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HYDRAULIC CYLINDER WITH FAST-ACTING MEANS

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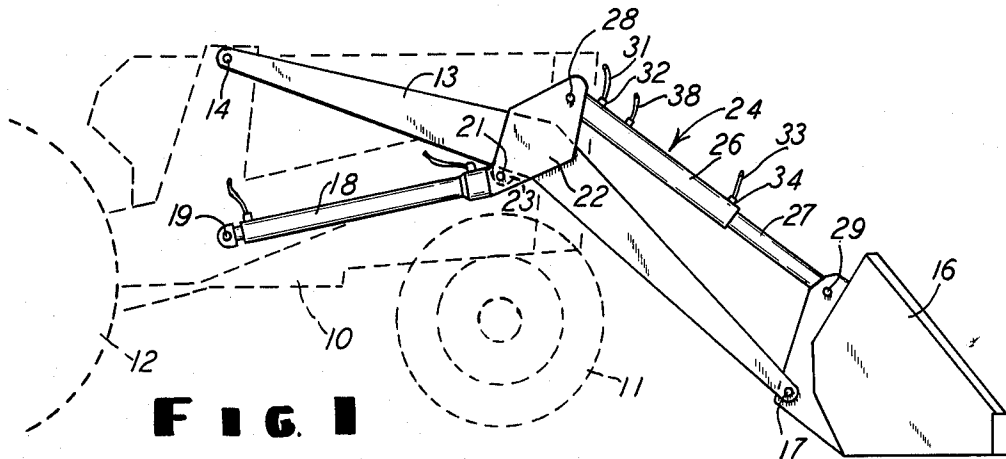


FIG. 1

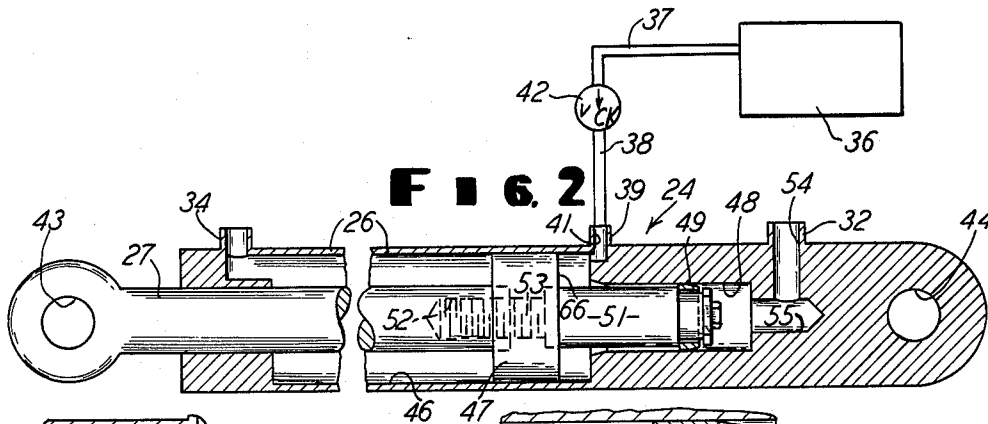


FIG. 2

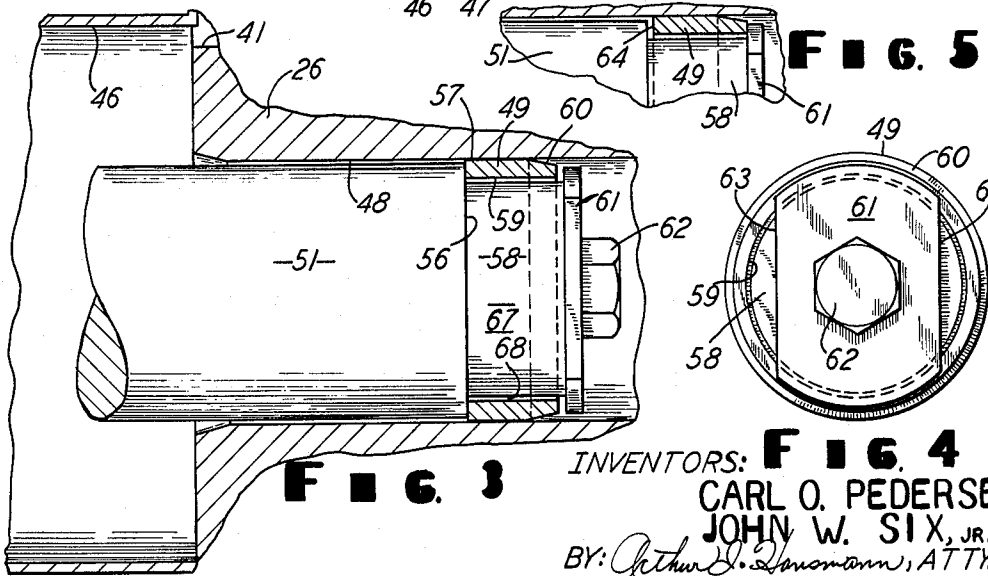


FIG. 3

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3,260,167 HYDRAULIC CYLINDER WITH FAST-ACTING MEANS

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This invention relates to a fluid actuated power unit, and more particularly, it relates to a hydraulic cylinder with a means for causing the cylinder to act rapidly during at least an initial portion of the stroke of the piston of the unit.

It is a general object of this invention to provide a fluid actuated power unit which receives a single supply of fluid in that the fluid is under a given pressure and it acts on the power unit to provide a fast action of the unit in one position thereof and to provide a powerful action of the unit in another position thereof.

A more specific object of this invention is to provide a hydraulic cylinder which receives fluid under pressure and has the piston move rapidly in one position or stage of the cylinder unit, and the piston moves slower but with more power in another stage of action of the unit. This particular object is accomplished by means of a constant supply of fluid pressure to the cylinder unit in that the fluid pump may be acting at one speed to produce one given flow of fluid, but the cylinder unit has the dual action mentioned.

Another object of this invention is to provide a hydraulic cylinder unit which can accomplish the aforementioned objects and to do so with a cylinder unit which is not complicated in its construction, and which can be readily provided and arranged in the manufacture thereof to have the accelerated portion of the stroke of a selected or desired length, and of course to have the more powerful portion of the stroke also of a desired length. The unit of this invention is also not only inexpensive and relatively simple to manufacture, but it is also easy to maintain and repair when necessary. There are no parts to become unduly subjected to wear, and there are no parts which can be inoperative in their normal use since the moving parts are limited to only one part which is movable to accomplish the high speed stage of action mentioned.

Still another object of this invention is to provide a hydraulic cylinder unit which initially reacts to fluid pressure to have a fast stroke, and to have the parts of the cylinder so arranged so that they are self-adjusting with respect to the cylinder bore.

Other objects and advantages become apparent upon reading the following description in light of the accompanying drawings, wherein:

FIG. 1 is a side view of a tractor in dotted lines having a front end loader mounted thereon and a hydraulic cylinder incorporating a preferred embodiment of this invention.

FIG. 2 is a fragmentary and sectional view of the cylinder shown in FIG. 1 and having additional parts shown thereabove.

FIG. 3 is an enlarged view of a fragment of FIG. 2.

FIG. 4 is an end view of a part of FIG. 3.

FIG. 5 is a fragment of FIG. 3 with a part thereof in a different position.

This particular invention has application to hydraulic cylinders, and accordingly it will be described in that art. Further, the invention has application to the power control of earth moving buckets, such as a front end loader mounted on a tractor, and accordingly FIG. 1 shows this arrangement, and the invention will be specifically described in this art to show a particular application. It

will of course be obvious from this description of the invention that the invention is useful in other applications as well as in the one to be described.

FIG. 1 shows a tractor in dotted lines and generally designated 10 and having a front wheel 11 and a rear wheel indicated 12. A boom 13 is shown in solid lines and is mounted on the tractor by means of a pivot member designated 14 to extend the boom forwardly of the tractor as shown. The forward end of the boom supports an earth loading bucket 16 which is pivoted to the boom by means of the pivot member 17 such as the pin shown. It will of course be understood that the boom 13 is thus pivotal up and down to raise and lower the bucket 16 in the well-known manner. To accomplish the pivotal movement, a hydraulic cylinder 18 is mounted on the tractor by means of the pivot pin 19, and it is connected to the boom by means of a pivot pin 21. A plate 22 is integral with the hydraulic cylinder 18, and it will thus be seen that a depending plate 23 on the boom 13, and the extension plate 22, have the pin 21 extending therethrough to connect the cylinder 18 to the boom 13. Thus upon extension and retraction of the cylinder 18, the boom 13 is pivoted up and down as desired.

The power unit of this invention is generally designated 24 and is shown to include a cylinder 26 and a piston rod 27. The cylinder 26 is pivotally connected to the plate 22 through the pin 28, and the piston rod 27 is pivotally connected to the bucket 16 through a pin 29. Thus it will also be understood that extension and contraction of the hydraulic cylinder unit 24 will cause the bucket 16 to pivot around its mounting pin 17 on the boom 13.

The hydraulic cylinder unit 24 is shown to be a double acting unit and it therefore has a hydraulic line 31 attached to one end of the cylinder 26 connecting stub 32 on the cylinder 26. Likewise a hydraulic line or hose 33 is connected to the other end of the cylinder 26 through a stub 34 on the cylinder 26.

In the particular application of this cylinder unit to the front end loader shown, it is desirable to have the cylinder unit 24 act quickly when the boom 13 is raised and it is desired that the bucket 16 be dumped of its contents. Conversely, when the fast dump stage is completed, it is desirable to have the cylinder unit 24 in a more powerful position both for further extension of the piston rod 27 and for the retraction of the rod 27 with respect to the cylinder 26.

FIG. 2 shows the interior of the hydraulic cylinder unit 24, and it also shows a reservoir 36 connected to the unit through lines 37 and 38 at a connecting stub 39 leading to the interior of the cylinder 26 through a pasageway 41. The lines 37 and 38 also have a check valve 42 therebetween so that the flow cannot move upwardly as indicated in the line 38 but can only move downwardly and into the cylinder 26 from the reservoir 36, all for a purpose more apparent hereinafter.

FIG. 2 also shows the piston rod 27 has a circular opening 43 for reception of the pin 29, and the cylinder 26 has a circular opening 44 for reception of the pin 28. The unit is therefore mountable in the position shown in FIG. 1.

Generally, the hydraulic unit 24 has a primary piston bore 46 and a primary piston 47 is fluid-tightly and slidably disposed within the bore 46. The unit also has a secondary piston bore 48 and a secondary piston 49 is slidably disposed in the bore 48 and is fluid tight with the circular wall shown defining the bore 48. The piston 47 is of course connected to and supported by the piston rod 27, and the piston 49 is connected to and supported by the piston rod 51. The latter is in turn connected to the piston 47 and the piston rod 27 by threading therein as indicated. Thus the piston rod 27 and the piston 47 have a threaded bore 52 extending therein, and the secondary

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piston rod 51 has a threaded stub 53 received in the threaded opening 52. In this manner, the secondary piston 49 is connected to and piloted by the primary piston rod 27 and its piston 47.

Of course the bores 46 and 48 are co-axial, and they are in fluid flow communication in that fluid introduced into the cylinder by the hose 31 and through a passageway 54 and a passageway 55 will flow into the secondary bore 48 and eventually into the primary bore 46 when the piston 49 is retracted from the bore 48. Such retracting action is accomplished upon a given extent of stroke of the piston rod 27.

FIG. 3 shows the position of the piston 49 when fluid under pressure is introduced through the passageways 54 and 55 and into the bore 48. The fluid in the end of the bore 48 will cause the piston 49 to move to the left as viewed in FIG. 1, until the piston 49 abuts a circular shoulder 56 on the end of the secondary piston rod 51. The piston 49 is of course annularly or ring shaped, and it is also made of a material such as nylon or other good fluid sealing material so that upon abutting the annular shoulder 56 it is fluid tight with the shoulder 56. The outer diameter of the secondary piston 49, as indicated at 57, is also fluid tight with the circular bore 48, and therefore the fluid under pressure in the end of the secondary bore 49 cannot pass to the left of the secondary piston 49 as viewed in FIG. 3. Since the bore 48 is smaller than the bore 46, this will cause the piston rod 27 to move rapidly to the left until the piston 49 moves out of the bore 48. Beyond that point, the fluid under pressure is then active against the larger piston 47 and the movement of the piston rod 27 is then slower as desired.

FIG. 3 also shows that the secondary piston rod 51 is slightly smaller than the diameter of the secondary bore 48. Also, the end of the secondary piston rod 51 has a reduced portion designated 58, and this portion is spaced radially from the inner surface designated 59 on the secondary piston 49. Still further, the end portion of the secondary piston 49 has a tapered surface designated 60, and this surface is available for piloting the secondary piston unit into the bore 48 after it has been retracted therefrom. It will also be appreciated that the secondary piston 49 being loose with respect to the piston rod end 58, will locate itself with respect to the bore 48 and somewhat irrespective of the secondary piston rod 51.

A retainer washer 61 is secured to the end of the piston rod 51 by means of a bolt 62 which extends into the end of the piston rod 51. FIG. 4 shows that the washer 61 has its sides shortened so that it terminates at side surfaces designated 63, and this provides for flow of the hydraulic fluid past the washer 61 as hereinafter described.

FIG. 5 shows the position of the secondary piston 49 when fluid pressure is acting on the piston from the sides of the bore 46. Thus the piston 49 is displaced to the right until it abuts the retaining washer 61. In this position, fluid can flow from the bore 46 and into the bore 48 past the secondary piston rod 51. Fluid continues to flow past the end surface 64 of the secondary piston 49 and between the piston surface 59 and the circumference of the piston portion 58. Fluid can then continue to flow past the washer sides 63 and on through the bore 48 and into the passageways 55 and 54 and out of the cylinder. This of course is the direction of flow of fluid when pressure is applied through the connector or stub 34 and onto the piston 47. Whatever fluid exists in the bore 46 to the right of piston 47 will therefore trace the path just described with respect to the secondary piston 49.

Referring again to the flow of fluid into the cylinder through the passageways 54 and 55, it will be seen that the bore 46 to the right of piston 47 creates a vacuum as the piston 47 moves to the left. This is actually prevented from becoming detrimental to the operation by having fluid enter the cylinder bore 46 through the fluid line 38. Thus the purpose of the check valve 42 so that

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fluid can enter the bore 46 to the right of the piston 47 as desired.

There is therefore one moving part, namely the secondary piston 49, and it is available for creating a fast action in the movement of the piston rod 27 in its initial extending stroke, and beyond the initial action it still permits the powerful continuous extending stroke. On the return, the secondary piston 49 does not impede the flow of fluid in the opposite direction.

When the piston 49 moves out of the bore 48, then the face or end area defined by the piston 49 and the annular surface 66 of the piston 47 are available to the fluid pressure. This results in the slower but more powerful stroke of the rod 27. The piston rod portion 58 thus defines with the washer 61 a groove 67 in which the piston or ring 49 is axially movable as the length of the ring 49 is shorter than the groove length. This is also radial clearance 68 between the portion 58 and the ring internal surface 59. It will also be noted that the bevel surface 60 extends radially a distance greater than the radial clearance 68 so the piston ring 49 has an adequate lead with the surface 60 in entering the bore 48.

While a specific embodiment of this invention has been shown and described, it should be obvious that certain changes could be made in the embodiment and the invention should therefore be determined only by the scope of the appended claims.

What is claimed is:

1. A fluid actuated power unit comprising a cylinder having two axially spaced and axially extended bores in fluid-flow communication and of different cross-sectional sizes to present a smaller bore and a larger bore, a piston axially slidably disposed in each of said bores and being fluid tight therein and connected together to slide axially with each other and provide a stroke, a piston rod connected to said pistons and extending externally of said cylinder and being movable in accord with the sliding movement of said pistons, said cylinder having a fluid passageway in fluid-flow communication with said smaller bore and at a location to the opposite axial side of said piston therein with respect to said larger bore, the axial extent of said larger bore being greater than the axial extent of said smaller bore, said piston in said smaller bore being fluid tight therein and being axially movable to one position and adapted to block fluid flow toward said larger bore and being axially movable to another position and adapted for the passage of fluid from said larger bore, and said piston in said smaller bore being supported and piloted by the other said piston and being movable out of said smaller bore with the movement of said piston in said larger bore so that fluid from said fluid passageway can flow into said larger bore.

2. A fluid actuated power unit comprising a cylinder having two axially spaced and axially extended bores in fluid-flow communication and of different cross-sectional sizes to present a smaller bore and a larger bore, a large piston axially slidably disposed in said larger bore and being fluid tight therein, a piston rod connected to said piston and extending externally of said cylinder, a secondary piston rod connected to said large piston and extending into said smaller bore, said cylinder having a fluid passageway in fluid-flow communication with said smaller bore and at a location to the opposite axial end from said larger bore, and a secondary piston movable on said secondary piston rod in said smaller bore and being fluid tight with said smaller bore and adapted to block fluid flow in the direction toward said large piston and being movable on said secondary piston rod to a position clear of the path of fluid flow in the opposite axial direction and being movable with said secondary piston rod out of said smaller bore so that fluid from said fluid passageway can flow into said larger bore.

3. A fluid actuated power unit comprising a cylinder having two co-axial bores in end-to-end relation and of different cross-sectional sizes to present a smaller bore and

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a larger bore, a piston axially slidably disposed in each of said bores and being fluid tight therein and connected together to slide axially with each other and provide a stroke, a piston rod connected to said pistons and extending externally of said cylinder and being movable in accord with the stroke of said pistons, said cylinder having a fluid passageway in fluid-flow communication with said smaller bore and at the end thereof opposite from said larger bore, said piston in said smaller bore having means for blocking fluid flowing in the direction toward said larger bore and passing fluid flowing in the opposite direction, and said piston in said smaller bore being movable out of said smaller bore so that fluid from said fluid passageway can flow into said larger bore.

4. A fluid actuated power unit comprising a cylinder having two axially spaced and axially extended bores in fluid-flow communication and of different cross-sectional sizes to present a smaller bore and a large bore, a piston axially slidably disposed in said larger bore and being fluid tight therein, a piston rod connected to said piston and extending externally of said cylinder, a secondary piston rod connected to said piston and extending into said smaller bore and having a groove extending therearound, said cylinder having a fluid passageway in fluid-flow communication with said smaller bore and at a location to the opposite axial end from said larger bore, and a ring disposed in said groove on said secondary piston rod in said smaller bore and being fluid tight with said smaller bore and having radial clearance with said secondary piston rod and being axially movable on the latter to fluid seal therewith in the limit of axial movement thereon toward said piston and adapted to permit fluid to pass said ring in the axial position away from said limit position and said ring being movable out of said smaller bore so that fluid from said fluid passageway can flow into said larger bore.

5. A fluid actuated power unit comprising a cylinder having two co-axial bores in end-to-end relation and of different cross-sectional sizes to present a smaller bore and a larger bore, a piston axially slidably disposed in said larger bore and being fluid tight therein, a piston rod connected to said piston and extending externally of said cylinder, a secondary piston rod connected to said piston and extending into said smaller bore and having a circular shoulder faced away from said larger bore, said cylinder having a fluid passageway in fluid-flow communication with said smaller bore and at a location to the opposite axial end from said larger bore, and a piston ring fluid tightly disposed in said smaller bore and axially movable therein and being abutable with said shoulder for fluid sealing therewith and blocking fluid flow to said larger bore, and said piston ring being movable away from said shoulder for flow of fluid therepast toward said fluid passageway and with said piston ring being movable out of said smaller bore so that fluid from said fluid passageway can flow into said larger bore.

6. An initially fast-acting fluid actuated power unit comprising a cylinder having two co-axial bores in end-to-end relation and of different cross-sectional sizes to present a

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smaller bore and a larger bore, a piston axially slidably disposed in said larger bore and being fluid tight therein, a piston rod connected to said piston and extending externally of said cylinder, a secondary piston rod connected to said piston and extending into said smaller bore and having a circular shoulder faced away from said larger bore, said cylinder having a first fluid passageway in fluid-flow communication with said smaller bore and at a location to the opposite axial end from said larger bore, said cylinder having a second fluid passageway in fluid-flow communication with said larger bore at the end thereof adjacent said smaller bore for maintaining a fluid pressure in larger bore, and a piston ring fluid tightly disposed in said smaller bore and axially movable therein and being abutable with said shoulder for fluid sealing therewith and blocking fluid flow to said larger bore, and said piston ring being movable away from said shoulder for flow of fluid therepast toward said first fluid passageway and with said piston ring being movable out of said smaller bore so that fluid from said first fluid passageway can flow into said larger bore.

7. An initially fast-acting power unit comprising a cylinder having two co-axial bores in fluid-flow communication and of different cross-sectional sizes to present a smaller bore and a larger bore, a primary piston axially slidably disposed in said larger bore and being fluid tight therein, a piston rod connected to said primary piston and extending externally of said cylinder, a secondary piston rod connected to said primary piston and extending into said smaller bore and having a circular portion radially spaced from the wall defining said smaller bore and having a radially outwardly extending circular shoulder adjacent said circular portion and faced away from said primary piston, said cylinder having a fluid passageway in fluid-flow communication with said smaller bore at the end thereof opposite from said larger bore, and a secondary piston fluid-tightly disposed in said smaller bore and axially movably disposed on said circular portion of said secondary piston rod and being fluid-tightly abutable with said circular shoulder to block fluid flow in one axial direction and being movable away from said circular shoulder to move out of the path of fluid flow in the opposite axial direction and being movable out of said smaller bore so that fluid from said fluid passageway can flow into said larger bore, said secondary piston being radially movable on said circular portion when the latter is withdrawn from said secondary bore to radially adjust to re-enter into said secondary bore.

References Cited by the Examiner

UNITED STATES PATENTS

2,755,775	7/1956	Flick	91—395
2,960,068	11/1960	Becker	91—396

MARTIN P. SCHWADRON, *Primary Examiner*.

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