United States Patent [19]

Farrell

[11] **3,893,518**

[45] **July 8, 1975**

[54] **BLADE ROTATING, BLADE TRIPPING AND SHOCK ABSORBING HYDRAULIC CYLINDER FOR SCRAPER-TYPE SNOW PLOWS**

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[73] Assignee: **Frink Sno-Plows,** Clayton, N.Y.

[22] Filed: **Mar. 11, 1974**

[21] Appl. No.: **449,857**

[52] **U.S. Cl.** ..... **172/794;** 172/264; 37/42 VL; 267/34; 267/61 R

[51] **Int. Cl.** **E02f 3/12**

[58] **Field of Search** ..... 172/794, 264, 261, 265, 172/269, 705; 37/42 R, 42 VL, 50; 267/34, 61 R, 63, 64 R, 65 R, 122; 91/462–466; 280/124 R, 6.11 X

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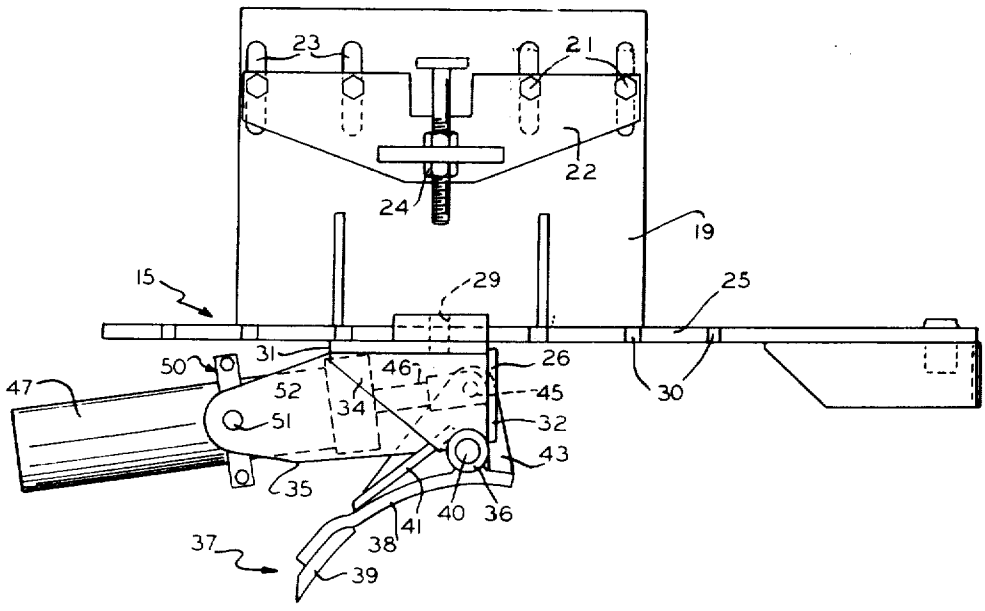
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Primary Examiner—E. H. Eickholt
Attorney, Agent, or Firm—Bruns & Jenney

[57] **ABSTRACT**

An under the vehicle carried road scraper plow extending substantially transversely of the vehicle has a scraper blade carried for rotary motion from a raised position out of contact with the road to a rotated position in contact with the road. A pair of hydraulic cylinders pivotally mounted with respect to the vehicle have the forward ends of their piston rods pivotally secured to operating ears secured to the blade and extending away from the forward surface of the blade. Each cylinder has a first piston secured to the rearward end of its piston rod and a second floating piston forward of the first piston, the pistons being spaced by a compression coil spring. A hydraulic system, controlled by a pivot valve, is arranged to provide fluid under pressure alternatively to the front or rear of pistons in the cylinder, the pilot valve being arranged to provide means for returning fluid to a reservoir from the end of the cylinder not subjected to pressure. The hydraulic line to the forward end of the cylinders is provided with an adjustable hydraulic relief valve adjusted to a pressure biasing the blade against the road and compressing the coil spring of the cylinder to about half its normal length and with a pilot operated check valve having piston means operable by pressure from the line to the rear of the cylinders for providing drainage from the forward ends of the cylinders when the blade is turned to raised position.

3 Claims, 15 Drawing Figures



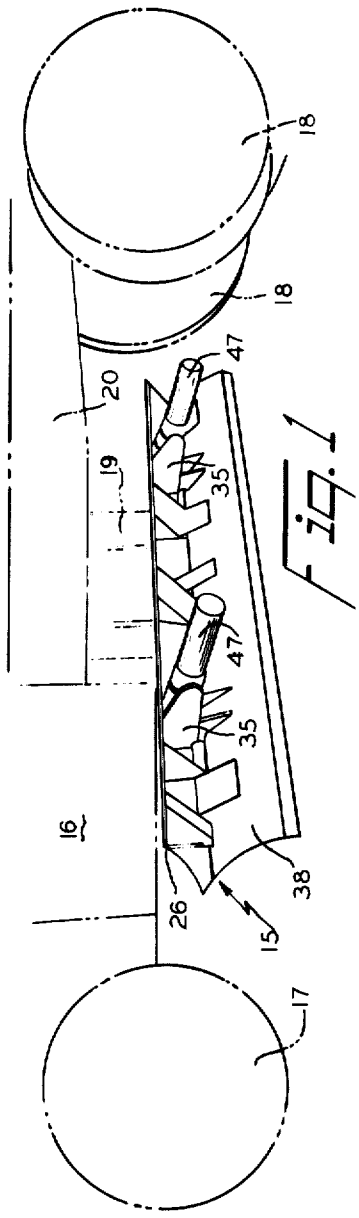


Fig. 1

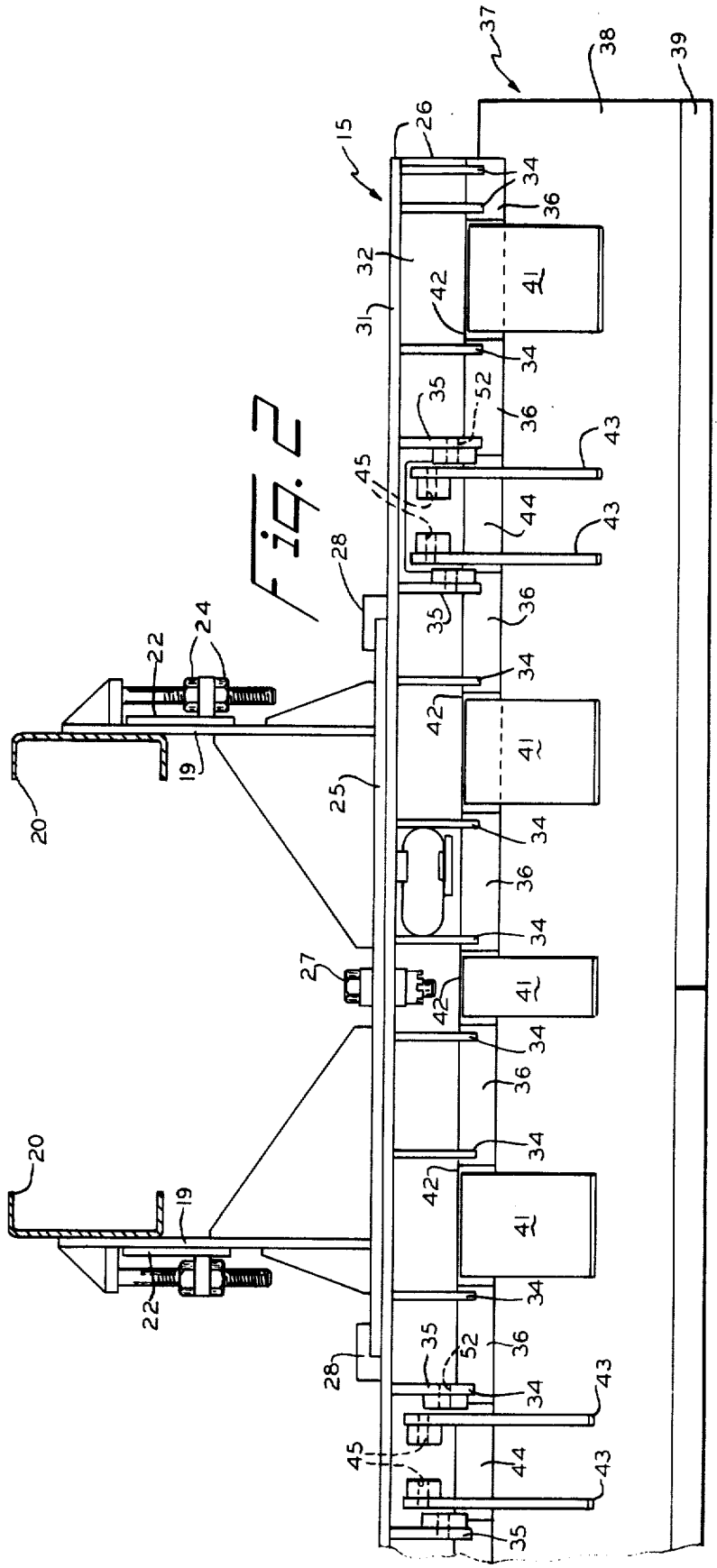


Fig. 2

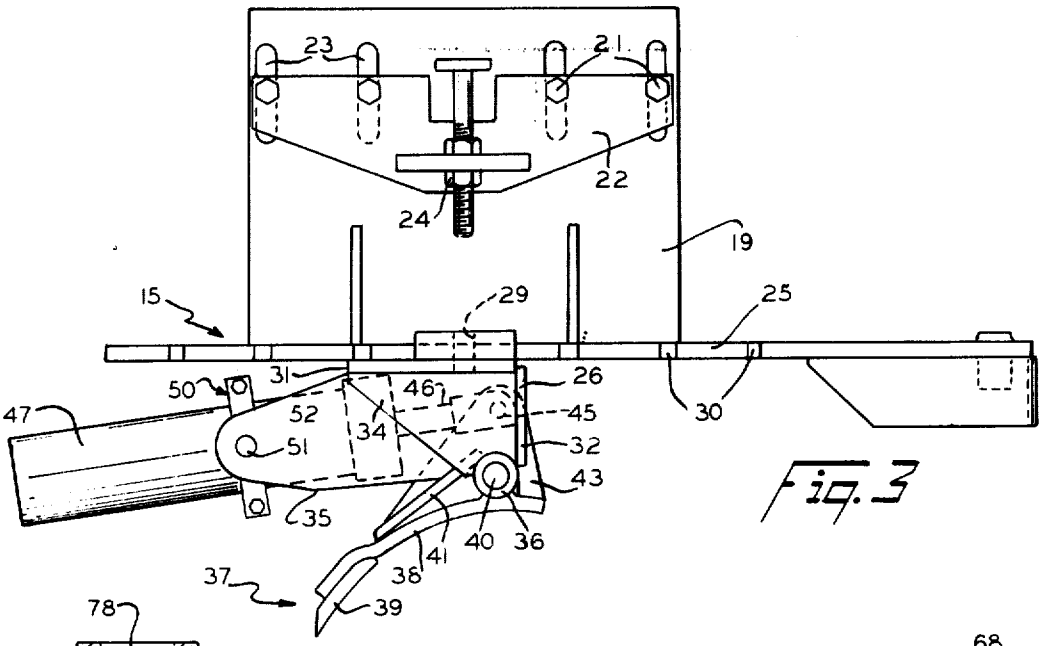


Fig. 3

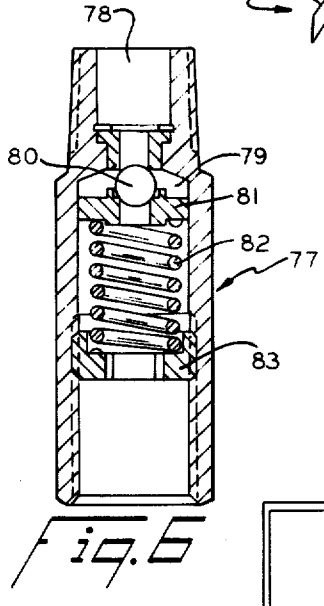


Fig. 6

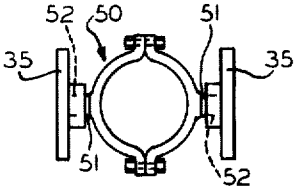


Fig. 4

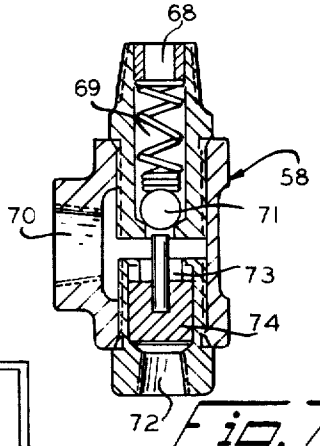


Fig. 7

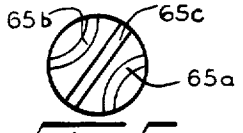


Fig. 5a

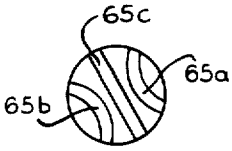


Fig. 5b

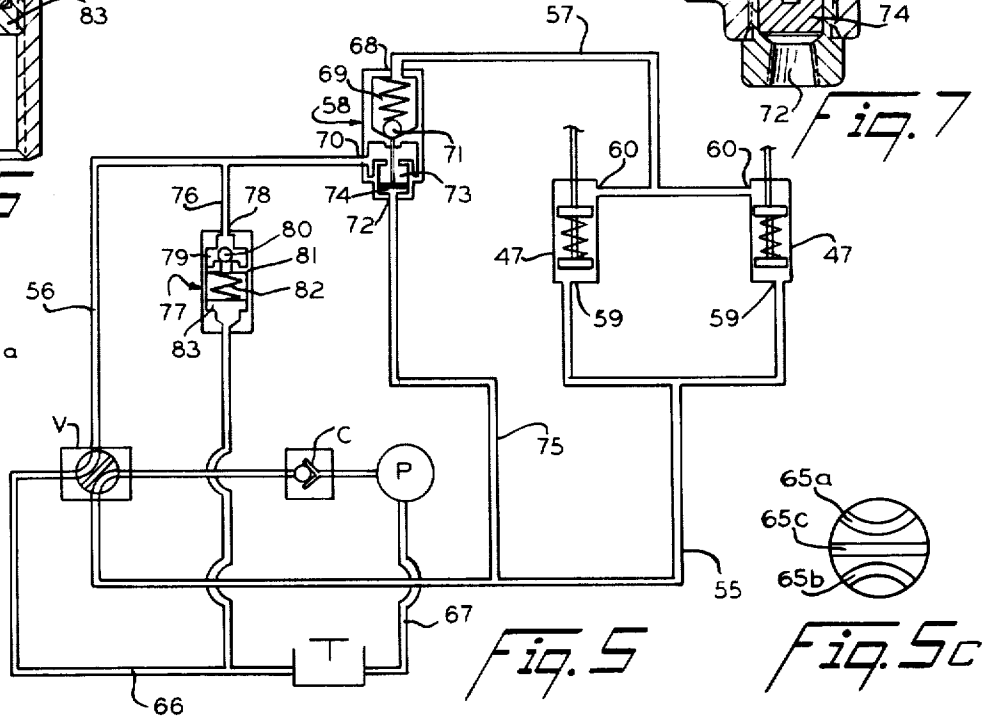


Fig. 5

Fig. 5c

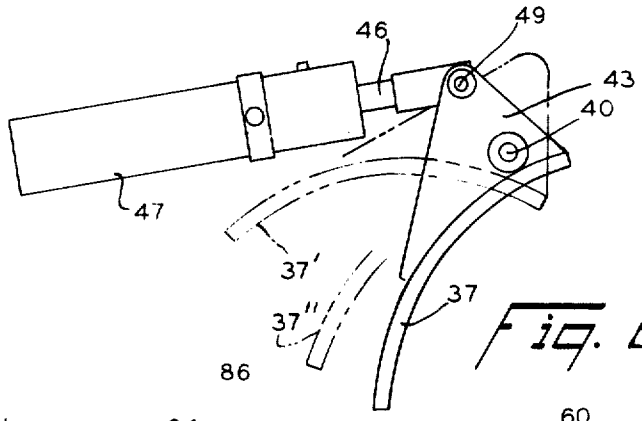


Fig. 8

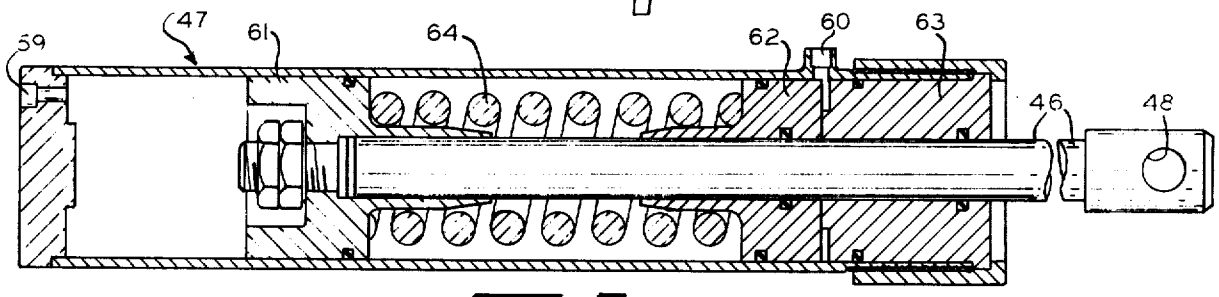


Fig. 9

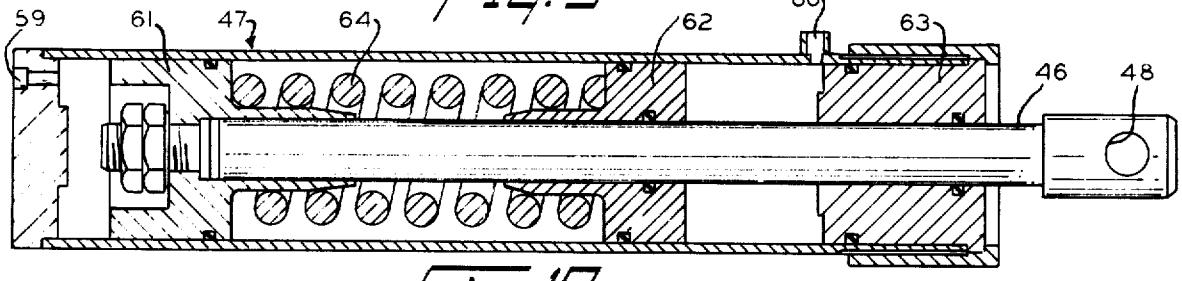


Fig. 10

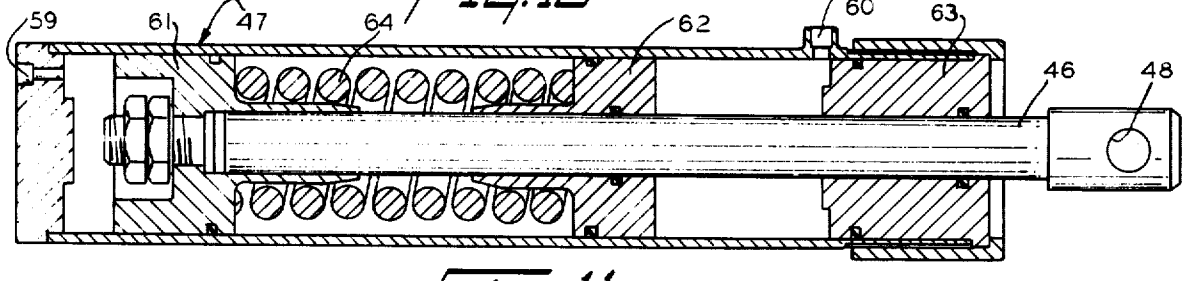


Fig. 11

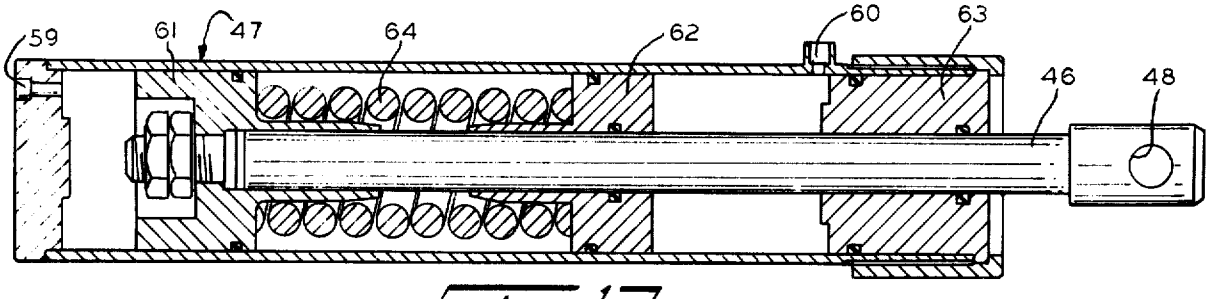


Fig. 12

BLADE ROTATING, BLADE TRIPPING AND SHOCK ABSORBING HYDRAULIC CYLINDER FOR SCRAPER-TYPE SNOW PLOWS

BACKGROUND OF THE INVENTION

This invention relates to road scraper plows for trucks and more particularly for hydraulic means for raising and lowering the blade thereof.

Prior art scraper plows have hydraulic cylinders for rotating the plow blade about an axis substantially transverse the truck for raising the blade away from the road and rotating it into contact with the road. Such hydraulic cylinders, however, require spring means between the plow-rotating cylinder and the blade because the cylinder motor mechanism lacks the resiliency to allow the blade to be tripped when it meets an obstruction in the road.

SUMMARY OF THE INVENTION

This invention contemplates providing a hydraulic cylinder and control system therefor which has operator-controlled means for rotating the blade from raised position to road contacting position and back again and also provides for constant pressure of the blade against the road surface but with resilient means within the cylinder for allowing automatic tripping of the blade when it meets an obstruction in the road, the blade being automatically returned with constant pressure against the road when the obstruction is passed.

The cylinder is provided with the usual piston fixed to the rearward end of the piston rod and an additional floating piston through which the piston rod is slideable, the two pistons being biased in spaced apart relation by a heavy compression coil spring extending around the rod between the pistons. The cylinder has two apertures for the entrance or exit of fluid under pressure, one forward of the pistons and the other to the rear thereof.

The hydraulic system for controlling the cylinder or cylinders, two preferably, includes the usual pump and fluid reservoir and a four-way three-position control or pilot valve located in the cab of the vehicle on which the plow is mounted. For raising the blade, the pilot valve is turned to a first position connecting fluid under pressure from the pump to a line leading to one entrance of each cylinder, the rearward entrance in the embodiment shown. For lowering the blade and applying pressure of the blade on the road, the pilot valve has a second position for connecting fluid under pressure to another line to the opposite entrances of the cylinders, the forward entrances.

The line to the forward entrances is provided with an adjustable hydraulic relief valve, provided with the usual return line to the reservoir, for providing pressure in the forward portion of the cylinder sufficient to compress the cylinder coil spring to substantially half its extended length thus providing a regulated loaded pressure of the blade against the road.

A pilot operated check valve is provided in the line between the hydraulic relief valve and the forward entrances to the cylinders so that fluid under pressure in the forward ends of the cylinders cannot be forced out of the cylinders so long as the pilot valve remains in its second position.

When the blade meets an obstruction it may be tripped to a position in which the cylinder coil spring

is completely compressed or, for smaller obstructions, less than completely compressed.

The pilot valve has a first passage for transmitting fluid under pressure to one end or the other of the cylinders, as described above, and also a second passage for providing return of fluid from the end of the cylinders not under pressure. When the pilot valve is in its second position providing pressure to the forward ends of the cylinders, the second passage connects the line to the rearward ends of the cylinders to a line leading to the reservoir.

The pilot operated check valve has a chamber in which a piston is reciprocable, the check valve being rendered inoperative when pressure is applied to the chamber. This chamber is connected by a line connected to the pressure line to the rearward ends of the cylinders so that when pressure is applied to the cylinder rear ends the check valve is inoperative and fluid may move out of the forward end of the cylinders.

The second passage through the pilot valve when it is in its first position connects the line to the forward ends of the cylinders to the line to the reservoir so that fluid from the cylinder front ends can return to storage.

When the pilot valve is in its second position, the pump is continually pumping oil under pressure to the hydraulic relief valve which allows oil to return to the reservoir. A third passage through the pilot valve is therefore provided and when the pilot valve is turned to its third position this third passage connects the pump to the line leading to the reservoir so that the pump is no longer pumping under pressure. In this third position, the lines to both ends of the cylinders are closed. When the pilot valve is turned from its second position to its third position the check valve is spring biased closed so that fluid cannot escape from the forward ends of the cylinders and when the pilot valve is turned from its first position to its third position fluid cannot escape from the rear ends of the cylinders by reason of the closed line to the cylinders and in both cases the pistons remain biased as before.

This construction provides shock absorbing and tripping means in the operating cylinders themselves which obviates a plurality of spring means and their attaching means and guides in exposed position on the plow blade. The cylinder coil springs being in the cylinder assembly provide a more compact arrangement and a reduction of the number of parts from constructions requiring springs between the blades and their operating cylinders. The hydraulic relief valve, being adjustable for different loading pressures, provides a single adjustment for the plurality of operating cylinders used.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a plow according to the invention with its scraper blade extended to contact the road surface, a supporting vehicle being fragmentarily indicated in phantom lines;

FIG. 2 is a fragmentary rear elevational view of the plow of FIG. 1, certain parts being omitted and showing longitudinal frame members of the supporting vehicle in section;

FIG. 3 is an end elevational view of the plow of FIG. 2 showing one of the blade operating cylinders in side elevation;

FIG. 4 is a rear elevational view of the gimbals-type mounting members of the cylinder shown in FIG. 3;

FIG. 5 is a diagram of the hydraulic circuit in which the blade operating cylinders shown in FIGS. 1 and 3 are connected;

FIGS. 5*a*, 5*b* and 5*c* are enlarged diagrammatic views of the pilot valve shown in FIG. 5, FIG. 5*a* being in blade raising position, FIG. 5*b* being in blade operating position and FIG. 5*c* being in low pressure pump position;

FIG. 6 is an enlarged longitudinal sectional view of the hydraulic relief valve shown diagrammatically in FIG. 5;

FIG. 7 is an enlarged longitudinal sectional view of the pilot valve operated check valve shown diagrammatically in FIG. 5;

FIG. 8 is a diagrammatic side elevational view of the plow blade and one of its operating cylinders shown in full lines in operating position, the blade being fragmentarily shown in raised position and tripped position in broken lines; and

FIGS. 9, 10, 11 and 12 are diagrammatic, longitudinal sectional views of an operating cylinder in blade-raised, blade-lowered but unloaded, blade-lowered and loaded, and blade-tripped position, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the plow 15 of the present invention is of the scraper blade type supported pendantly underneath a truck 16 between its front wheels 17 and rear wheels 18.

As best seen in FIGS. 2 and 3, support plates 19 are bolted to longitudinally extending frame members 20 of the truck at 21 and a clamping plate 22 may be included. Provision is made at 23 and 24 for suitable vertical adjustment of the plow 15.

A horizontally extending circle or turntable 25 is welded along with suitable reinforcing ribs to the bottom edges of the plates 19. A generally transversely extending blade frame 26 is supported by bolt 27 (FIG. 2) at the center of the turntable so as to be rotatable with respect to the turntable for adjusting the plow at different angles underneath the vehicle. Suitable gibs 28 at either side of the turntable are shown in FIG. 2 secured to frame 26. As indicated in FIG. 3, holes 29 in the gibs and cooperating notches 30 in the edge of the turntable are provided for vertically extending locking pins, not shown, for securing the plow 15 at the desired substantially transverse angle.

Frame 26 is substantially in the form of an angle of rugged welded construction, having a rearwardly extending flange 31 and a pendant vertical flange 32, as best seen in FIG. 3, extending the transverse length of the plow. As seen in FIG. 2, reinforcing braces 34 and 35 are secured to the flanges 31 and 32 and also to tubular bushings or hinge tubes 36.

A scraper blade 37, including the usual curved moldboard 38 and scraper edge 39 is hingedly connected to the frame 26 by a rod or rods 40 seen in FIG. 3.

Moldboard 38 and reinforcing plates 41 have welded thereto tubular bushings or hinge tubes 42. At either side of the plow a spaced pair of operating ribs 43 are similarly welded to moldboard 38 and other tubular bushings or hinge tubes 44 (FIG. 2).

The operating ribs 43 project away from the face of blade 37 as ears, as shown in FIG. 3, and are provided with aligned holes 45 therethrough, each pair of ribs 43 embracing the forward end of a piston rod 46 of a novel operating cylinder 47, the rod having a hole 48 therethrough as shown in FIGS. 9–12. The piston rod is pivotally connected to the ribs 43 by a pin 49, as indicated in FIG. 8, passing through holes 45 and 48.

As best seen in FIG. 3, the reinforcing ribs 35 on frame 26 project rearwardly of the plow and each pair is adjacent a pair of operating ribs 43, as shown in FIG. 2. As best seen in FIG. 4 a gimbals ring 50, adapted to securely clamp around cylinder 47, has a gimbals shaft 51 projecting laterally on diametrically opposite sides and received in aligned holes 52 in the rearward ends of the ribs 35. As may be seen in FIG. 3, extension of the piston rod 46 raises the blade 37 out of contact with the road and contraction of the rod turns the blade for contact with the road.

The vehicle mounting, frame and blade of the plow 15 are essentially conventional as described above.

The present invention contemplates utilization of a novel form of cylinder at 47 connected in a hydraulic circuit, shown in FIG. 5, for not only raising and lowering the blade 37 but also, by providing a spring within the cylinder 47, utilizing the cylinder 47 as a shock resisting and blade tripping mechanism without the use of other spring means.

The circuit of FIG. 5 includes a pilot valve V, located in the cab of the truck, which may be turned either to the position shown in FIG. 5*a* for allowing fluid under pressure from the pump P to flow through a pressure chamber provided with the usual check valve C and tubular line 55 to the rear of hydraulic cylinders 47 for turning and maintaining the blade 37 out of contact with the road and in raised position, or to the position shown in FIG. 5*b* for conducting fluid under pressure through tubular lines 56 and 57 to the front ends of cylinders 47 for turning blade 38 into contact with the road and for thereafter biasing the blade in contact therewith. Lines 56 and 57 are connected through a pilot operated check valve 58 hereinafter described.

Since the cylinder 47 (FIG. 3) rocks about an axis coaxial with the gymbal pins 51 as it turns the blade 37, the portions of lines 55 and 57 adjacent each cylinder 47 are necessarily of flexible tubing.

Referring to FIG. 9, each cylinder 47 has a rearward entrance-exit 59 for connection with line 55 and a forward entrance-exit 60 for connection with line 57. The rearward end of the piston rod is connected to a piston 61 fixed to the rod and, forward of piston 61, the rod passes through a floating piston 62 and through the head 63 closing the forward end of the cylinder. Pistons 61 and 62 and head 63 are provided with annular grooves, as indicated, for O-ring seals. A heavy coil compression spring 64 is interposed between pistons 61 and 62.

Referring again to FIG. 5, it will be noted that the pilot valve V is a four way valve and that when it is in the position shown in FIG. 5*a* it has one passage 65*a* for conducting fluid under pressure to the line 55 and another passage 65*b* for conducting fluid from the front of cylinders 47 from line 56 to line 66 leading to reservoir or tank T, a supply line 67 leading from the tank to pump P.

Line 57 extends from entrances-exits 60 of the cylinders to an entrance-exit 68 of the check chamber 69 of the pilot operated check valve 58 shown in detail in FIG. 7. Valve 58 has an entrance-exit 70 from beyond the spring-biased valve ball 71 connected to line 56 for receiving and returning of fluid to pilot valve V.

Check valve **58** has another pressure fluid entrance **72** leading to a piston chamber **73** whose piston **74** bears a rod which, when the piston is operated, lifts ball **71** off its seat. Entrance **72** is connected by a line **75** to line **55** so that, when line **55** is exposed to fluid under pressure, the check valve **71** is open allowing return of fluid to tank T.

When the pilot valve V is turned to the position shown in FIG. **5***b*, it will be noted that passage **65***a* conducts fluid under pressure from the pump to line **56** leading through entrance-exit **70** of valve **58** past the check valve **71** to line **57** and the forward entrance **60** of cylinders **47.**

Line **56** is connected by a line **76** through a hydraulic relief valve **77,** shown in detail in FIG. **6,** to the line **66** leading to the tank T. The relief valve **77** has an entrance **78** leading to a check chamber **79** controlled by a ball valve **80** controlling the exit of fluid from passage **78.** The ball **80** is supported by a perforate piston **81,** the ball normally blocking a passage through the piston, and the piston is biased by a spring **82** so that ball **80** is normally biased against an upper seat. Spring **82** is adjustably anchored by a Nylon locking device **83** so that fluid pressure in lines **56** and **57** may be adjusted to a desired cracking pressure, typically 230 p.s.i. When the pressure at entrance **78** exceeds this cracking pressure, the ball **80** is forced away from its upper seat and fluid is admitted through the passage in piston **81** to return to tank T until the pressure at entrance **78** drops to the desired level.

Pressure in the forward entrances **60** of the cylinders **47** is thus regulated to a chosen pressure. At the same time passage **65***b* in pilot valve V connects line **55** to line **66** allowing fluid from the rear of cylinders **47** to flow back to tank T.

Check valve **58** and relief valve **77** are both readily obtainable commercial items.

Referring to FIGS. **8–12,** when fluid under pressure is admitted through an entrance **59,** the fixed piston **61** is advanced to the position shown in FIG. **9** and the floating piston, biased by spring **64,** advances to the position shown expelling fluid from entrance **60.** As the rod is extended blade **37** is rotated to the position shown at **37′** in FIG. **8.**

When the pilot valve V is turned to the position shown in FIG. **5***a*, fluid under pressure is admitted through entrance **60** to lower blade **37** to the position shown in full lines in FIG. **8.** When blade **37** first contacts the ground the parts of cylinders **47** are in the position shown in FIG. **10.** Since it is desirable that the scraping edge of blade **37** be biased against the surface of the roadway, shown at **86** in FIG. **8,** with considerable force, the setting of spring **82** of the valve **77** is chosen so that spring **64** of the cylinders **47** is normally partially compressed about halfway of its completely compressed length as shown in FIG. **11,** the blade being lowered and loaded as shown at **37** in full lines in FIG. **8.**

When blade **37** meets an obstruction in the roadway, it may move to a position shown at **37″** in FIG. **8,** the spring **64** of the cylinders **47** being substantially fully compressed, as shown in FIG. **12.**

It will now be apparent that cylinders **47** operate, not only as operating motors for the scraper blade, but also as shock absorbing and tripping means.

The pilot valve V has a third passage **65***c* therethrough and, when the valve is moved to the third position shown in FIG. **5***c*, pump P is connected directly through passage **65***c* to line **66** which leads to tank T so that the pump runs freely without pressure. In the third position, moreover, the valve entrances from lines **55** and **56** are closed.

When valve V is turned from its first position to its third position line **55** is closed so that fluid under pressure at the rear ends of the cylinders **47** cannot escape through lines **55.** Line **75** is closed by the piston **74** at the pilot operated check valve **58** and line **55** at valve V is closed. The blade will therefor remain at position **37′** of FIG. **8.**

When valve V is turned from its second position to its third position line **57** is closed by the spring operation of check valve **58.** Fluid under pressure cannot escape from the forward ends of cylinders **47** and blade **37** remains in contact with the road and spring **64** remains partly compressed as shown in FIG. **11** and blade **37** may move to its tripped position if any obstacle is met.

I claim:

1. In a vehicle carried snow scraper having a blade rotatable in one direction to a raised position out of contact with the road and rotatable in a reverse direction to a lowered position in contact with the road, motor means for rotating the blade, comprising: a fluid reservoir and a source of fluid under pressure, at least one hydraulic cylinder oscillatably secured to a scraper portion fixed to the vehicle, the cylinder having a piston therein fixed to one end of a piston rod, a second floating piston through which the rod is slideable, the pistons being resiliently spaced by a compression coil spring around the rod, passages into the cylinder at the fixed piston end and at the floating piston end, the blade having ear means projecting therefrom, the other end of the rod being pivotally secured to the ear means, a four way pilot valve; tubular lines from the pilot valve connected respectively to the source of pressure fluid, the fixed piston end passage, the reservoir, and the floating piston end passage; the pilot valve having a first position for connecting fluid under pressure to the fixed piston end passage by one valve passage for raising the blade and connecting the floating piston end passage to the reservoir by another valve passage, the pilot valve having a second position for connecting fluid under pressure to the floating piston end passage by one valve passage for lowering the blade and connecting the fixed piston end passage to the reservoir by another valve passage, the line from the pilot valve to the floating piston end passage including a hydraulic relief valve and a pilot operated check valve in that order connected therein, the relief valve having a cracking pressure chosen to turn the blade into contact with the road and to apply sufficient pressure to the road so as to compress the cylinder spring to substantially half its free length, a tubular line leading from the relief valve to the reservoir for carrying off fluid when the relief valve is cracked, the check valve having a chamber therein and a piston in the chamber adapted to open the check valve when the chamber is subjected to pressure, and a tubular line from the chamber connected to the line from the pilot valve to the fixed piston end passage for opening the check valve when the blade is raised, whereby the blade is raised when the pilot valve is moved to its first position and the blade is lowered and spring loaded when the pilot valve is moved to its second position and the cylinder acts as a

shock absorbing trip for the blade when it meets an obstruction thereby further compressing the cylinder spring.

2. In a vehicle carried snow scraper having a portion fixed to the vehicle and a blade hinged to the fixed portion and rotatable in one direction to a raised position out of contact with the road and rotatable in a reverse direction to a lowered position in contact with the road, motor means for rotating the blade, comprising: a fluid reservoir, a source of fluid under pressure, a pair of transversely spaced hydraulic cylinders oscillatably secured to the scraper fixed portion, each cylinder having a forwardly extending piston rod whose forward end is pivotally secured to the blade, a piston in each cylinder fixed to the rear end of the rod, a floating piston in each cylinder through which the rod is slideable, a compression coil spring in each cylinder around the rod for spacing the pistons therein, a four way pilot valve; tubular lines from the pilot valve connected, respectively, to the source of pressure fluid, the forward and rear ends of both cylinders, and the reservoir; the pilot valve having a first position for connecting pressure fluid to the rear ends of both cylinders by one valve passage for raising the blade and connecting the forward ends of both cylinders to the reservoir by another valve passage, the pilot valve having a second position for connecting pressure fluid to the forward ends of both cylinders by one valve passage for lowering the blade and connecting the ends of both cylinders to the reservoir by another passage, the line from the pilot valve to the forward cylinder ends including a hydraulic relief valve and a pilot operated check valve in that order connected therein, the relief valve being adjustable and adapted to be adjusted to a cracking pressure chosen to turn the blade into a loaded contact with the road sufficient to compress the cylinder springs to substantially half of their free lengths, a tubular line leading from the relief valve to the reservoir for carrying off fluid when the relief valve is cracked, the check valve having a chamber therein and a piston in the chamber adapted to open the check valve when the chamber is subjected to pressure, and a tubular line from the chamber connected to the line from the pilot valve to the cylinders rear ends for opening the check valve when the blade is raised, whereby the blade is raised when the pilot valve is moved to its first position and the blade is lowered and spring loaded when the pilot valve is moved to its second position and the cylinder acts as a shock absorbing trip for the blade when it meets an obstruction thereby further compressing the cylinder springs.

3. The vehicle carried snow scraper defined in claim **2** wherein the pilot valve has a third passage therethrough adapted to connect pressure fluid to the line to the reservoir when it is turned to a third position, the passages through the pilot valve being arranged to close the lines to the forward and rear ends of the cylinders when the pilot valve is turned to its third position, whereby when the pilot valve is turned from its first position to its third position the blade remains raised and when the pilot valve is turned from its second position to its third position the blade remains in contact with the road and biased downward.

* * * * *