May 20, 1941. R. W. KEELER 2,242,826

SNOWPLOW

Original Filed June 23, 1938 7 Sheets-Sheet 1

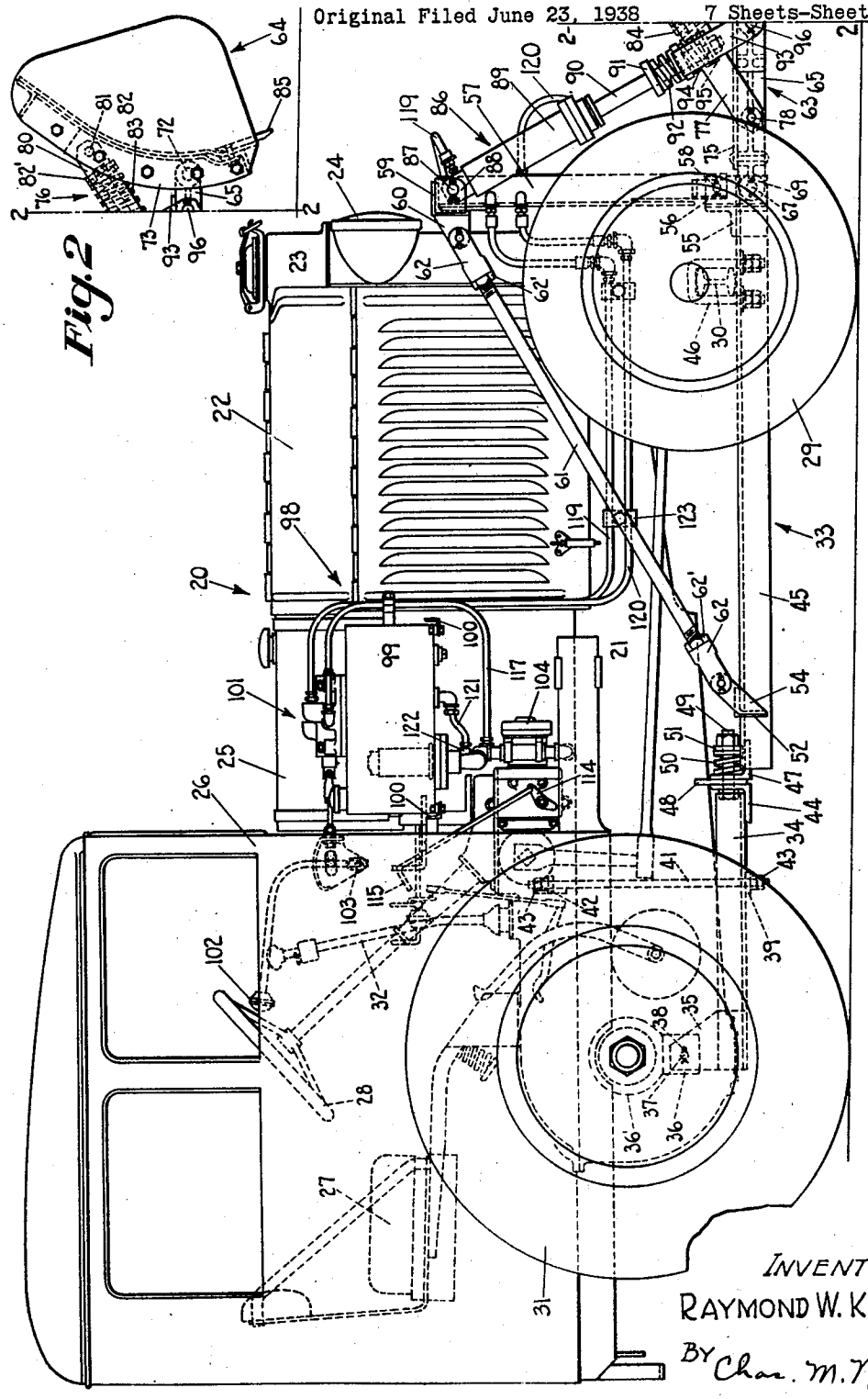


Fig. 2

Fig. 1

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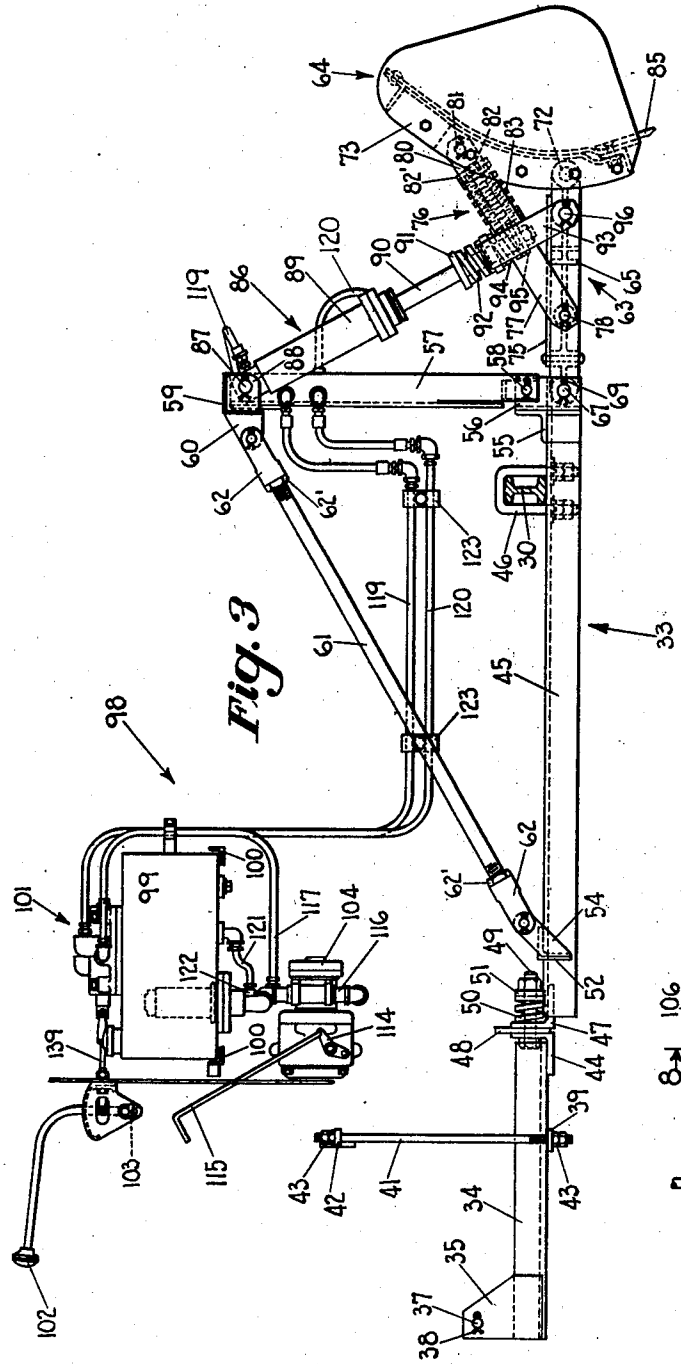


Fig. 3

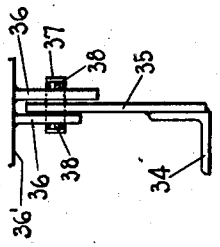


Fig. 6

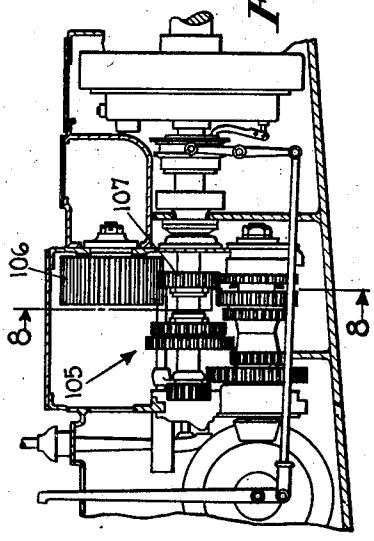


Fig. 7

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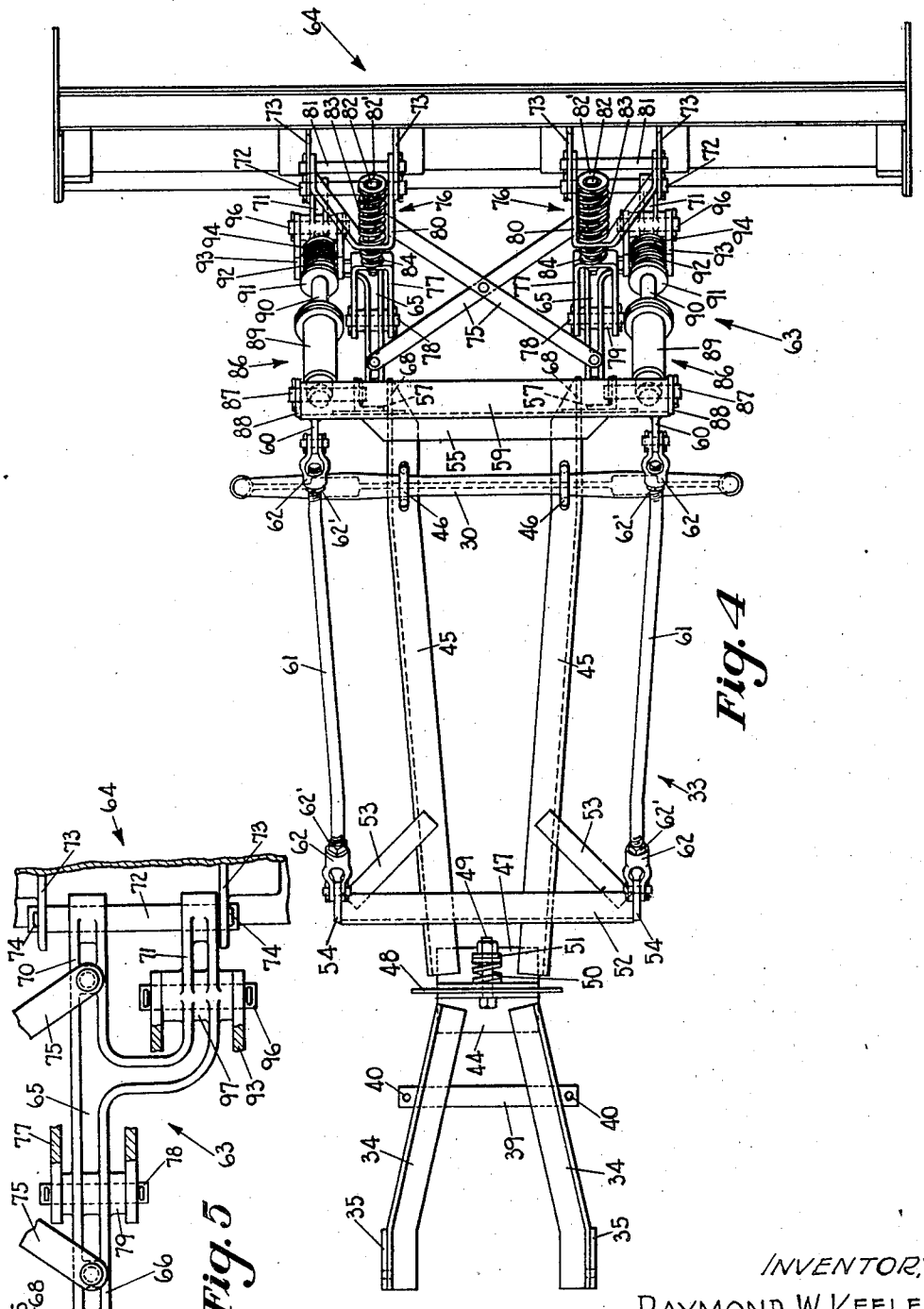


Fig. 4

Fig. 5

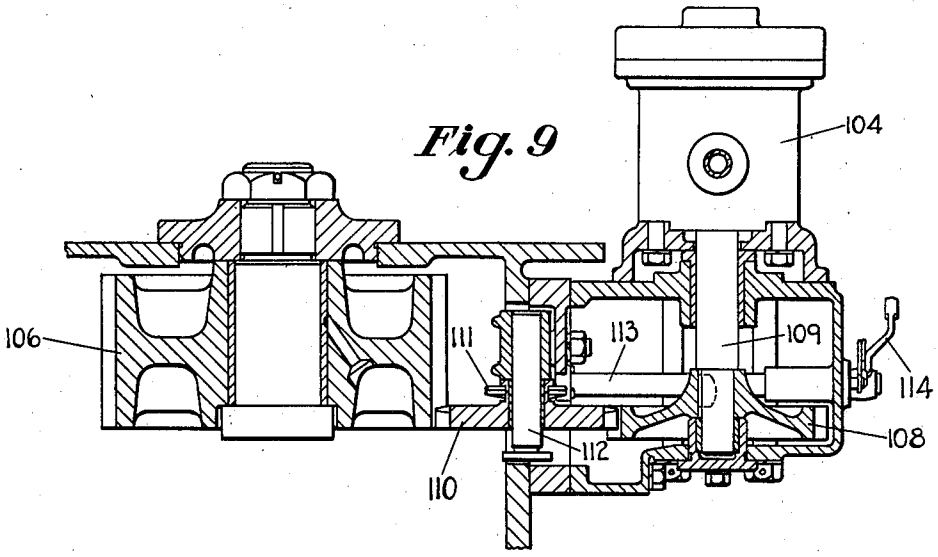
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SNOWPLOW

Original Filed June 23, 1938 7 Sheets-Sheet 4

Fig. 9



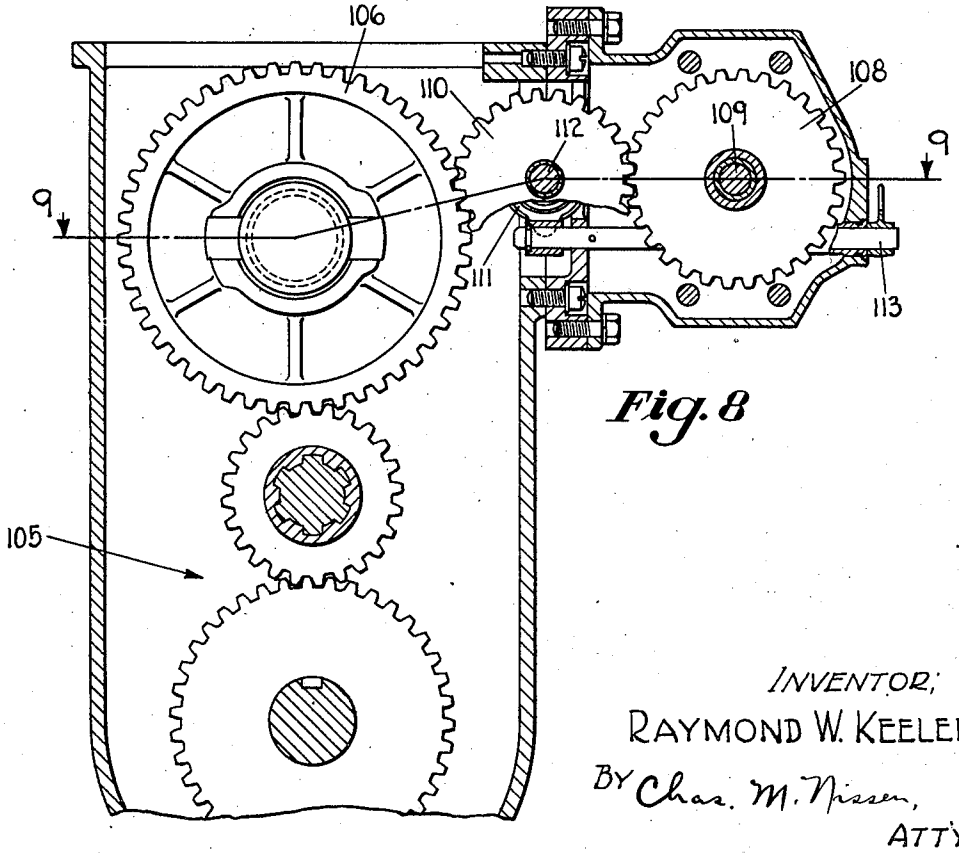


Fig. 8

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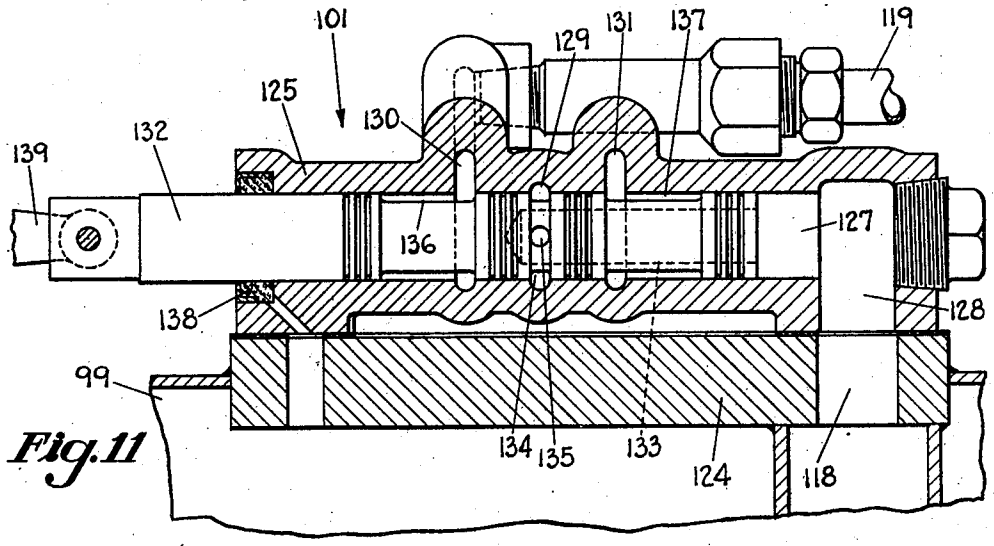


Fig. 11

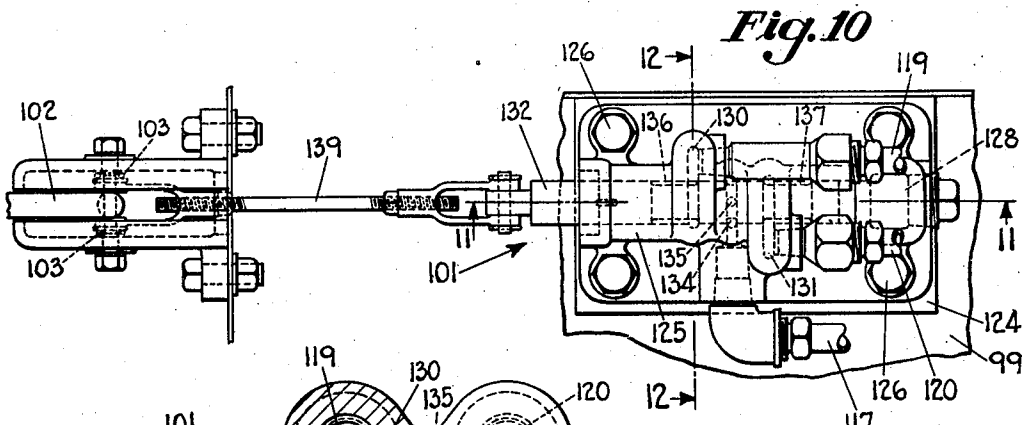


Fig. 10

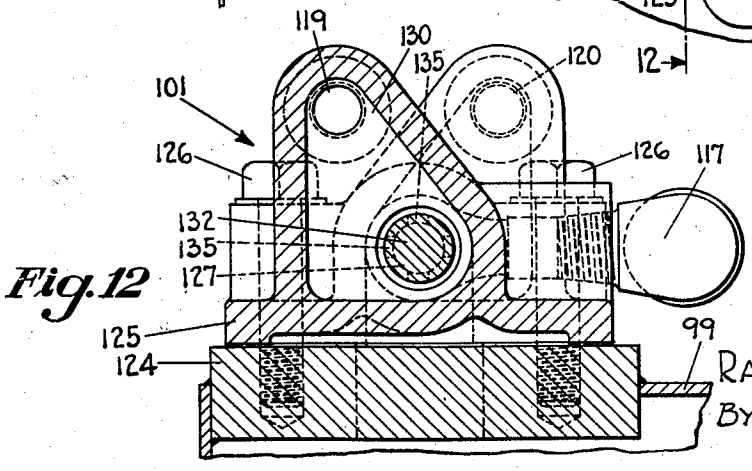


Fig. 12

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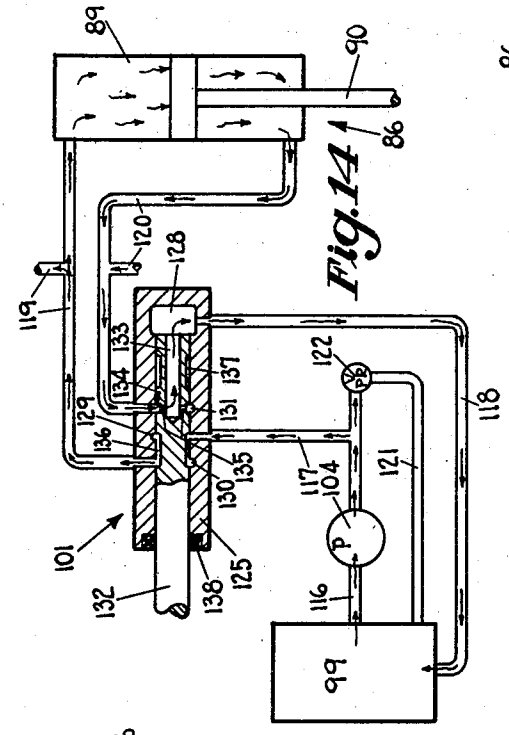


Fig. 14

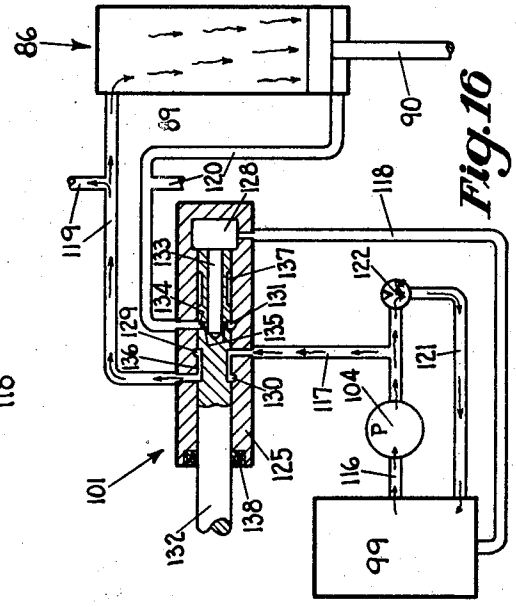


Fig. 16

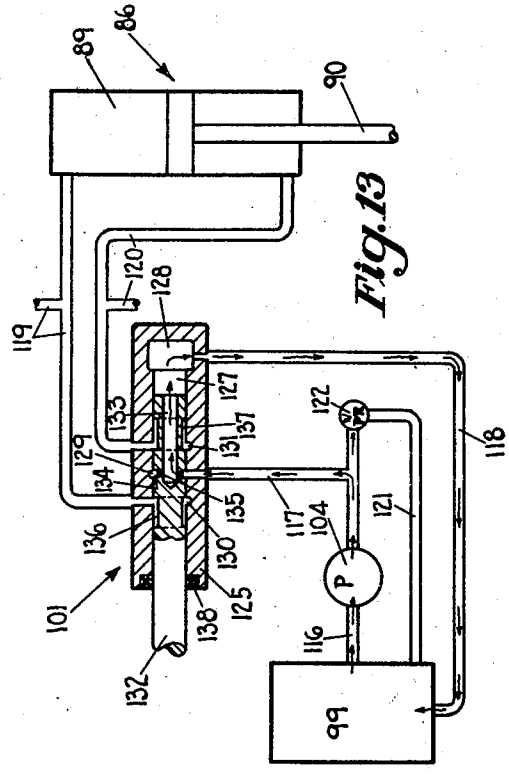


Fig. 13

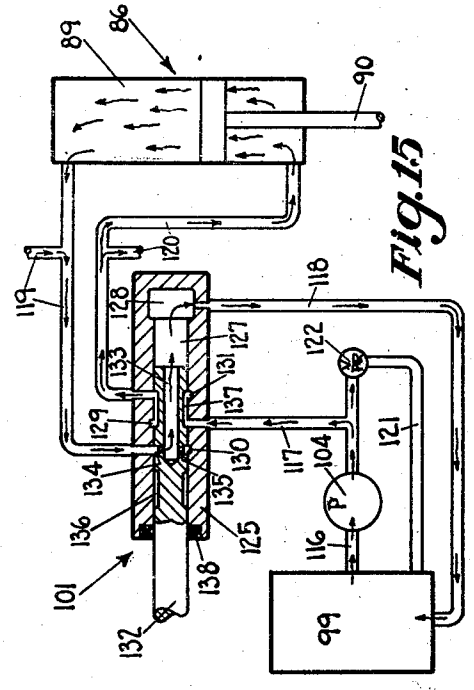


Fig. 15

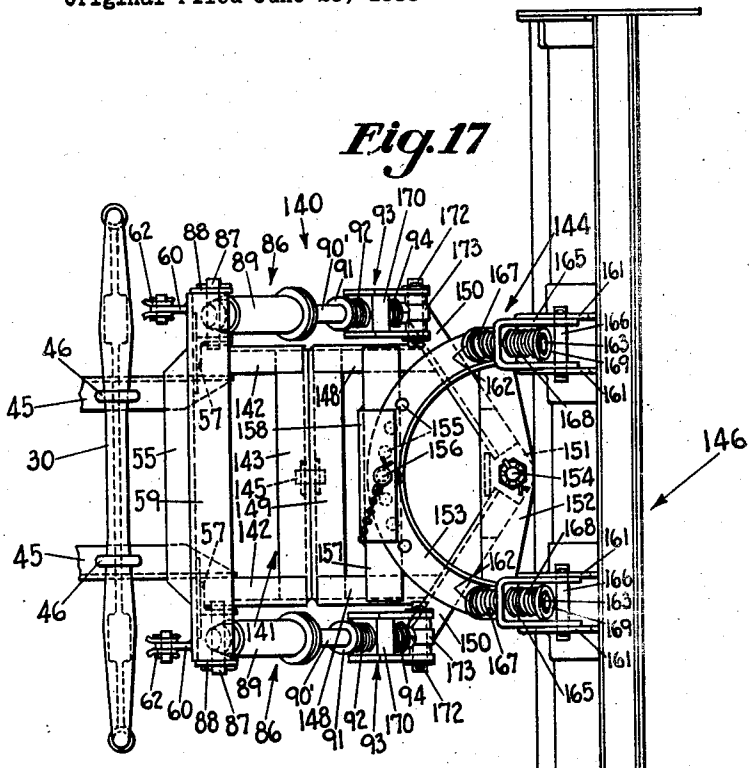
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SNOWPLOW

Original Filed June 23, 1938 7 Sheets-Sheet 7

Fig. 17



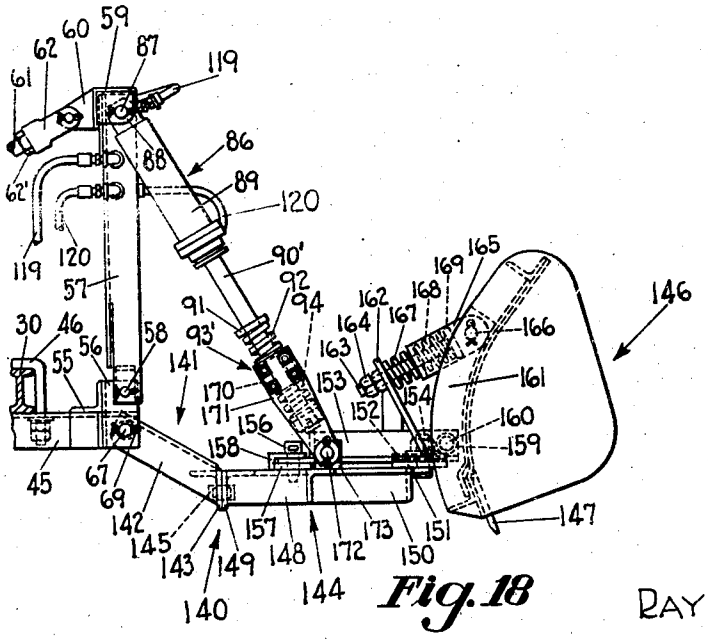


Fig. 18

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Patented May 20, 1941 2,242,826

UNITED STATES PATENT OFFICE

2,242,826

SNOWPLOW

Raymond W. Keeler, Galion, Ohio, assignor to The Galion Iron Works & Manufacturing Company, a corporation of Ohio

Original application June 23, 1938, Serial No. 215,440. Divided and this application February 29, 1940, Serial No. 321,516

4 Claims. (Cl. 37—42)

This invention relates to a new and improved type of snowplow or similar equipment in which the plow or blade is positioned in front of a tractor to remove snow or to grade a road.

An object of the invention is to provide an improved snowplow construction which is operated by a tractor in which there are power operated means comprising hydraulically controlled means for adjusting the position of the snowplow.

Another object of the invention is to provide an improved control means for a snowplow including a hydraulic system, the pump of which may be selectively connected to be driven from or disconnected from the motor of the tractor associated with the snowplow.

Still another object of the invention is to provide a snowplow attachment to a tractor and means for readily adjusting the position of the snowplow from the operator's position of the tractor.

A further object of the invention is to provide improved and rugged snowplow supporting and operating means which provide for very flexible control of the snowplow while at the same time providing a simple and efficient construction.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings,

Figs. 1 and 2 combine to make a side elevational view of the apparatus comprising my invention, Fig. 2 being an extension along the line 2—2 of Fig. 1;

Fig. 3 is a side elevational view of the mechanism of Figs. 1 and 2 shown detached from the tractor;

Fig. 4 is a plan view of the apparatus of Fig. 3 after the hydraulic control system generally has been removed;

Fig. 5 is an enlarged detail view of a portion of the supplemental frame comprising the attachment which connects the snowplow and the tractor;

Fig. 6 is an enlarged end elevational view showing the method of mounting the rear end of the main attaching frame to the tractor;

Fig. 7 is a longitudinal sectional elevational view showing the drive means for the tractor and particularly a gear which is employed to drive the pump of the hydraulic system;

Fig. 8 is a transverse sectional elevational view taken substantially on the line 8—8 of Fig. 7 and enlarged looking in the direction of the arrows;

Fig. 9 is a sectional plan view taken on the line 9—9 of Fig. 8 looking in the direction of the arrows;

Fig. 10 is a plan view of the control valve of the hydraulic system and the operating mechanism therefor, the operating handle being broken away;

Fig. 11 is a longitudinal sectional elevational view taken on the line 11—11 of Fig. 10 looking in the direction of the arrows;

Fig. 12 is a transverse sectional elevational view taken on the line 12—12 of Fig. 10 looking in the direction of the arrows;

Figs. 13, 14, 15 and 16 are diagrammatic representations of the hydraulic control system showing four operating conditions encountered in actual practice, Fig. 13 being the no-load condition of the system, Fig. 14 being the condition when the snowplow is being lowered, Fig. 15 being the condition when the snowplow is being raised, and Fig. 16 being the condition when the hydraulic piston motor has reached one extreme position of expansion;

Fig. 17 is a plan view of a modified form of supplemental frame for supporting and attaching the snowplow to the main frame; and

Fig. 18 is a side elevational view of the mechanism of Fig. 17.

This application is a division of my co-pending application, Serial No. 215,440, filed June 23, 1938, for an improvement in a snowplow.

Referring particularly to Figs. 1 to 5, inclusive, of the drawings, it will be seen that my invention comprises a tractor 20 which is essentially a commercial form of tractor having a self-contained unitary tractor frame 21 which is formed as a unit with the rear axle housing, gear housing and crank case of the tractor motor, which is carried under the hood 22. The tractor is provided with the usual radiator 23, headlights 24, fuel tank 25, cab 26, seat 27 and steering wheel 28 which steers the front operating wheels 29 provided with pneumatic tires and carried upon front axle 30. Said tractor 20 also includes pneumatically tired ground engaging traction wheels 31 and a gear shift lever 32.

To provide for the attaching of a snowplow or other scraper blade to the tractor 20 so as to operate ahead thereof, I provide a main frame 33 comprising a pair of rearwardly positioned angularly extending angle members 34 which at their rear ends are provided with upwardly extending plates 35 each of which is adapted to be pivotally attached between a pair of downwardly extending lugs 36 by a pin 37 removably held in place by cotter keys 38, as shown in Fig. 6. The

depending lugs 36 may be integral with the rear tractor axle housing 36' or they may be rigidly secured thereto by means of U-bolts.

Extending transversely between the angle members 34 is a cross-bar 39 having holes 40 at opposite ends thereof adapted to receive hang rods 41 (see Figs. 1 and 3) which are attached at their tops to brackets 42 secured to and carried by the body of the tractor 20. The hang rods 41 are provided with double locking nuts 43 at each end to provide for adjustment of the effective length thereof. At their forward ends the angle members 34 are attached to a transverse angle member 44. The elements just described as part of the main frame 33 form the rear portion thereof which is pivotally attached to a front portion for pivotal movement about a horizontal longitudinally extending axis now to be described.

Said front portion of the main frame 33 comprises a pair of substantially longitudinally extending angle members 45 which are rigidly attached near their front ends to the axle 30 of the tractor 20 by U-bolts 46. At their rear ends the angle members 45 are attached to a transverse angle member 47 between which and the aforedescribed angle member 44 is positioned a spacer plate 48. A horizontally positioned longitudinally extending bolt 49 passes through the upright webs of the angle members 44 and 47 and through the plate 48 to provide the aforedescribed pivotal connection between the front and rear portions of the main frame 33. A helical spring 50 cooperates with appropriate washers 51 and a nut on the bolt 49 to provide a longitudinally extensible connection as well as a pivotal connection between the above mentioned parts of the main frame 33. Extending transversely of the angle members 45 near the rear ends thereof is an angle member 52 which is braced with respect to the angle members 45 by braces 53. The opposite ends of the angle member 52 carry brackets 54, 54 the function of which is described in complete detail hereinafter.

At their forward ends the angle members 45 carry a rigidly attached transversely extending angle member 55 which carries at opposite ends upstanding angles 56 (see Fig. 5). As seen by reference to Figs. 3 and 4 of the drawings, there extends upwardly from the angles 56 a pair of pivotally attached uprights 57, 57 formed of angle members and pivotally attached to said angles 56 by pivot pins one of which is seen at 58 in Fig. 3 of the drawings. The tops of the uprights 57 are rigidly attached by a cross-piece 59 in the form of an angle member which is provided at opposite ends with brackets 60, 60. Extending between the previously described brackets 54, 54 and the brackets 60, 60 are adjustable brace rods 61, 61 provided at each end with adjusting yokes 62, 62 associated with which are appropriate lock nuts 62'.

By reference to Fig. 1 of the drawings, it will be seen that the afore-described main frame 33 is positioned generally below the tractor 20 with the uprights 57 and cross-piece 59 positioned in front thereof with the brace rods 61 extending one on each side of the motor and tractor frame 21 of the tractor 20. Extending forwardly from and pivotally attached to the main frame 33 is an auxiliary frame 63 to the front end of which is attached a snowplow or scraper blade 64. The auxiliary frame 63 is constructed of a pair of similar heavy brackets or castings 65 the structure of which is best seen by reference to Fig. 5 of the drawings. Each of said castings 65 is formed with a main shank 66 which is pivotally attached to the lower portion of one of the aforementioned angle members 56 by a pivot pin 67 one end of which is carried by said angle member 56 and the other end of which is carried by the forward extension 68 of the vertical flange of an angle 45 of the main frame 33. Appropriate removable cotter keys 69 are provided to maintain the pivot pin 67 in position.

Each of the castings 65 is bifurcated at its forward end to provide spaced arms 70 and 71 adapted to receive the pivot pin 72 which extends between reinforcing ribs 73, 73 rigidly attached to and forming part of the snowplow 64. Appropriate cotter keys 74, 74 are provided to maintain the pivot pin 72 removably in place.

As clearly seen by reference to Fig. 4 of the drawings, a pair of cross rods 75 extend diagonally across and between the castings 65, 65 and rigidly attach them together thus insuring their pivotal movement substantially in unison, the rods being bolted or riveted together where they cross each other and the ends of the rods being bolted or riveted to the castings.

In addition to the pivotal connection above described between the auxiliary frame 63 and the snowplow 64, further resilient connecting means 76, 76 are provided to maintain the slope of the leading face of the snowplow or grader blade in any desired position. Said connecting means 76, 76 are of similar construction and each comprises a yoke 77 pivotally attached by a pin 78 to a bearing box 79 (Fig. 5) formed as an integral part of the main shank 66 of the casting 65, and a yoke 80 pivotally attached by a pin 81 to the afore-described ribs 73 of the snowplow 64, which yokes 77 and 80 are resiliently connected together by a through bolt 82 which extends through each end is provided with a pair of surrounding helical springs 83 and 84, the latter of which is interposed between the two yokes 77 and 80, and the former of which is interposed between a washer 82' at one end of the bolt 82 and the yoke 80. It will be evident that the connecting means 76 is designed to maintain the blade 85 of the snowplow 64 at a normal predetermined angle but that the snowplow is provided for limited resilient pivotal movement about the axis of the pivot pins 72 both in a clockwise and a counter-clockwise direction with respect to said normal position. This provides for the absorption of shocks received by the blade 85 in the operation of the snowplow 64 such as, for example, those received when a stone is struck on the road surface.

To provide for the pivotal adjustment of the auxiliary frame 63 with respect to the main frame 33 about the axis of the pivot pins 67, which is a substantially horizontal axis, with the consequent raising and lowering of the snowplow 64 or blade 85, I provide at each side of the auxiliary frame 63 a power operated adjusting mechanism which is preferably in the form of an expansible hydraulic piston motor 86, there being two such motors 86 of similar construction. The upper end of each of the cylinders 89 of the motors 86 is pivotally attached by a pin 87 to an upright 57 and a spaced vertical plate 88 rigidly attached to the angle member or cross-piece 59, said pin 87 being removably held in place by appropriate cotter keys.

The piston rod 90 of each motor 86 is provided with a flange 91 against which abuts a helical spring 92 which rides on a yoke 93, which piston rod 90 is provided with a further helical spring.

94 cooperating with a large washer 95 carried at the lower end of the piston rod 90 to provide a resilient connection between said yoke 93 and said piston rod 90 for movement in reverse directions. That is, the two helical springs 92 and 94 provide for reverse movement of the piston rod 90 with respect to the yoke 93 resiliently in reverse directions. By reference to Fig. 5 of the drawings, it will be seen that the yoke 93 is pivotally attached by a pin 96 to a bearing box 97 formed integral with the arm 71 of the casting 65. It will thus be evident that the snowplow 64 is held in any adjusted position by the hydraulic piston motors 86, 86 but resilient movement from the normal position as determined by said motors 86, 86 is permitted in reverse directions due to said springs 92 and 94. The hydraulic piston motors 86 are very powerful and constitute easily controllable power operated means for adjusting the position of the auxiliary frame 63 with respect to the main frame 33 about the horizontal axis provided by the pivot pins 67, thus providing for the ready adjustment of the snowplow 64. As hereinafter described in full detail, the motors 86 are locked in any position of adjustment to which they are adjusted thus preventing either expansion or contraction of them under the influence of the snowplow 64 when in operation.

By reference to Figs. 1 and 3 of the drawings, it will be seen that I have provided a hydraulic system 98 to control the hydraulic piston motors 86, 86. Said hydraulic system comprises a hydraulic fluid tank or reservoir 99 which is preferably positioned along one side of the tractor 20 ahead of the cab 26 and is supported upon brackets 100 which extend from the tractor frame. Positioned on top of the reservoir 99 is a control valve 101, hereinafter described in full detail, which is provided with an operating lever 102 located within easy reach of the tractor operator, as clearly seen by reference to Fig. 1 of the drawings. The operating lever 102 is spring biased to a normal or neutral position by spring means 103 which are operative to restore the control valve 101 to its normal or central position whenever the operating lever 102 is released. The fluid under pressure is derived from a pump 104 which is driven from the motor of the tractor 20 under the control of the operator, as now to be described.

By reference to Fig. 7 of the drawings, it will be seen that associated with the transmission 105 of the tractor is a wide gear 106 which is always in mesh with the driving gear 107 regardless of the position of said driving gear 107. By reference to Figs. 8 and 9 of the drawings, it will be seen that the wide gear 106 drives gear 108 keyed to pump shaft 109 through intermediate control gear 110 which is shiftable by a shipper mechanism 111 along the shaft 112 either into or out of mesh with the wide gear 106. In Figs. 8 and 9 of the drawings, the driving relation between the gear 106 and the shaft 109 is illustrated. Associated with and operating the shipper 111 is a rock shaft 113 controlled by operating lever 114 which in turn is controlled by operating rod 115 (Fig. 1) within easy reach of the tractor operator. It is thus evident that the operator may control the operating rod 115 either to connect or disconnect the pump 104 with respect to the tractor motor.

By reference to Figs. 1, 3 and 13 of the drawings, it will be seen that a feed conduit 116 leads from the tank 99 to the in-put of the pump 104. The out-put of the pump 104 is connected by a pressure conduit 117 to the control valve 101. A return conduit 118 provides a return path from the control valve 101 to the tank 99. Control conduits 119 and 120 extend from the control valve 101 to opposite ends of the cylinders 89 of the hydraulic piston motors 86 which are connected in parallel. Also extending from the out-put of the pump 104 to the tank 99 is a by-pass conduit 121 controlled by a high pressure relief valve 122.

It may be stated that the afore-described conduits 119, 120 are preferably flexible fabricated rubber hoses capable of standing relatively high pressures, which conduits may be readily directed over tortuous paths to reach the hydraulic piston motors 86, while at the same time providing for relative adjustment between the portions of the main frame 33, particularly between the uprights 57 and the angle members 45 as provided by the brace rods 61. Appropriate brackets 123 are also provided to support the conduits 119, 120 from the tractor frame (Fig. 1).

Before describing the operation of the hydraulic control system, attention is directed to Figs. 10, 11 and 12 of the drawings which illustrate the structure of the control valve 101. Said control valve comprises a main base 124 which is formed as an integral part of the tank 99 upon which is bolted a main body or casting 125 as by machine bolts 126. Extending longitudinally through the casting 125 is a cylindrical bore 127 one end of which communicates with a chamber 128 in communication with the conduit 118 which is nothing more than a bore in the base 124 providing a return path to the tank 99.

Centrally of the bore 127 is a circumferential chamber 129 which communicates with the pressure conduit 117. To the rear of the chamber 129 is a circumferential chamber 130 which communicates with the control conduit 119. In front of chamber 129 is a circumferential chamber 131 which communicates with the control conduit 120. Slidably mounted within the bore 127 is a slide piston 132 provided with a central bore 133 which communicates with the right hand end thereof, as viewed in Fig. 11 of the drawings, and which communicates with a circumferential groove 134 in said piston 132 by way of four radial ports 135. Rearwardly of the groove 134 is a relatively wide groove 136 and forwardly of the groove 134 is another relatively wide groove 137. A felt packing 138 is provided to prevent a flow of fluid from the control valve 101, which packing is provided with appropriate drain conduits to the tank 99. As clearly seen by reference to Figs. 1, 3 and 10 of the drawings, an operating shaft 139 extends between the operating lever 102 and the slide piston 132.

The normal position of the control valve 101 is illustrated in Figs. 11 and 13 of the drawings, wherein a no-load by-pass is provided from the pressure conduit 117 through chamber 129, groove 134, ports 135, bore 133, bore 127 and conduit 118 to the tank 99. This is the normal or non-operating position of the control valve 101 and provides for no-load operation of the pump 104 by virtue of the afore-described low pressure by-pass. It is to be noted that at the same time the piston rod 90 is locked in its position of adjustment by virtue of the fact that the control conduits 119 and 120 have hydraulic fluid trapped in them which cannot escape due to the fact that the chambers 130 and 131 are sealed by the grooves 136 and 137.

In Fig. 14 of the drawings, the piston 132 has been moved forwardly from its normal position in which position the hydraulic piston motor 86 is expanded by virtue of the fact that pressure conduit 117 is placed in communication with control conduit 119 by wide groove 136 and control conduit 120 is placed in communication with return conduit 118 by way of ports 135 and bore 133.

Fig. 15 illustrates a reverse positioning of the slide valve 132 which is effective to contract the piston motors 86 by virtue of the fact that pressure conduit 117 is placed in communication with control conduit 120 by way of wide groove 137 and control conduit 119 is in communication with return conduit 118 by way of ports 135 and bore 133.

By reference to Figs. 13, 14 and 15 it will thus be evident that when the control valve 101 is in its normal position to which it automatically returns when operating lever 102 is released, the pump 104 will be operated under no-load by virtue of a no-load by-pass and the piston motor 86 will be sealed in any position to which it has been adjusted. By adjusting the control valve 101 by moving the piston 132 to the right, as viewed in Fig. 14, the no-load by-pass for the pump 104 will be automatically shut off and the piston motors 86 will be expanded. As illustrated in Fig. 15, when the control valve 101 is operated by moving the piston 132 to the left from its normal position, the no-load by-pass will again be cut off and the hydraulic piston motors 86 will be contracted. It is thus manifest that the tractor operator need only operate the lever 102 to control the valve 101 to adjust the snowplow 64 either by raising or lowering it and when it is adjusted it will be held in adjusted position against both upward and downward movements except as provided by the afore-described resilient connections.

In Fig. 16 of the drawings the position of the valve 101 is the same as illustrated in Fig. 14, but the piston of the illustrated hydraulic piston motor 86 has reached the end of its stroke. When such a condition is realized, the high pressure relief valve 122 will come into operation to provide a return path for the fluid delivered by the pump 104 by way of the high pressure by-pass 121. This prevents any damage to the pump or any of the other elements of the hydraulic control system should the control valve 101 be maintained in an operating condition after the hydraulic piston motors 86 have been completely expanded.

The high pressure relief valve 122 will likewise operate to provide a by-pass should the hydraulic piston motors be completely contracted with the valve 101 maintained in an operating position, or should the hydraulic piston motors 86 attempt to move the snowplow 64 in either direction against a very rigid obstruction. In other words, the high pressure relief valve 122 is effective to relieve any abnormal pressure which may appear at the out-put of the pump 104 thereby preventing any damage to the hydraulic control system.

Attention is now directed to Figs. 17 and 18 of the drawings wherein there is illustrated a modified form of auxiliary frame 140 which may be substituted for the auxiliary frame 63, it being understood that all of the other structure disclosed in the other figures of the drawings have not been modified unless definitely indicated. In this connection, it may be stated that the auxiliary frame 140 may simply replace the auxiliary frame 63 with certain modifications of the snowplow and hydraulic piston motors, as hereinafter described in full detail.

Said auxiliary frame 140 comprises a rear part 141 formed by a pair of longitudinally extending downwardly sloping angle members 142 connected together by a transversely extending cross-angle 143. The rear ends of the angle members 142 are pivotally attached to the main frame 33 by the previously described means including the pivot pins 67 similar to the manner in which the castings 65 were attached thereto as disclosed in detail in Fig. 5 of the drawings and as above described.

Pivotally attached to said rear part 141 of the auxiliary frame 140 is a front part 144, the attachment being effected along a central horizontal longitudinal axis by a pivot pin 145 provided with appropriate retaining cotter keys. This pivot pin 145 provides for relative movement of the front and rear parts 144 and 141 about a horizontal longitudinally extending axis which is particularly desirable where the snowplow 146 is adjusted about a vertical axis, as hereinafter described in full detail, because whenever the front part 144 of the auxiliary frame 140 is in any position other than horizontal, a slight tilting movement about the axis of pin 145 is required to maintain the blade 147 of said snowplow 146 in a horizontal position. This will be explained in more complete detail hereinafter.

The front part 144 of said auxiliary frame 140 is formed by a pair of longitudinally extending angle members 148, the rear ends of which are connected by a transversely extending angle member 149 which receives the afore-described pivot pin 145. Extending diagonally from the angle members 148 at their forward ends is a pair of angle members 150 the inner ends of which are attached to a bearing plate 151 upon which is pivotally supported a cross-piece 152, the ends of which support a semi-circle 153 formed of an angle, which cross-piece 152 is pivotally supported upon the bearing plate 151 by a pivot bolt 154 thereby providing pivotal movement of the semi-circle 153 about the axis of said bolt 154. The semi-circle 153 is provided with a plurality of spaced apertures 155 adapted selectively to receive a pin 156 removably extending between a cross-piece 157, the ends of which are supported by the angles 148, and an angle member 158 which is rigidly attached to said cross-piece 157 as by welding.

As clearly seen by reference to Figs. 17 and 18 of the drawings, the horizontal flange of the semi-circle 153 slides between the cross-piece 157 and the horizontal flange of the angle member 158 thereby preventing vertical movement of said semi-circle 153 with respect to said angle member 158, but permitting free rotation of said semi-circle 153 about the axis of the pivot bolt 154. It is, of course, evident that the pin 156 locks the semi-circle 153 in any position of adjustments which can be varied in accordance with the accommodation of the apertures 155.

At each end the semi-circle 153 is provided with a horizontally disposed transversely aligned journal box 159 which carries a pivot pin 160 which extends between a pair of ribs 161 on the rear face of the snowplow 146 and provides a pivotal connection between each end of said semi-circle 153 and said snowplow 146.

To provide a further and resilient connection

between the semi-circle 153 and the snowplow 146 I provide at each end of said semi-circle 153 an upwardly inclined bracket 162 provided with a through bolt 163 having appropriate adjusting and locking nuts 164 associated therewith and threading through a yoke 165 pivotally attached by a pivot pin 166 to the aforementioned ribs 161 of the snowplow 146. Reversely operable helical springs 167 and 168 are provided on opposite sides of the bottom of the yoke 165 to provide for resilient movement of the snowplow 146 about the axis of the two spaced-apart pivot pins 160 as determined by the operating conditions encountered when the snowplow is in actual operation.

As clearly seen by reference to Fig. 17 of the drawings, through bolt 163 is provided with a large washer 169 which cooperates with the spring 168. It is thus seen that the snowplow 146 is pivotally and resiliently supported by the semi-circle 153 which may be adjusted about the upright axis of the pivot bolt 154 to adjust the angle of attack of the snowplow 146 with respect to the direction of travel of the tractor.

It is manifest that if the frame 140 is adjusted on the pivots 67 to move the snowplow 146 from its position shown in Fig. 18, the pivot 154 will be moved to an inclined position. Now upon adjusting the snowplow from its transverse position shown in Fig. 17 on such inclined pivot 154 to a diagonal position relative to the path of travel of the machine one end of the cutting blade 147 will strike against the road surface while the other end will be elevated farther from the road surface. Consequently, if the adjustment of the cutting blade to such diagonal position is made while the pivot 154 is vertical and this is followed by operation of the motors 86 to swing the frame on the pivots 67, that end of the cutting blade farther away from the axis of the pivots 67 will be moved to a position at a higher elevation than the opposite end of the blade. This is because both ends of the blade are given the same angular movement on the axis of the pivots but the more remote end of the blade moves through a longer arc by reason of its movement on a longer radius.

In order to maintain the lower edge of the cutting blade 147 in a horizontal plane under such conditions, the front section 144 of the frame 140 is free to pivot about the longitudinally extending central axis of the pin 145.

When the motors 86 are operated to lift the frame 140 on the axis 67, they will operate equally since they are connected in parallel. While suspended above the road surface the snowplow may be adjusted manually from the transverse position shown in Fig. 17 to a position extending diagonal to the path of travel of the machine, and locked. Then that end of the cutting blade nearer the axis of the pivots 67 will be in a relatively low position and the other end in a relatively high position. Now upon reversing the motors 86 to lower the snowplow the lower end will strike the road surface first and finally the other end will engage the road surface and front section 144 of the frame will be automatically tilted on the horizontal longitudinally extending pivot pin 145 to permit the lower edge of the cutting blade 147 to move to a horizontal plane. The motors 86 being connected in parallel will stop their expansions one after the other, that motor nearer the lower end of the blade stopping first. If the operator does not move the controlling valve to neutral position when both motors are automatically stopped by the resistance offered by the road surface to further downward movement of the blade, the high pressure relief valve may be set to automatically open the by-pass around the pump.

After the snowplow has been adjusted to its diagonal position and the lower edge of the cutting blade has been adjusted to the level of the road surface the front section 144 of the frame 140 will remain in its adjusted tilted position on the pivot pin 145 with the motors 86 expanded to different lengths accordingly. After such adjustments have been effected, the snowplow may be adjusted in elevation through a wide range because the motors are connected in parallel and operate equally so long as the upward and downward movements thereof do not meet with unequal obstructions to such movements and so long as the pistons of the motors do not either of them reach the limits of their strokes.

It may be stated that the hydraulic piston motors 86 illustrated in Figs. 17 and 18 are the same as those illustrated in other figures of the drawings, except for a small change in that the piston rods 90' are somewhat longer than the piston rods 90 due to the slope of the rear part 141; and the yokes 93' differ from the yokes 93 previously described, in that said yokes 93' are built up from relatively heavy blocks 170 to which are bolted a pair of side plates 171. The side plates 171 of the yokes 93' are pivotally attached by pivot pins 172 to bearing boxes 173 carried upon outward extensions of the afore-described angle members 150. It is thus manifest that the hydraulic piston motors 86 may be operated in the manner previously described in connection with Figs. 1 to 17 of the drawings, to adjust the auxiliary frame 140 about the axis of the pins 67 and thereby adjust the snowplow 146 upwardly and downwardly.

In the operation of the device comprising my invention, an operator can drive the tractor 20 along a roadway to remove snow or to perform a grading or maintaining operation while having complete control of the tractor and the snowplow ahead of it, all from a single station.

It is preferred to positively hold the snowplow down to its work with the valve mechanism in the position shown in Fig. 13, but if at any time the snowplow can not cut a path for itself, such as when obstructed by or riding up on solid ice, the valve mechanism may be moved to the position shown in Fig. 15 to effect lifting of the framework supporting the snowplow and after such obstruction has been passed the valve mechanism may be moved to the positions shown in Figs. 14 and 16 and finally restored to the position shown in Fig. 3. Adjustment of the snowplow upwardly and downwardly is very easily and readily effected by the operator simply by controlling the lever 102 in response to which very powerful power operating hydraulic control mechanism comes into play to adjust the snowplow or grader tool and to hold it resiliently in any position of adjustment.

In the form of the invention illustrated in Figs. 17 and 18 of the drawings, it is further possible to adjust the angle of attack of the snowplow or blade by pivoting it with respect to the axis of the pivot bolt 154 and locking it in any desired position of adjustment. At the same time, the pivotal connection 145 provides for the automatic compensation of differences in the normal elevation of the opposite ends of the blade 147 which are caused by the pivotal adjustment

of the auxiliary frame 140 on the horizontal axis 67. It is thus seen that a snowplow or grader mechanism has been provided as a complete unit which can be operated with a minimum of effort by a single operator on the tractor.

It should be particularly noted by reference to Figs. 17 and 18 that the reciprocable hydraulic motors 86, 86 are arranged in parallelism at the sides of the auxiliary frame 140 and are pivotally connected at their lower ends at 172, 172 to the forward frame section 144 independently of the semi-circle 153. The piston rods 90', 90' are extended downwardly beyond the annular flanges 91, 91 and through the blocks 170, 170 of the yokes or stirrups 93', 93'. The lower ends of these rod extensions are screw-threaded to receive nuts as illustrated in dotted lines in Fig. 18 and such nuts may be locked in adjusted positions.

The springs 92 and 94 above and below the blocks 170 are preferably stiff and heavy so as to be sufficiently strong to co-operate with the hydraulic motors to form rather rigid extensible connections between the main and auxiliary frames adapted to be held at adjusted lengths by locking the pistons in the cylinder 86, 86. Consequently the nuts at the extreme lower ends of the piston rod extensions are not tightened sufficiently to place any initial tension in the springs 92 and 94, these nuts serving merely to hold the springs in place against the blocks 170. However, downward pressure on the scraper blade 147 is yieldingly exerted through the springs 92 and lifting of the snowplow assembly is yieldingly exerted through the springs 94.

It will also be seen by referring to Figs. 17 and 18 that the springs 92 and 94 will act as shock absorbers to cushion sudden up and down movements of the scraper assembly when passing over irregularities in the roadway while the hydraulic motors are locked at adjusted lengths. Main reliance for this purpose, however, may be had on the presence of the springs 167 and 168. When the blade 147 strikes an obstruction the tilting of the snowplow 146 on the axis 160 will be yieldingly resisted by the springs 168 and the recoil will be absorbed by the springs 167. Due to the presence of the stirrups 165 pivoted at their forward ends to the back side of the snowplow and the co-relation between the cross-pieces of these stirrups and the springs 167, 168, the front and rear sides of the brackets 162 serve as abutments for these springs when compressed by the successive rearward and forward tilting movements of the snowplow. Initially the nuts 164 merely hold the springs 167 and 168 in place against their end abutments.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I therefore wish not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention, what I desire to secure by Letters Patent of the United States is:

1. In scraper apparatus, the combination with a main frame, of an auxiliary frame pivoted to said main frame for adjustment relative thereto on a horizontal transverse axis, said auxiliary frame comprising two sections pivoted together on a longitudinal axis, a scraper, mechanism mounting said scraper on the forward section of said auxiliary frame for adjustment relative thereto on an upright axis, spaced-apart fluid-pressure motors connected between said main frame and the forward section of the auxiliary frame at transversely spaced-apart points, and a fluid-pressure control system for operation of said motors in parallel to effect transverse tilting of the forward section of the auxiliary frame on said longitudinal axis when the scraper occupies a position extending diagonally of the line of draft of the machine and said auxiliary frame is moved downwardly to cause the entire length of the lower edge of the scraper to engage the ground, the construction and arrangement being such that after the lower edge of the scraper has been thus adjusted the motors may be operated equally to adjust the elevation of the scraper equally relatively to the road surface.

2. In scraper apparatus, the combination with a main frame, of a supplemental frame pivoted thereto on a transverse horizontal axis, a tertiary frame pivoted to said supplemental frame on a longitudinal axis, a moldboard pivotally mounted on said tertiary frame for adjustment relative thereto on an upright axis, means for holding said moldboard in adjusted angular relation to the path of travel of the scraper apparatus, spaced-apart fluid pressure motors between said main frame and said tertiary frame, and a fluid pressure system for operating said motors in parallel to push down on the tertiary frame to bring the lower cutting edge of the moldboard into contact with the ground surface, said fluid pressure system including equalizing means to allow the stopping of one fluid-pressure motor while the other continues to act to cause said tertiary frame to tilt on said longitudinal axis until the lower cutting edge of the moldboard contacts with the ground surface throughout its entire length.

3. In scraper apparatus, the combination with a main frame, of a supplemental frame pivoted thereto on a transverse axis, a tertiary frame pivoted to said supplemental frame on a longitudinal axis, a moldboard pivotally mounted on said tertiary frame on an upright axis, means for holding the moldboard in adjusted position relative to said tertiary frame with the moldboard inclined relative to the path of travel of said scraper apparatus, spaced-apart fluid pressure motors connected to said tertiary frame, and a fluid pressure control system connecting said fluid pressure motors in parallel for double action in either positively lifting or positively lowering said tertiary frame, said fluid-pressure control system comprising automatic by-pass to permit expansion of said motors to unequal lengths to effect leveling of the lower cutting edge of the moldboard by automatic tilting of the tertiary frame on said longitudinal axis in response to one end of the moldboard contacting with the ground and the expansion of the motor on that side of the machine remote from the ground contacting end of the moldboard.

4. In scraper apparatus, the combination with a main frame, of an elongated scraper, mechanism flexibly connecting said scraper to said frame for adjustment in elevation and in angular relation to the path of travel of the scraper apparatus, spaced-apart fluid pressure motors connected to said mechanism for effecting adjustment in elevation of said scraper including pushing down of the lower edge of the scraper against the ground surface, said mechanism being so constructed and

arranged that when said scraper is thus pushed down it will be automatically moved to such position that its lower edge contacts with the ground surface substantially throughout its length while the scraper is in the aforesaid angular position, and a fluid pressure control system for operating said motors in parallel but enabling said motors to be expanded to different lengths to secure the aforesaid contact of the lower edge of the scraper with the ground surface throughout its length while in inclined position.

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