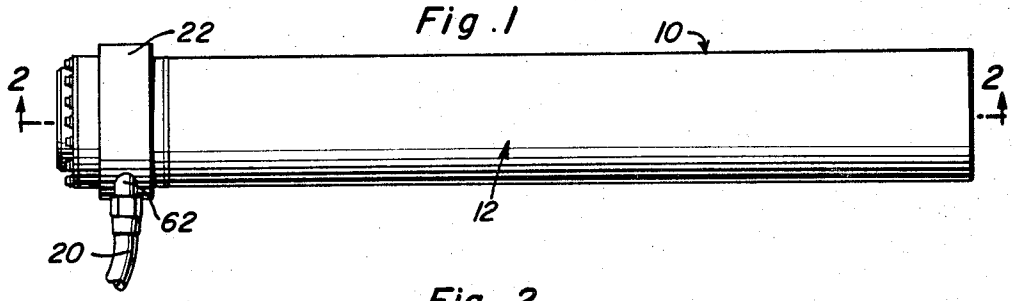


Fig. 2

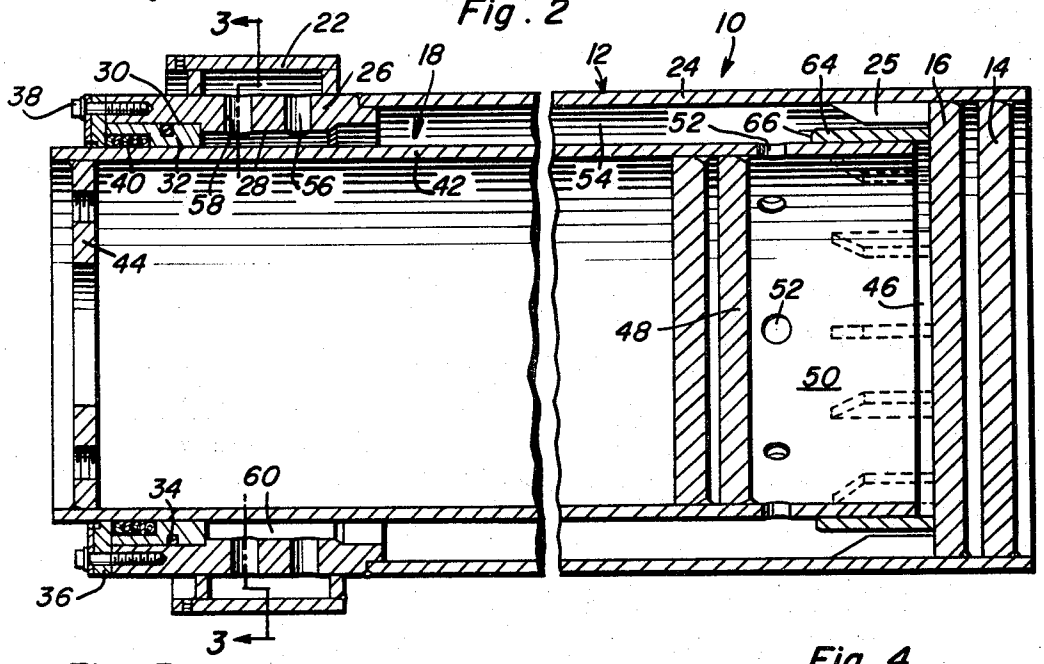


Fig. 3

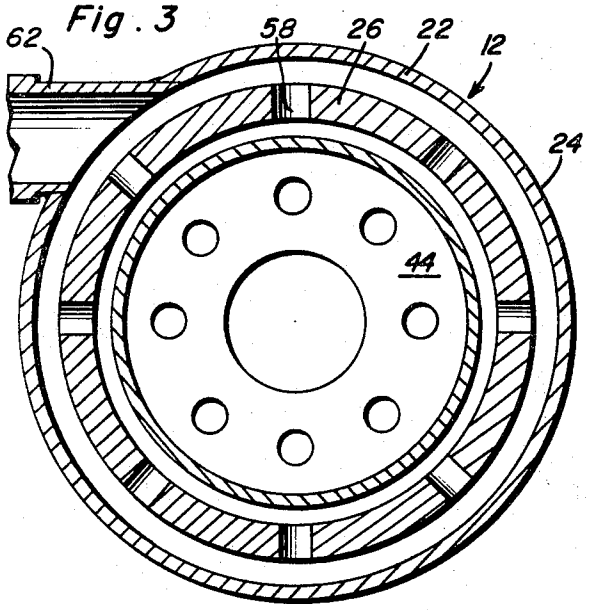
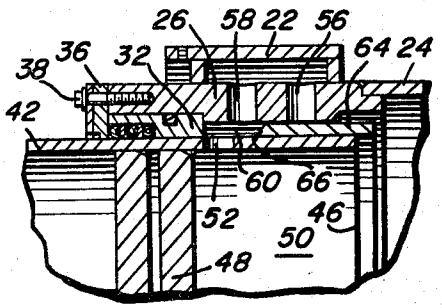


Fig. 4



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Fig. 5

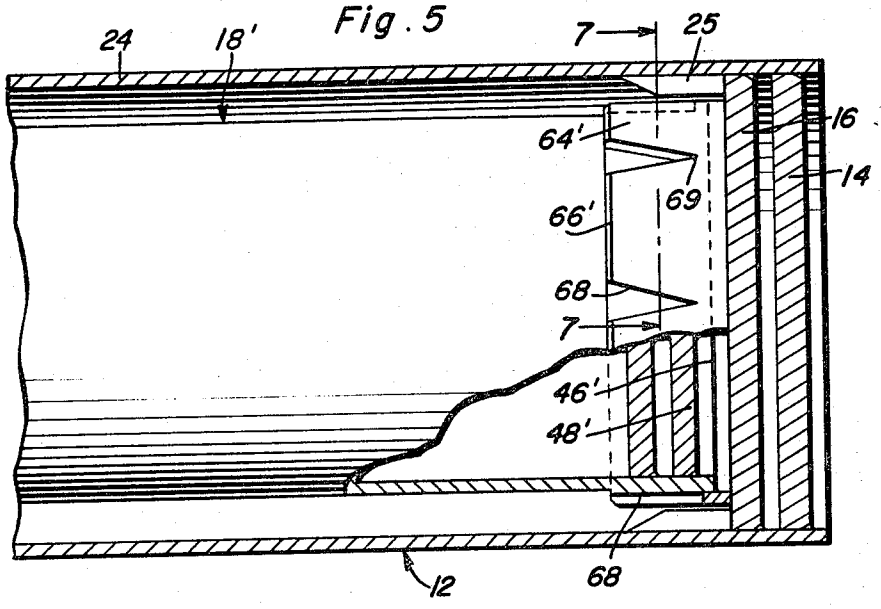


Fig. 6

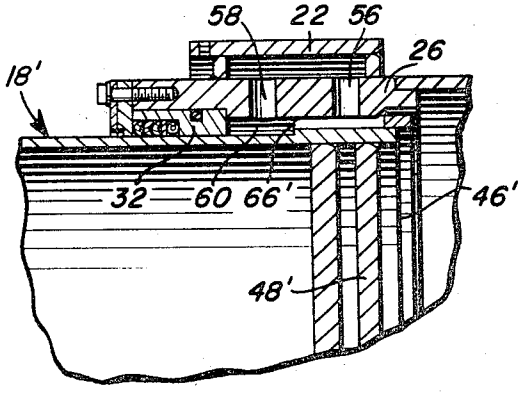


Fig. 7

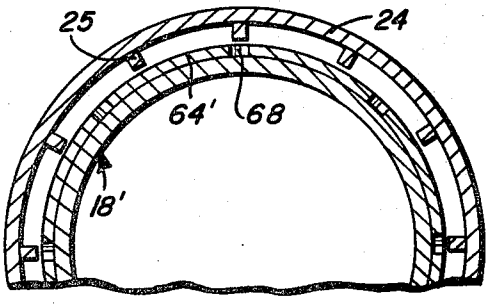
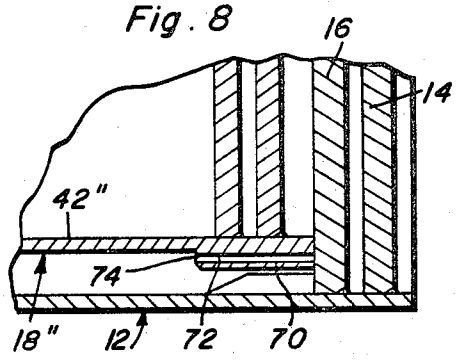


Fig. 8



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HYDRAULIC RAM WITH MOVEMENT DECELERATING LIMIT STOP

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13 Claims. (Cl. 91—27)

ABSTRACT OF THE DISCLOSURE

A hydraulic cylinder assembly equipped with an emergency slow-down device progressively cutting off the inflow of hydraulic fluid to the volumetrically expanding work chamber as the piston ram approaches the end of its stroke, in order to prevent damage to the assembly from impact of the ram with a positive stop. The reduction in the inflow rate of hydraulic fluid to the work chamber is accomplished internally of the cylinder assembly.

Background of the invention

This invention relates to fluid operated cylinder assemblies utilized for example in elevator installations, having a positive stroke limiting stop as well as fluid control means for decelerating and stopping movement of the ram before it approaches the end of its stroke.

In connection with the usual hydraulic cylinder assemblies associated with elevator installations, electrical control facilities are usually provided for decelerating movement of the ram so as to stop such movement before the stroke limiting stop is engaged. Inasmuch as such cylinder assemblies do not have any built in decelerating device, malfunction of the electrical decelerating controls would result in substantial damage in view of the relatively high flow rate of hydraulic fluid and high pressures utilized to advance the ram. The impact forces generated as a result of any instantaneous stop of the ram at the end of the stroke should the electrical decelerating system fail, would be virtually impossible to contain without damage to the system and the equipment.

Summary of the invention

In accordance with the present invention, the hydraulic cylinder assembly of the aforementioned type is provided internally with emergency slow-down means through which movement of the ram is decelerated as it approaches a positive stop position should the valve control system through which fluid under pressure is supplied to the cylinder assembly fail to effect decleration and stop movement of the ram in the usual manner.

An important feature of the present invention in accordance with the foregoing objective, is to effect deceleration of the ram by volumetrically reducing the flow rate of hydraulic fluid into the working chamber of the cylinder device without any excessive build-up in pressure as in the case of the usual hydraulic cushion devices.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Brief description of the drawing

FIGURE 1 is a side elevational view of a hydraulic cylinder assembly with which the present invention is associated.

FIGURE 2 is an enlarged partial, side sectional view through the cylinder assembly taken substantially through a plane indicated by section line 2—2 in FIGURE 1.

FIGURE 3 is a transverse sectional view taken substantially through a plane indicated by section line 3—3 in FIGURE 2.

FIGURE 4 is a partial side sectional view of a portion of the cylinder assembly shown in FIGURE 2 with the ram approaching the end of its stroke.

FIGURE 5 is a partial side sectional view of another form of the invention.

FIGURE 6 is a partial side sectional view of the form shown in FIGURE 5 in another operative position.

FIGURE 7 is a partial transverse sectional view taken substantially along section line 7—7 in FIGURE 5.

FIGURE 8 is a partial side sectional view of a third form of the invention.

Description of the preferred embodiment

Referring now to the drawings in detail, it will be observed from FIGURES 1 and 2 that the hydraulic cylinder assembly generally referred to by reference numeral **10** with which the present invention is concerned, includes an axially elongated cylindrical housing **12** one end of which is closed by the end walls **14** and **16** welded internally to the cylindrical wall **24** of the housing. The opposite end of the cylindrical housing is open so that the ram generally referred to by reference numeral **18**, may project therefrom. Fluid such as hydraulic oil is supplied under pressure to the housing adjacent the axial end from which the ram projects by means of a fluid supply conduit **20** connected by fitting **62** to a fluid inlet manifold **22** mounted on the housing. By controlling the inflow rate of fluid to the cylinder assembly by a suitable electrically controlled valve system (not shown) movement of the ram from the cylinder assembly may be decelerated before it reaches the end of its stroke. However, should the control valve assembly fail to stop movement of the ram, it will be decelerated in accordance with the present invention by facilities mounted internally of the cylinder assembly.

As shown in FIGURES 2 and 3, the major portion of the housing **12** may be constructed from the annular wall **24** provided with circumferentially spaced ram guides **25** projecting radially inwardly at the end wall **16** for maintaining the ram **18** concentric to the housing **12** during shipment of the cylinder assembly. At the other end of the housing wall **24**, a valve sleeve portion **26** is secured as by welding to the housing wall **24** having the same outside diameter but presenting an internal annular valve surface **28** of a substantially smaller internal diameter than the housing wall **24**. The valve sleeve **26** also is provided with a recessed end portion **30** receiving an annular slide bearing member **32** slidably supporting the ram and having an annular groove seating O-ring seal **34**. The slide bearing member **32** is held assembled within the recess portion **30** by means of the annular end plate **36** fastened to the valve sleeve portion **26** by a plurality of circumferentially spaced fasteners **38**. A pressure sealing gland **40** is also held assembled by the end plate **36** within the slide bearing member **32** in wiping engagement with the ram **18** in order to seal the open end of the housing **12**.

The ram **18** is formed from a tubular member **42** dimensioned for slide bearing contact with the annular bearing member **32** and wiping contact with the gland **40**. The forward end of the ram has welded thereto an annular plate **44** through which the load may be attached to the ram. Mounted in spaced relation to the other end **46** of the ram, are a pair of internal walls **48** forming an end cavity **50** within the ram. The end portion of the tubular member **42** of the ram adjacent to the internal wall **48**, is provided with a plurality of circumferentially spaced passage openings **52** through which fluid communication is established between the end cavity **50** and the annular portion of the work chamber **54** formed between the in-

ternal wall of the housing member 24 and the external surface of the tubular member 42 of the ram.

It will be observed, that the valve sleeve 26 of the housing is provided with at least two axially spaced series of inlet ports 56 and 58 through which fluid under pressure is conducted from the annular manifold 22 to the work chamber 54 through the annular valve passage 60 formed between the internal valve surface 28 and the external surface of the tubular ram member 42. The inlet ports 56 and 58 are enclosed by the inlet manifold to which the supply conduit 20 is connected by the fitting 62. Fluid at an undiminished inflow rate may therefore enter the work chamber 54 so as to exert pressure on the end wall 16 of the housing and the internal cavity wall 48 of the ram causing outward movement of the ram from the housing. In order to limit movement of the ram, a stop sleeve 64 is mounted as by welding on the external surface thereof adjacent to and projecting axially from the end 46. The stop sleeve 64 is shown in FIGURE 2 in abutment with the end wall 16 of the housing corresponding to the fully retracted position of the ram.

With reference to FIGURE 2 and FIGURE 4, it will be observed that the external diameter of the stop sleeve is dimensioned so as to form a sliding fit with the internal valve surface 28 of the valve sleeve 26 in order to progressively close the inlet ports 56 and 58 as the stop sleeve enters the valve passage 60. It will be apparent from the foregoing, that as the ram approaches the end of its stroke defined by abutment between the end 66 of the stop sleeve and the bearing member 32, the axially spaced inlet ports 56 and 58 and then the passage openings 52 are progressively closed in order to gradually reduce the inflow of fluid under pressure to the work chamber 54 through the cavity 50 of the ram. This gradual reduction in the inflow of fluid causing expansion of the work chamber results in a deceleration of the ram as the work chamber volume expands to its maximum volume. Thus, this slow-down in ram movement avoids excessive impact and escape of fluid without any substantial increase in fluid pressure as in the case of hydraulic cushioning devices. Further, the gradual cut-off of fluid to the work chamber of the cylinder assembly is accomplished by facilities mounted internally of the cylinder assembly which will always be available and in a functioning condition should the usual external decelerating controls fail to operate.

FIGURES 5, 6 and 7 illustrate a cylinder assembly having a modified form of ram 18' closed adjacent the inner axial end 46' by the end walls 48' wherein the passage openings 52 and work chamber 50 as shown in FIGURE 2 are eliminated. Instead, a stop sleeve 64' having circumferentially spaced, triangular slots 68, is welded to the end portion of the ram projecting axially therefrom for engagement with end wall 16 of the housing as shown in FIGURE 5. The slots 68 converge away from the stop edge 66' terminating at points 69 just axially beyond end walls 48' to restrictively conduct fluid into the work chamber and gradually reduce the inflow of fluid to the work chamber, formed between the end walls 16 and 48' of the housing and ram respectively, when the ram approaches the end of its stroke as shown in FIGURE 6.

A further modified form of ram 18'' is shown in FIGURE 8 having a diametrically enlarged end valve portion 70 replacing the stop sleeves as shown in the previously described forms of the invention. Stop portion 70 cooperates with the cylinder housing 12 as in the other forms of the invention to progressively reduce inflow through the inlet ports for slow-down purposes. Restricted flow of fluid is however conducted into the working chamber through axial passages 72 formed in end portion 70 at circumferentially spaced locations. The end portion 70 also provides a stop edge 74 which functions to positively limit movement of the ram by abutting the bearing 32 as hereinbefore described in connection with stop edges 66 and 66'.

The foregoing is considered as illustrative only of the

principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. In combination with a ram having a fluid cavity portion adjacent one axial end, an axially elongated housing having a closed axial end and sealed bearing means slidably supporting the ram within the housing to form an annular chamber thereabout in fluid communication with said fluid cavity portion, means mounted on the housing adjacent to the bearing means for supplying fluid under pressure to the annular chamber causing movement of the ram relative to the housing, and decelerating means mounted on the ram adjacent said cavity portion cooperating with said fluid supplying means for volumetrically reducing the supply of fluid when the cavity portion of the ram reaches the bearing means to decelerate said movement of the ram.

2. The combination of claim 1 wherein said fluid supplying means comprises an end portion of said housing having axially spaced inlet ports therein in spaced adjacency to the bearing means and a fluid pressure manifold mounted on the housing enclosing the inlet ports, said inlet ports being progressively closed by the decelerating means when approaching engagement with the bearing means.

3. The combination of claim 2 wherein said cavity portion of the ram includes an annular wall opened at said one axial end of the ram, an internal wall axially spaced from said one axial end, said annular wall having a plurality of passage openings therein between the internal wall and said one axial end of the ram conducting fluid from the annular chamber of the housing toward said closed axial end of the housing.

4. The combination of claim 3 wherein said decelerating means includes a stop portion on said ram adjacent said one axial end thereof forming an abutment shoulder engageable with the bearing means and an external valve surface progressively closing the inlet ports of the fluid supplying means.

5. The combination of claim 1 wherein said cavity portion of the ram includes an annular wall opened at said one axial end of the ram, an internal wall axially spaced from said one axial end, said annular wall having a plurality of passage openings therein between the internal wall and said one axial end of the ram conducting fluid from the annular chamber of the housing toward said closed axial end of the housing.

6. The combination of claim 5 wherein said decelerating means includes a stop portion on said ram adjacent said one axial end thereof forming an abutment shoulder engageable with the bearing means and an external valve surface progressively closing the flow supplying means.

7. The combination of claim 1 wherein said decelerating means includes a stop portion on said ram adjacent said one axial end thereof forming an abutment shoulder engageable with the bearing means and an external valve surface progressively closing the flow supplying means.

8. The combination of claim 7 wherein said fluid supplying means comprises an end portion of said housing having axially spaced inlet ports therein in spaced adjacency to the bearing means and a fluid pressure manifold mounted on the housing enclosing the inlet ports, said inlet ports being progressively closed by the external valve surface when approaching engagement with the bearing means.

9. In combination with a ram and a housing having one end from which the ram is advanced in response to expansion of a work chamber of varying volume, means supplying fluid under pressure to the chamber for expansion thereof, emergency decelerating means mounted on

the ram for volumetrically reducing the supply of fluid when the volume of said chamber approaches a maximum value, said decelerating means including a stop portion on said ram adjacent a closed inner end forming a valve surface to progressively close said fluid supplying means, and restrictive passage means on the ram conducting fluid into the work chamber from the fluid supplying means.

10. The combination of claim **9** wherein said fluid supplying means includes axially spaced inlet ports formed in the housing adjacent said one end thereof, a fluid pressure manifold mounted on the housing enclosing the inlet ports, said inlet ports being progressively closed by the valve surface of the stop portion on the ram.

11. The combination of claim **10** wherein said stop portion includes a sleeve fixed to the ram axially projecting from said inner end thereof within the housing, said sleeve having a stop edge axially spaced from the inner end of the ram for abutting the housing at said one end thereof.

12. The combination of claim **11** wherein said restrictive passage means is formed by slots formed in said sleeve converging from said stop edge to locations, axially beyond the closed inner end of the ram.

13. The combination of claim **10** wherein said restrictive passage means is formed by axial passages formed in the stop portion.

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