United States Patent

[11] **3,599,728**

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[54] **PLOW TRIP MECHANISM**
4 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **172/265,** 172/484, 172/710
[51] **Int. Cl.** **A01b 61/04**
[50] **Field of Search** 172/265, 699, 484, 710

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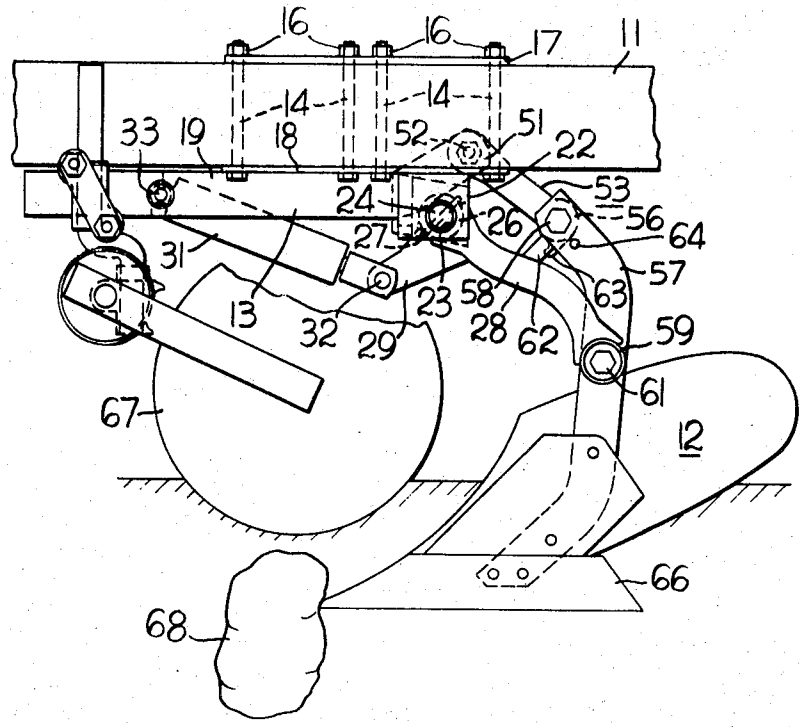
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ABSTRACT: A safety trip mechanism for a plow which permits a plow to raise up, move rearwardly and pivot upon striking a buried object and which mechanism returns the plow to operative position after the object has been cleared.



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SHEET 1 OF 4

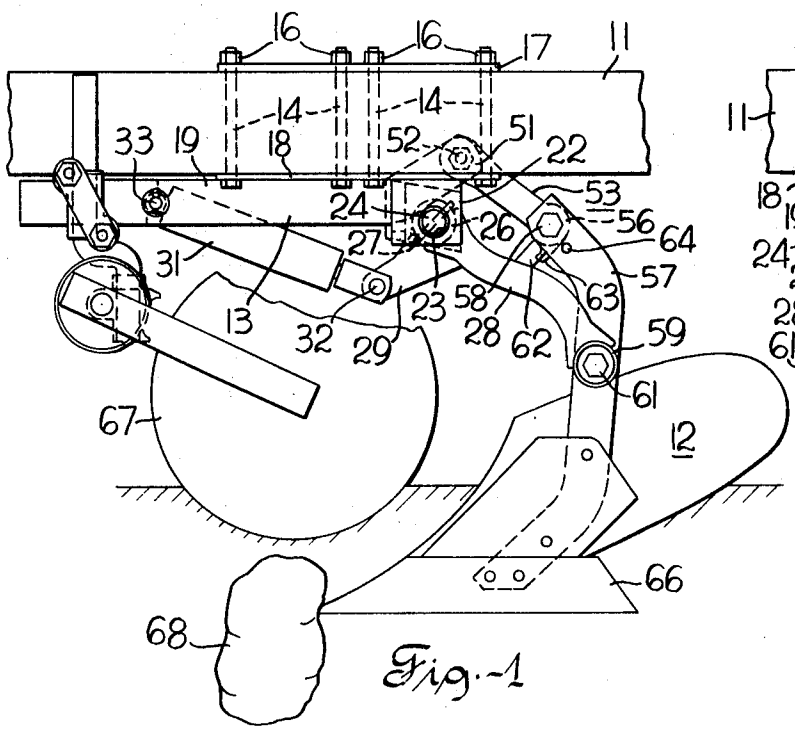


Fig. 1

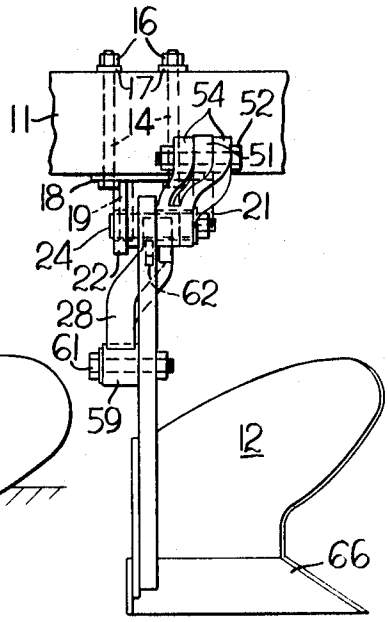


Fig. 2

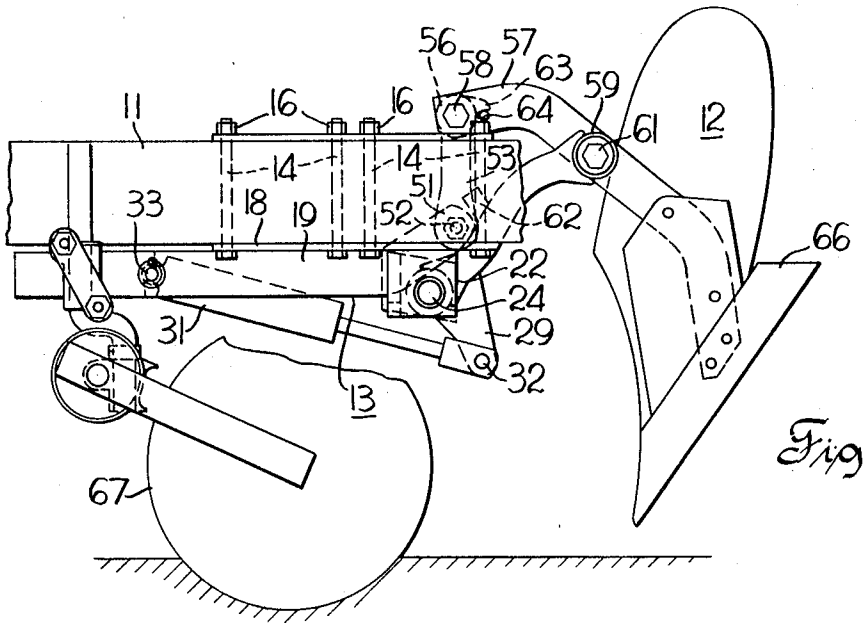


Fig. 3

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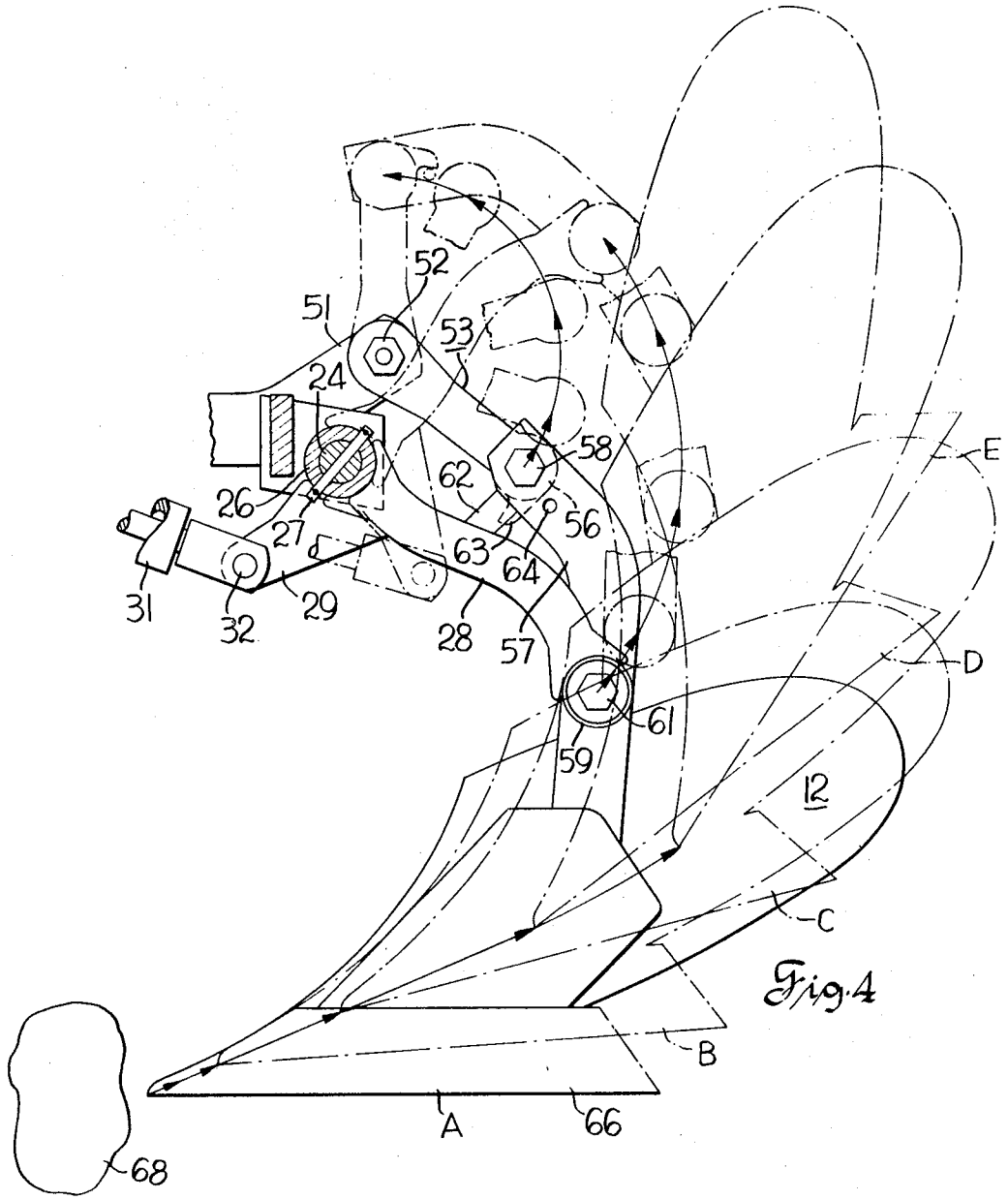


Fig. 4

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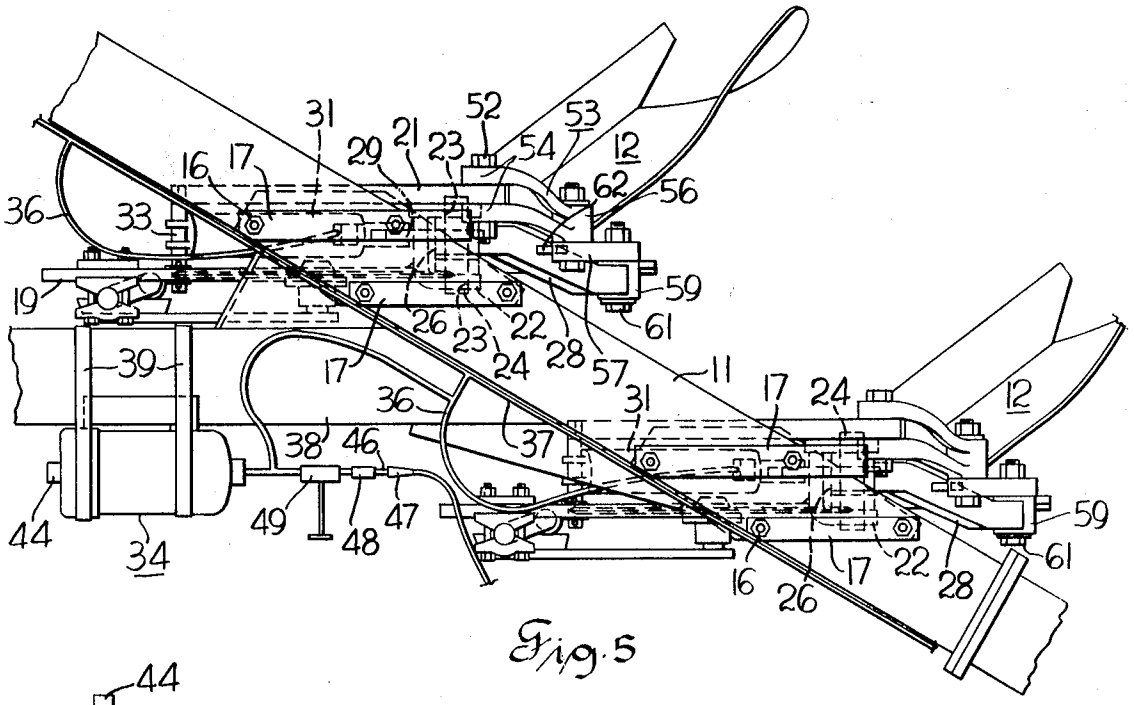


Fig. 5

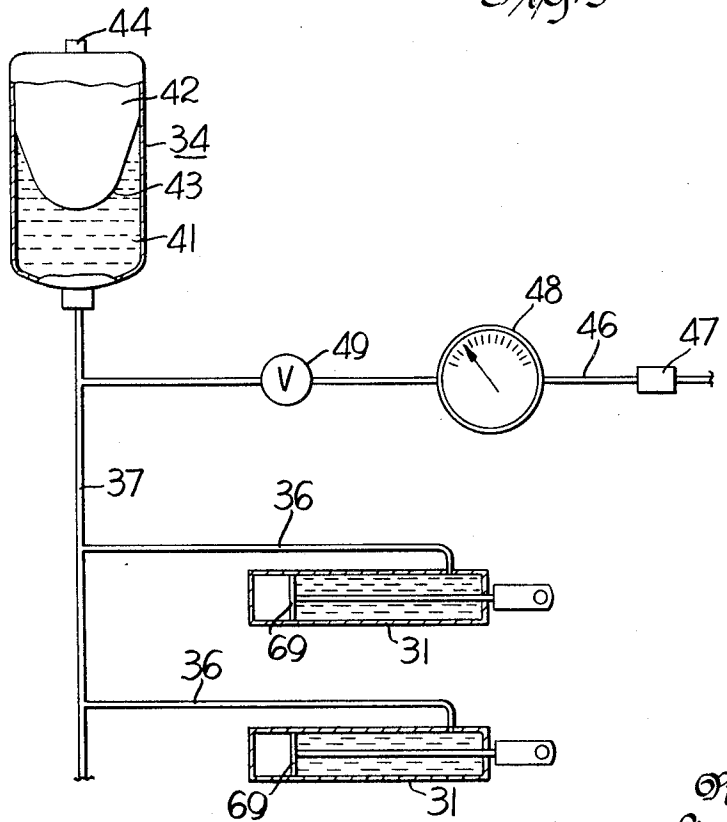


Fig. 6

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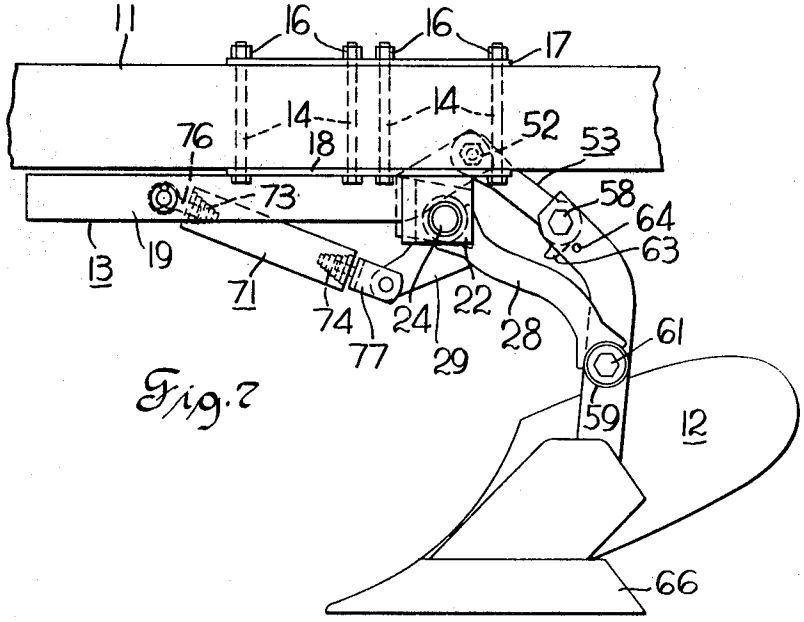


Fig. 7

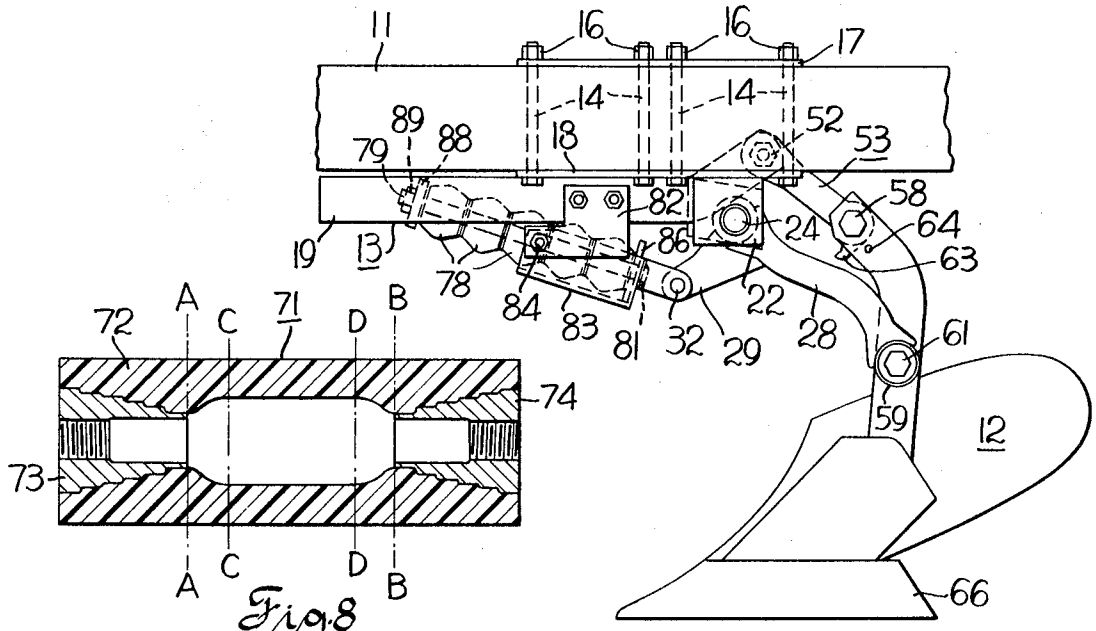


Fig. 9

Fig. 8

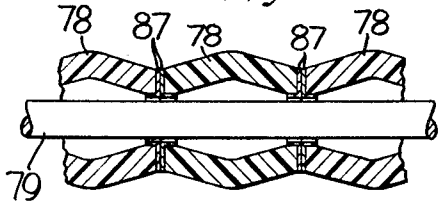


Fig. 10

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PLOW TRIP MECHANISM

This invention relates to moldboard plows and more particularly to the type that are individually self-restoring.

An object of this invention is to provide a self-restoring plow trip mechanism of the hydraulic type wherein a tripping of such mechanism to clear small obstructions results in a minumum amount of oil being pumped into the accumulator while maintaining a good plowing attitude.

A further object of this invention is to provide a self-restoring plow trip mechanism of the hydraulic type and wherein the trip functions with a very low actuating force and a small accumulator is adequate to handle many plow bottoms.

A further object of this invention is to provide a self-restoring plow mechanism wherein the mechanism is in close and under the frame of the plow.

A further object of this invention is to provide a self-restoring plow trip mechanism wherein the tripping arc is short and is traversed rapidly leaving substantially no skipped or unplowed ground.

A further object of this invention is to provide a self-restoring plow trip mechanism utilizing a hydraulic cylinder and wherein the rod of the cylinder is ordinarily protected and only extended during a tripping operation.

A further object of this invention is to provide easily operated means for retaining a plow bottom in tripped position to provide easy access to the plow bottom.

A further object of t is invention is to provide a self-restoring plow trip mechanism utilizing a hydraulic cylinder and wherein an elastomeric spring may be substituted directly for such cylinder.

A further object of this invention is to provide a self-restoring plow trip mechanism wherein the geometry of the trip mechanism is such that the plow trips without any portion of the plow traveling below the furrow bottom.

A further object of this invention is to provide a self-restoring plow trip mechanism wherein either a hydraulic cylinder, an elastomeric tension spring or an elastomeric compression spring may be used therewith for returning a tripped plow to functioning position.

A further object of this invention is to provide a self-restoring plow trip mechanism wherein such mechanism functions according to the object it has contacted; if the object is small the mechanism returns the plow to plowing position without changing the plowing aspect thereof and if large the mechanism rapidly removes the plow from the ground and returns it so as to minimize the unplowed area created in the plowing furrow.

A further object of this invention is to provide a self-restoring plow trip mechanism of simple inexpensive design.

A further object of this invention is the provision of an improved implement trip wherein the plow bottom is carried upon a supporting frame by generally parallel links which are biased downwardly to maintain the bottom in plowing position but which permits the plow bottom to rise in response to objects being contacted and which only withdraws the bottom from the ground in response to abnormal conditions.

A further object of this invention is to provide an elastomeric tension spring wherein stepped metal ends provide adequate bonding for the elastomer so that maximum stress is at the smallest diameter of the metal and greatest of the elastomer.

A further object of this invention is to provide an elastomeric tension spring wherein the cross section of the midportion of the spring is proportioned to allow maximum uniform elongation out in the main body area, thereby realizing the full tensile potential of the material. As the spring is extended, cross-sectional area is decreased, which tends to reduce the load required for further extension thereby flattening the load-deflection curve, which is desirable and very difficult to achieve with conventional springs.

A further object of this invention is to provide an elastomeric compression spring which is so proportioned that a columnar effect is achieved, thereby producing only compressive deflection at ordinary operating loads.

Other objects, purposes and advantages of the invention will hereinafter more fully appear or will be understood from the following description of trip mechanisms constructed in accordance therewith and adapted for use with a moldboard plow, the mechanism being illustrated in the accompanying drawings in which:

FIG. 1 is a side elevation of a plow embodying the invention shown in plowing position;

FIG. 2 is an end view of the plow shown in FIG. 1;

FIG. 3 is a side view similar to FIG. 1 but showing the plow in full tripped position;

FIG. 4 is a side view similar to FIGS. 1 and 3 showing the path of travel of the plow as it is tripped to its maximum position;

FIG. 5 is a plan view of two plows similar to that shown in FIG. 1 and showing the hydraulic accumulator connected to the plows;

FIG. 6 is a diagrammatic showing of the hydraulic accumulator shown in FIG. 5;

FIG. 7 is a side elevation of a plow similar to FIG. 1 but showing an elastomeric tension spring substituted for the hydraulic cylinder of FIG. 1;

FIG. 8 is a longitudinal section view through the elastomeric tension spring shown in FIG. 7;

FIG. 9 is a side elevation view of a plow similar to FIG. 7 but showing an elastomeric compression spring substituted for the hydraulic cylinder of FIG. 1; and,

FIG. 10 is a longitudinal section view through the elastomeric compression spring shown in FIG. 9.

In the drawings plow-supporting frame 11 in FIG. 1 is shown supporting one plow bottom 12. Ordinarily, there would be a plurality of such plows supported on such frame, however, the remaining plows would function the same as the plow herein described. A supporting framework 13 is attached to the underside of frame 11 by means of bolts 14 and nuts 16 contacting bracing members 17. Framework 13 includes a horizontal portion 18 in contact with the underside of frame 11 and vertical side portions 19 and 21 extending generally vertically from the underside of frame 11.

Adjacent the rearward right-hand end of horizontal portion 18 a U-shaped bracket 22 is attached thereto as by welding. Bracket 22 has aligned openings 23 therein for receiving a pivot pin 24. Between the sidewall portions of bracket 22, a collar 26 is received about pivot pin 24 and is attached thereto by means of pin 27. Attached to collar 26 as by welding are link 28 and bell crank arm 29. Arm 29 has its outer end pivotally connected to the piston end of hydraulic cylinder 31 by means of pin 32. The other end of cylinder 31 is pivotally connected to pin 33 carried by members 19 and 21 of framework 13. Referring to FIGS. 5 and 6 the piston end of cylinder 31 is hydraulically connected to an accumulator 34 by means of tube 36 and tube 37. Accumulator 34 is attached to frame 38 by means of bands 39.

Referring to FIG. 6 accumulator 34 is made up of two portions; one portion 41 is hydraulically connected to line 37 and contains ordinary hydraulic fluid. The other portion 42 of accumulator 34 contains nitrogen gas which is separated from portion 41 by means of a suitable diaphragm 43. A connection 44 is provided for charging 42 with nitrogen when required. Means for charging portion 41 with the desired amount of hydraulic fluid is provided by a tractor hydraulic system (not shown) but includes a line 46 connected to line 37 and connectable to a tractor hydraulic system by means of a coupling 47. A gauge 48 is installed in line 46 so the desired amount of hydraulic pressure can be readily determined. A shutoff valve 49 is also installed in line 46 so that line 46 can be disconnected from line 37 when accumulator portion 41 has been charged with sufficient hydraulic fluid at a desired pressure.

FIG. 6 shows but two hydraulic cylinders connected to accumulator 34. Actually any number of hydraulic cylinders could be attached for operation by such accumulator.

Referring to FIG. 1, the rearward end 51 of vertical member 21 of framework 13 extends upwardly and is provided with an opening for receiving a fastener 52. A link 53 is provided with a bifurcated end 54 (see FIG. 2) which pivotally receives fastener 52. Bifurcated end 54 also receives end portion 51. The other end of link 53 is attached to a collar 56 which is in turn pivotally attached to plow stub beam 57 by means of fastener 58.

The other end of link 28 is attached to a collar 59 as by welding and which is pivotally connected to a midportion of stub beam 57 by means of bolt 61. Link 28 has a stop member 62 attached at a midportion thereof. This stop member 62 contacts stub beam 57 to limit the downward movement of plow stub beam 57 and plow bottom 12 to the position shown in FIG. 1. If desired, link 28, collar 26, arm 29, collar 59, and stop 62 can be cast as a unitary member rather than being fabricated as previously described.

Link 53 is provided with a hook portion 63 adjacent fastener 58 which will coact with any desired cylindrical rod or the like such as a screwdriver which will fit into opening 64 t o retain plow stub beam 57 in the raised position shown in FIG. 3. This is a handy feature when it is desired to change the plow share 66 or any part of plow bottom 12. If the plow share 66 became damaged pin 32 can be removed disconnecting hydraulic cylinder 31 from arm 29. The plow can now be manually raised to the position show in FIG. 3, and a screwdriver or the like can be inserted in opening 64 and positioned under hook 63 for retaining the plow assembly in the position shown in FIG. 3 until the desired repairs are accomplished. Then the screwdriver or the like would be removed from under hook 63 and from opening 64. The plow would be returned to its lowered position and the hydraulic cylinder 31 would be reconnected to arm 29.

In FIG. 1 a disc coulter 67 is shown mounted forwardly of plow bottom 12. Disc coulter 67 is mounted on frame 11 in a conventional manner.

Referring to FIG. 4 it is seen how the previously described plow functions when it strikes a stone 68. Upon striking the stone, the plow moves backwards and upwardly as shown by the lower set of arrows. Links 28 and 53 are substantially parallel when plow is in plowing position and during the first part (from position A to position B) of the raising movement (a matter of 1 or 2 inches) plow 12 substantially retains its normal plowing aspect because of this substantially parallel linkage. As the raising continues from position B to C to D and E the point of the plow begins to point downwardly as more pivoted movement is given to the plow thereby permitting the plow to rid itself of obstructions.

One of the advantages of this construction is that the plow only raises high enough to clear the obstruction encountered whereas prior art devices cycled through a complete lift and would leave an unplowed area even for a relatively minor obstruction. In other words, for a relatively small obstruction, the plow of the present invention might raise to the B position or less and immediately return to its full plowing position A or if the obstruction was greater it might raise to the C or D position but would immediately return to the plowing position A when the obstruction was eliminated and therefore by only raising sufficient to clear the obstruction a large transfer of hydraulic fluid is eliminated, thus permitting several plows operating from one accumulator.

The force that returns plow 12 to its plowing position is the force supplied by the accumulator. Originally the accumulator is provided with a balanced loading of nitrogen and hydraulic fluid so that the desired force for keeping the plow in plowing position for normal operation is obtained. Then when the plow strikes an obstruction and starts moving backwards piston 69 in cylinder 31 moves toward the right in FIG. 6 forcing the hydraulic fluid back into line 37 and portion 41 of the accumulator compressing diaphragm 43 against the nitrogen gas and thereby compressing the gas. When the plow has cleared the obstruction then the force built up by compression of the nitrogen gas acts upon piston 69 to return the plow to plowing position.

Referring to FIGS. 7 through 10 it is seen that elastomeric (an elastic polymer such as polyurethane) springs may be substituted for the hydraulic accumulator system already discussed. In FIG. 7 an elastomeric tension spring assembly 71 has been substituted for the hydraulic cylinder 31 of FIG. 1. This assembly 71 (see FIG. 8) includes an elastomeric cylinder 72 bonded internally at each end to stepped internally threaded metal inserts 73 and 74. From viewing FIG. 8 it is apparent that elastomeric cylinder 72 has its thickest section at lines A–A and B–B. The stepped metal end of inserts 73 and 74 provide adequate bonding surface and the elastomeric cross section increases as the stress increases. As previously stated, maximum stress is at the smallest diameter end of the metal inserts. From that point the elastomeric cross section is then decreased toward the longitudinal center of the elastomeric cylinder to allow maximum uniform elongation out in the main body area between line C and D, thereby realizing the full tensile potential of the material. As this spring is extended the cross-sectional area is decreased, which tends to reduce the load required for further extension thereby flattening the load-deflection curve, which is desirable and very difficult to achieve with metal springs. Eye bolt 76 and yoke member 77 are threadably engaged with inserts 73 and 74, respectively, so that the assembly may be directly substituted for hydraulic cylinder 31 in FIG. 7.

Referring to FIGS. 9 and 10 it is seen how elastomeric compression springs may be substituted for the elastomeric tension springs of FIG. 7. Individual elastomeric spring sections 78 are mounted about an internal rod 79 having a portion 81 attached at one end thereof as by welding. This portion 81 is pivotally connected to arm 29 as by pin 32. A pair of brackets 82 (only one of which is shown) are bolted to opposite sides of frame 11 and pivotally support a U-channel member 83 by means of a pair of aligned pivot fasteners 84 (only one of which is shown). The rear of the right-hand end of channel member 83 is closed by plate 86 which is provided with an opening through which rod 79 extends. Each spring section 78 is provided with a washer spacer 87 mounted about rod 79 and these washer spacers abut each other between adjacent springs sections 78. Washer 88 is adjustably retained on rod 79 by nut 89 which is threadably engaged with the left-hand end of rod 79. The preloading on springs 78 can be accomplished by turning nut 89 relative to rod 79 thereby compressing springs 78 between washer 88 and plate 86.

From the foregoing it is apparent that when the plow strikes a stone or the like the plow will move rearward and upwardly as previously described concerning FIG. 1. This causes rod 79 to move generally toward the right as viewed in FIG. 9. This movement of rod 79 causes washer 88 to move rearward contacting springs 78 and compressing them between washer 88 and plate 86. During this compression process the entire spring assembly will pivot about the bolts 84 as arm 29 moves rod to the right. Like the tension elastomeric spring, this compression spring 78 is also very successful in achieving a flat load-deflection curve. Spring section 78 is so shaped that upon loading the spring a columnar effect is achieved thereby producing only compressive deflection at normal operation loads. Since the column as seen in FIG. 10 is not straight and has a greater diameter at the center than at the ends, failure of the columnar effect can be predicted and will collapse at the largest diameter. From that moment on, increased loading causes bending of the spring wall at the large diameter. This puts the elastomeric material in tension at that point and will resist increased loading (but less effectively than when the columnar effect was present) which produces the flat portion of the curve. Finally, as load is applied, the spring assumes the shape of a torus and the ends make contact with each other. At this point, the load-deflection curve rises rapidly and the effective useable deflection has been fully utilized.

The use of washer spacers 87 between compression springs 78 also effects the load-deflection curve since drag on the natural rod 79 is reduced and the elastomeric material will flow around the spacer resulting in more total deflection before the upper limit is reached.

From the foregoing it is seen that an improved plow trip linkage of the self-restoring type has been provided and that this linkage is inexpensive and consists of few parts of common configuration and it is adapted for use with a hydraulic cylinder and accumulator system, or with an elastomeric tension spring substituted for such hydraulic cylinder and accumulator system or with an elastomeric compression spring substituted for the tension spring.

While the preferred construction in which the principles of the present invention have been incorporated is s own and described herein, it is to be understood that the invention is not to be limited to the particular details, shown and described herein, but that in fact, widely different means may be employed in the practice of the broader aspects of this invention.

The embodiments of the invention in which we claim an exclusive property or privilege are defined as follows:

1. A self-restoring plow trip comprising a supporting frame, a moldboard plow attached to a stub beam, a pair of vertically spaced solid links pivotally connected at their forward ends to said supporting frame and at their rear ends to said stub beam, biasing means connected between one of said links and said frame for biasing said stub beam into plowing position, in all positions of said plow said pivotal connection of the lower of said links and said frame being positioned forwardly of the pivotal connection of the upper of said links with said frame and said pivotal connection of said lower link and said stub beam being positioned rearwardly of the pivotal connection of said upper link with said stub beam whereby when said plow strikes an object said plow will move rearwardly and upwardly without the point of said plow striking the bottom of said plow furrow, one of said links is provided with a stop member coacting with said stub beam for limiting the forward movement of said plow under the influence of said biasing means.

2. A self-restoring plow trip as recited in claim 1 and wherein said upper link is provided with a hook portion coactable with a member inserted through an opening in said stub beam for retaining said plow in tripped position.

3. A self-restoring plow trip comprising a supporting frame, a moldboard plow attached to a stub beam, a pair of vertically spaced solid links pivotally connected at their forward ends to said supporting frame and at their rear ends to said stub beam, biasing means connected between one of said links and said frame for biasing said stub beam into plowing position, in all positions of said plow said pivotal connection of the lower of said links and said frame being positioned forwardly of the pivotal connection of the upper of said links with said frame and said pivotal connection of said lower link and said stub beam being positioned rearwardly of the pivotal connection of said upper link with said stub beam whereby when said plow strikes an object said plow will move rearwardly and upwardly without the point of said plow striking the bottom of the plow furrow, said upper link is approximately one-half the length of said lower link and is vertically spaced therefrom to provide said plow with a twofold tripping action when an object is struck, a first action of moving backwards principally while maintaining a plowing aspect of the plow, a second action of pivoting the plow as it is moved rearwardly, and said biasing means comprises a hydraulic cylinder pivotally connected at one end to said frame and pivotally connected at the other end thereof to a crank arm of one of said links, said hydraulic cylinder being hydraulically connected to an accumulator carried by said frame for providing a hydraulic force resisting upward movement of said plow and for storing energy provided by the upward movement of said plow.

4. A self-restoring plow trip comprising a supporting frame, a moldboard plow attached to a stub beam, a pair of vertically spaced solid links connected at their forward ends to said supporting frame rearwardly of the forward point of said plow when in plowing position and said links being connected at their rear ends to said stub beam, biasing means connected between one of said links and said frame for biasing said stub beam into plowing position and permitting relief upon striking an object, in all positions of said plow said pivotal connection of the lower of said links and said frame being positioned forwardly of the pivotal connection of the upper of said links with said frame and said pivotal connection of said lower link and said stub beam being positioned rearwardly of the pivotal connection of said upper link with said stub beam whereby when said plow strikes an object said plow will move rearwardly and upwardly without the point of said plow striking the bottom of the plow furrow, and the pivotal connections of said lower link lie in a line generally parallel to a line connecting the pivotal connections of said upper link while plowing with said upper link being approximately one-half the length of said lower link so that the initial movement of the plow upon striking an object will be upward and rearward followed by a final pivotal movement of said plow presenting the point of the plow downwardly to aid the plow in clearing itself of the object struck.