AUTOMATIC POSITIONING SYSTEMS FOR SCRAPER ELEVATORS

6 Claims, 3 Drawing Figs.

ABSTRACT: The elevator of a self-loading earth-moving scraper is moveable as a unit relative to the bowl thereof and automatic controls are provided which shift the elevator at predetermined stages in the operating cycle of the scraper. The automatic controls operate by sensing forces which react on other components of the scraper and which are indicative of the need for shifting the elevator. The elevator may, for example, pivot gradually upward as loading progresses or may be raised substantially prior to load ejection without requiring control of these movements by the operator.
AUTOMATIC POSITIONING SYSTEMS FOR SCRAPER ELEVATORS

This application is a continuation of our copending application Ser. No. 656,559, filed July 27, 1967 and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to scrapers of the class employed for moving earth or other materials and more particularly to means for shifting the elevator of a self-loading scraper to preferred positions in the course of the operating cycle thereof. A form of a self-loading scraper has a motor-driven elevator, generally of the chain and flight type, mounted at the bowl to facilitate the loading of material and to aid in retaining the load. The elevator is generally coupled to the bowl by pivot arms, which provide for upward and forward movement of the elevator as a unit, so that it may override rocks and other large objects and may adjust itself to variable depths of cut. Within narrow limits, a floating elevator of this type is self-positioning for these purposes.

A marked improvement in scraper efficiency can be realized if powered means are provided to forcibly vary the elevator position to a greater extent than is inherent in the above-described structure. By providing for a greater and more controlled shifting of the elevator as a unit during loading, it is possible to utilize a longer bowl and to load the bowl more fully. This positive control provides for more effective interaction between the elevator and the material being loaded during all stages of the loading operation and aids in avoiding stalling of the elevator.

In prior apparatus of this type, any such powered adjustments of the elevator position have necessarily been controlled manually by the scraper operator. This imposes a considerable burden on the operator, who must simultaneously attend to the steering of the scraper vehicle and to various other adjustments.

To make efficient use of such a system during loading, the operator must continually estimate the optimum elevator position for successive stages in the filling of the bowl. Since the operator is not generally situated at a position where it is convenient to observe the elevator action, and since he cannot directly sense the forces reacting against the elevator, the potential advantages of the powered elevator positioning system have not heretofore been fully realized. Stalling from excessive loading can result if the elevator is momentarily too low in the bowl; and conversely, effective use of the elevator may be forestalled if the elevator is raised somewhat higher than is optimum at a particular time. Thus, continued concentrated attention on the part of the operator is required to achieve reasonably satisfactory operation.

Direct powered shifting of the elevator at other stages of the scraper operating cycle may be equally advantageous but cannot be accomplished with prior constructions without manual control by the operator.

SUMMARY OF THE INVENTION

The present invention provides for automatic repositioning of a scraper elevator, during at least portions of the scraper operating cycle, to increase operating efficiency without imposing additional control functions on the operator. In particular, the powered elevator positioning mechanism is made automatically responsive to forces acting on other components of the scraper which are of a character that signals the need for the elevator movement.

In one embodiment of the invention, for example, continued optimum positioning of the elevator relative to the load throughout the loading operation is realized. The elevator initially lays well back in the bowl and is pivoted upward and forward as loading progresses through the action of a control connection between the elevator shifting means and the motor which drives the elevator chain and flights. The elevator is thereby raised automatically whenever the load on the elevator motor reaches a predetermined magnitude.

Where it is desired to retain manual control of the elevator position during the loading portion of scraper operation, the principles of the invention may still be utilized to provide for automatic control during other portions of the operating cycle. In an essentially manually controlled system, for example, the elevator raising mechanism may be controlled through a connection to the operator drive means to ensure that the elevator is raised prior to operation of the elevator thereby avoiding interference with the release of material.

Accordingly, it is an object of this invention to increase the operating efficiency of self-loading scrapers and to simplify and facilitate the control thereof.

It is another object of this invention to provide for automatic optimization of the interaction between the elevator of a self-loading scraper and material being loaded into the scraper.

It is still a further object of the invention to provide for the automatic actuation of powered means for raising the elevator of a self-loading scraper prior to ejection of a load therefrom.

The invention, together with other objects and advantages thereof, will be better understood by reference to the following description of preferred embodiments in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a side elevation view of a self-loading scraper embodying an automatic elevator positioning system in accordance with the invention, with portions of the structure broken out to better illustrate interior components;

FIG. 2 is a schematic view of the elevator of FIG. 1, together with hydraulic circuitry associated therewith; and

FIG. 3 is a schematic view of the elevator of a second embodiment of the invention, together with control means therefor through which the elevator is automatically raised prior to operation of the elevator.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawing, a self-loading scraper 11 is shown in which the elevator 12 is automatically pivoted upward and forward as loading of the bowl 13 progresses in order to maintain an optimum degree of interaction between the elevator and the material being loaded.

In a scraper 11 of this type, the bowl 13 is formed in part by sidewalls 14 which are connected by an arculate rear wall 16. The bowl 13 is supported at the back by rear wheels 17 which connect therewith through a frame 18. A single-axle tractor 19, having front wheels 21 and carrying an engine 22 and operator station 23, is situated forward from the bowl 13 and is coupled thereto through a pivot hitch 24 and gooseneck 26.

Gooseneck 26 carries a transverse spreader arm 27 and a draft arm 28 extends rearwardly from each end thereof to connect with the corresponding bowl sidewall 14 through a pivot coupling 29. To control the elevation of the bowl 13, a pair of hydraulic jacks 31 are connected between spreader arm 27 and the forward portion of the bowl. Thus, by extending jacks 31, the bowl may be lowered to cause a cutting edge 32 at the lower forward end thereof to bite into the ground surface and guide a superficial layer of earth upward into the bowl as the scraper 11 moves forward. When the bowl 13 has been loaded in this manner, jacks 31 may be retracted to raise the bowl for transporting the material to another site.

In this type of scraper 11, ejection of the contents of the bowl 13 is effected by pivoting the floor 34 of the bowl backward and upward along the inner surface of rear wall 16. For this purpose, the floor 34 is supported by triangular side members 36 which extend upward adjacent the inner surface of each bowl sidewall 14 and are connected thereto through pivots 37. The pivoting movement of the floor 34 is controlled by hydraulic jacks 38 connected between frame 18 and an angled arm 39 having an upper end which is pivoted to the frame.
at a joint 41 and having a lower end which extends forwardly to connect with a link 42 at another pivot joint 43. Link 42 extends forwardly and is coupled to the underside of floor 34 at the front end thereof through still another pivot joint 44. Accordingly, contraction of jacks 38 draws the floor 34 backward and upward about the axes of pivots 37 whereby providing for the release of the contents of the bowl through the bottom thereof. At the completion of the ejection operation, jacks 38 are extended to restore floor 34 to the forward load-carrying position thereof.

The elevator 12 is situated at the forward face of the bowl 13 and functions to forcibly assist the movement of earth up over the cutting edge 32 and into the bowl. Elevator 12 also acts to retain the contents of the bowl therein at the forward end thereof. For this purpose, the elevator 12 has a rectangular frame including side members 46 with sprockets 47 and idlers 48, carried thereon at the upper and lower ends respectively. Endless chains 49 extend between the sprocket 47 and idler 48 at each side of the frame and carry spaced-apart transverse flights 51 which bite into the earth immediately above the cutting edge 32 to aid in moving the earth backward and upward into the bowl 13.

The elevator flights 51 also pulverize the earth and bring about a better distribution of the material within the bowl so that a greater load may be carried therein.

To provide additional support for the elevator flights 51, a series of carrier rollers 52 are mounted on the frame side members 46 to engage the chains 49. The elevator flights 51 are driven by means of a rotary hydraulic motor 53 carried on the elevator 12 and operatively coupled to one of the top sprockets 47.

The elevator 12 of a self-loading scraper 11 has heretofore been made moveable relative to the bowl 13 primarily in order that it may rise somewhat to override rocks and in order that it may adjust itself to varying depths of cut at the cutting edge 32. In accordance with the present invention, the elevator 12 in this example is arranged to have a greater range of movement relative to the bowl 13. With this arrangement, the elevator 12 may lay well back in the bowl 13 during the initial stages of loading to carry soil to the rear thereof and the elevator may then gradually be pivoted upward and forward as loading progresses to ensure filling of the upper portions of the bowl.

To provide for these motions, the elevator 12 is coupled to the bowl in part through a pair of lower links 54, each of which extends from a pivot 56 at the lower end of an elevator frame side member 46 to a pivot 57 at the bowl sidewall 14, pivot 57 being situated above and rearwardly from the pivot 56. Thus, the lower end of elevator 12 may move upward and forward from the cutting edge 32 about the axis of pivot 57 in response to increased thicknesses of material passing over the cutting edge. A stop 58 is attached to the bowl sidewall 14 around pivot 57 to define the limits of this movement so that the elevator flights will not contact the cutting edge 32 and so that the lower end of the elevator cannot pivot upward for an excessive distance.

To further provide for the above-described elevator motion, it has been customary to connect the upper end of the elevator 12 to the bowl 13 through a second set of pivot links. This type of coupling is provided for in the present invention and, in addition, means are associated therewith to forcibly vary the inclination of the elevator relative to the bowl over a wide angular range. Structure for this purpose is comprised of an angled arm 59 having the angle section thereof coupled to the upper portion of the elevator frame side member 46 through a pivot 61. The rearward end of arm 59 is coupled to a link 62 through an additional pivot 63 which extends rearwardly and is in turn pivoted to a link 64 through a ball and socket joint 64. Joint 64 is situated above the pivot connection 37 between the elevator and bowl sidewall 14 so that when the elevator cylinders 38 are actuated as hereinbefore described, the pivoting movement of the bowl floor 34 is accompanied by a forward and upward movement of the upper portion of the elevator 12. This lifting of the elevator 12 in synchronization with movement of the ejector avoids jamming of material against the elevator during ejection as described in more detail in copending application, Ser. No. 563,403 of Trevor G. Campbell, et al. filed July 7, 1966, and entitled SELF-LOADING SCRAPER ELEVATOR MOUNTING, and assigned to the Assignee of the present invention.

To provide for the positive powered control of the inclination of elevator 12, a single acting hydraulic jack 66 is connected between the forward end of angle arm 59 and the bowl sidewall 14 through pivot joints 67 and 68, respectively. Pivot 68 is situated below pivot 67 so that contraction of the jack 66 pivots the upper end of the elevator upward and forward while a reverse movement is produced by the weight of the elevator when fluid is released from the jack. It should be understood that the coupling structure at the upper end of the elevator 12, including angle arm 59, link 62, cylinder 66 and the above-described connections therebetween are duplicated at both sides of the elevator.

While the jacks 66 which control the elevator inclination may be manually controlled by the scraper operator if desired, the structure is most efficiently utilized if automatic control is provided in accordance with the present invention so that the elevator continually shifts upward in response to the gradual filling of the bowl. In this way, the elevator is always optimally related to the material being loaded without requiring any diversion of the operator's attention, and stalling of the elevator is avoided. Referring now to FIG. 2, there is shown a suitable automatic control system for this purpose.

In FIG. 2, the elevator 12 is shown at its lowered position corresponding to the start of a loading cycle. In the present embodiment, the elevator 12 lays back at an angle of approximately 45° at this time. The elevator drive motor 53 is, as previously described, operated by high-pressure hydraulic fluid and for this purpose has a driving fluid input conduit 69 and an exhaust conduit 71 leading to a reservoir 72. Fluid under pressure is supplied to motor intake conduit 69 by a pump 73 which may be driven by the scraper engine or by an auxiliary engine.

The inclination of the elevator 12 is fixed as hereinbefore described by the degree of contraction of the jacks 66 connected between the bowl sidewall 14 and one end of angle arm 59. For optimum efficiency in loading, it is desirable that the jack 66 contract to pivot the upper end of the elevator 12 upward in response to a predetermined increase of the load force which material exerts against the elevator. This is provided for by controlling the jack 66 through a valve assembly 74 which senses the pressure in conduit 69 to elevator motor 53 and which acts to contract the jack when the motor intake pressure rises above a predetermined level indicative of more than optimum loading of the elevator 12. Valve assembly 74 has a valve body 76 with a bore 77 therein in which a spool 78 is disposed. One end of spool 78 extends into a chamber 79 containing a compression spring 81 which urges spool 78 toward the opposite end of body 76. Spool 78 has an axial passage 82 with a flow restriction 83 communicating with chamber 79. A fluid inlet 84 to valve body 76 communicates a groove 86 with the inlet conduit 69 to the elevator motor. At the closed position of the valve assembly 74, groove 86 is adjacent a groove 87 on spool 78 and an aperture 88 therein communicates the grooves with axial passage 82. Thus, the inlet pressure at the motor 53 is communicated to chamber 79 to counterbalance the pressure acting on the opposite end of spool 78 through passage 82 so that spring 81 holds the valve spool in the closed position.

By relieving the fluid pressure within chamber 79, the pressure drop across orifice 83 will move spool 78 against the force from spring 81 to bring the fluid inlet groove 87 into communication with an additional groove 89 in the valve body. A conduit 91 communicates groove 89 with the rod ends of jacks 66 through a flow restriction 92. Thus, the above-described movement of the valve spool 78 acts to
supply high-pressure fluid from pump 73 to the jack 66, thereby raising the elevator 12. In order to automatically relieve the pressure within chamber 79 when the motor 53 inlet pressure reaches the predetermined level, a relief valve assembly 93 is attached to the valve body 76. The relief valve assembly 93 includes a body 94 with a passage 96 therein and having a valve seat aperture 97 at one end communicating with the chamber 79. A needle 98 is disposed in passage 96 and a compression spring 99 urges the needle to seat in aperture 97. Passage 96 of the relief valve is communicated with still another groove 101 in valve body 76 which encircles the spool 78 and which is communicated with fluid reservoir 72 through an exhaust conduit 102.

In operation, the needle valve 98 remains closed as long as the pressure within chamber 79 remains below a predetermined value. When the material which is being loaded acts against elevator 12 in such a way as to tend to load the motor 53 more strongly, the pressure within the motor inlet conduit 69 begins to rise and this pressure increase is communicated to chamber 79 of valve assembly 74 through grooves 86 and 87, aperture 88, passage 82 and the flow restriction 83 within the spool valve 78. Upon reaching its predetermined level as fixed by the force of spring 99, the increased pressure causes needle valve 98 to open and thereby vents the chambers 79 of the valve assembly. The release of pressure from chamber 79 causes the pressure drop across orifice 83 to move the spool against the action of spring 99, thereby communicating groove 86 with groove 89 and supplying fluid under pressure to the rod ends of jacks 66. The resulting contraction of the jacks 66 turns the angle arm 59 which then reacts through its pivot connection 61 to the elevator and through link 62 to pivot the elevator upwardly and forwardly about the pivots 56 at the lower end of the elevator. Thus, by withdrawing the elevator from the material being loaded, the reaction against elevator motor 53 is decreased and accordingly the pressure within the motor inlet conduit 69 tends to drop. The pressure decrease is communicated to valve assembly chamber 79 wherein needle valve 98 closes and the valve spool 78 again moves to the closed position thereof. Such movement cuts off the supply of fluid to jack 66 so that upward movement of the elevator 12 is stopped until such time as the pressure of material against the elevator 12 again exceeds the optimum force.

In practice, this action may be more or less continuous so that the valve spool 78 tends to remain in a slightly open position and to bring about a more or less continual but gradual raising of the elevator. The amount of loading needed to initiate rotation of the elevator is determined by spring 99 and may be changed by changing the force exerted by this spring.

To allow the elevator 12 to settle back against the material being loaded when necessary to avoid overfilling of the elevator, grooves 89 and 101 are communicated when the valve spool 78 is in the closed position through a lip 103 therebetween. Lip 103 has an inside diameter conforming to a land 104 of spool 78 so that the venting of the rod end of the cylinder is stopped when the spool moves to communicate high-pressure fluid thereto. This venting of the rod ends of jacks 66 when the valve assembly 74 is in the closed position also provides for the automatic return of the elevator 12 to the lowered position following ejection of load. Flow restriction 92 in conduit 91 functions to prevent too rapid lowering of the elevator 12. To avoid drawing a vacuum within the jacks 66 and to provide for the return of any fluid leakage therein, the base of each jack is communicated with reservoir 72 through a return conduit 106.

At the start of the ejection phase of scraper operation, the elevator 12 will generally be at, or near, its maximum elevation as a result of the above-described automatic raising. It may be preferable, to facilitate engagement of the elevator drift back towards the lowered position as the content of the scraper are released. This may be provided for by situating a blocker valve 105 in conduit 102. Valve 105 is piloted by the fluid pressure supplied to ejector jacks 38 so that conduit 102 is closed while the ejector jacks are actuated. Under some operating conditions, such as in the loading of unusually light material, it may be desirable to provide for manual control of the elevator position by means which override the automatic control system described above. This is readily accomplished by providing for manual opening of the needle valve 98. Consideration of a suitable structure for this purpose, a slidable piston 107 may be disposed in bore 96 of relief valve body 93 to contact the end of spring 99 opposite needle valve 98. Thus, the axial position of piston 107 in bore 96 will determine the amount of fluid pressure required to open the needle valve. By backing the piston 107 away from needle valve 98, the valve may be caused to open at a pressure less than that required for automatic opening as described above. For this purpose, the piston 107 may have a flange 108 at the end opposite spring 99 and a heavier spring 109 is disposed in relief valve housing 94 to act against the flange 108 and thus hold the piston 107 in the position required for automatic operation of the control system as described above. However, by admitting high-pressure air from a suitable reservoir 111 into a passage 112 where it acts against the side of flange 108 opposite spring 109, the piston 107 may be caused to move away from the flange 98 and thereby vent chamber 79 irrespective of the momentary pressure within the motor inlet 69. Suitable manual controls for admitting air into passage 112 for this purpose may include a valve 113 mounted on the operator's bowl control lever 114 and operated through the bowl control handle 116 by pivoting the handle relative to lever 114. Pivoting of the handle 116 actuates a valve 117 to actuate a valve control rod 118 to communicate reservoir 111 with a conduit 119 connecting with passage 112 of the relief valve assembly 93. At the closed position of air valve 113, conduit 119 is vented thereby causing spring 109 to move the piston 107 to the position at which automatic operation is effective.

The scraper elevator mechanism described with reference to FIGS. 1 and 2 can be utilized for automatic control of the elevator position, with manual override, during all stages of elevator operation including loading, carrying and ejection. Variations of the invention are possible in which automatic elevator movement is effected only during certain portions of the complete operating cycle, with manual control being used at other times. Similarly, variations may be made in the structure which couples the elevator to the bowl while still providing for positive control of elevator position. FIG. 3, for example, illustrates a second embodiment of the invention having differing linkage for coupling the elevator to the bowl and in which automatic raising of the elevator is limited to the stage in the operating cycle which immediately precedes ejection.

To facilitate understanding of the elevator control circuit 121 shown in FIG. 3, an elevator 122 of a self-loading scraper and some of the associated components of the scraper are shown schematically therein. The elevator 122 may be of essentially conventional construction and thus includes a frame with side rails 123 and sprockets 124 and idlers 126, carrying and endless chain and flight assembly 127. A hydraulic motor 128 is carried at the upper portion of the elevator and is operatively coupled to the upper sprocket 124. The elevator 122 in this example is carried on a scraper of the class having an auxiliary bowl 129 of the general type described in copending application, Ser. No. 639,753 of Rodney H. Anderson, et al. entitled METHOD AND APPARATUS FOR IMPROVING THE STABILITY OF AN ELEVATOR SCRAPER DURING UNLOADING and filed May 19, 1967. In this form of scraper, the main bowl 131 terminates somewhat to the rear of the lower end of the elevator 122 and has an inclined strike-off plate 132 extending transversely across the lower forward edge. Auxiliary bowl 129 forms a short forward extension of the lower portion of the main bowl 131 and is operatively connected thereto through pivots 133 so that the auxiliary bowl may swing forwardly and upwardly about the pivots to provide for ejection of a load.

Ejection is effected by an ejector plate 134 which defines the rear wall of the main bowl 131 and which may be moved...
forward therein by a hydraulic jack 136 to force material out of the lower front end of the main bowl 131 when the auxiliary bowl has been pivoted therefrom as will hereinafter be described.

In this type of scraper, the lower end of the elevator 122 is pivotally connected to the auxiliary bowl 129 through lower links 137 while the upper portion of the elevator is coupled to the main bowl 131 through upper links 138 which in this invention are extensible hydraulic jacks. Lower links 137 in conjunction with stop 139 carried on the auxiliary bowl 129 limit the lower end of the elevator 122 at a position slightly above and forward from a cutting edge 141 along the forward surface of the auxiliary bowl and provide for an upward and forward pivoting of the lower end of the elevator to override rocks and to adjust to varying depths of cut. The jacks 138 which form the upper links are pivotally connected to both the elevator 122 and main bowl 131 to provide for the above-described movement of the lower end of the elevator and further to provide for selective and automatic raising of the upper end of the elevator as will hereinafter be described in more detail.

To pivot the auxiliary bowl 129 forwardly and upwardly in preparation for ejection, additional hydraulic jacks 142 are coupled to the auxiliary bowl and to the main bowl 131 at pivot joints 143 which are situated above the auxiliary bowl.

Considering now the fluid system for driving elevator 122 and the several jacks 136, 138 and 142, high-pressure fluid from a suitable reservoir 144 is supplied to a motor inlet conduit 146 by a first pump 147. An overpressure relief valve 148 is provided between motor inlet conduit 146 and a fluid return line 149 leading to the reservoir 144. To control the motor 128, a first spool valve 151, within an operator's control housing 152, has three positions including one at which the flow from pump 147 is diverted directly to return line 149 thereby inactivating the motor. At a second position of the manually controlled valve 151, the diversion of high-pressure fluid to the return line 149 is cut off thereby establishing a first speed for the motor 128; and at the third position of the valve 151, the flow of high-pressure fluid to the motor is augmented by an additional flow from a second pump 153 thereby providing for high-speed operation of the motor. An additional overpressure relief valve 154 is connected between the reservoir 144 and the conduit 156 which connects pump 153 to valve housing 152.

To provide for a manually controlled changing of the inclination of elevator 122 during the loading of the scraper, a three-position manually operated valve 157 is situated near valve housing 152. Valve 157 has a first position at which motor inlet conduit 146 is communicated with a conduit 158 leading to the head end of the jacks 138 which control the inclination of the elevator so that at this position of the valve, fluid from pump 147 is delivered to the jacks 138 in such a way as to raise the upper end of the elevator 122. Valve 157 further has a second position at which the conduit 158 supplying jacks 138 is blocked so that the elevator 122 is held at the selected degree of inclination. At the third position of valve 157, conduit 158 is communicated with return conduit 149 through a flow restriction 159 so that the jacks 138 may slowly contract through the weight of the elevator 122 acting thereon in such a way as to return the elevator to the lowered rearward position thereof. An additional conduit 161 connects the rod end of jacks 138 with return line 149 to return any leakage fluid to the reservoir 144 and the conduit 161 may have a branch 161' connecting with elevator motor 128 for a similar purpose.

Thus, by operating valve 157, the operator may gradually raise the elevator 122 during loading of the scraper to maintain an optimum relationship between the elevator and the material in bowl 131 and 129. By further actuation of valve 157, the operator may hold the elevator at a selected inclination and, following ejection of the load, may restore the elevator to its initial position at which it lays back within the bowl 131.

Ejection of the contents of the bowl 131 is manually initiated by another spool valve 162 disposed within valve housing 152. The manually operated valve 162 has a first position in which high-pressure fluid is supplied to the head end of elevator jack 136 and to the rod end of auxiliary bowl lift jack 142 through a branched supply conduit 164 thereby pivoting the auxiliary bowl and the lower end of elevator 122 forwardly and upwardly as previously described and causing the elevator 134 to advance within main bowl 131 to eject material from the strike-off plate 132. Valve 162 has a return position at which the head ends of elevator jacks 136 and the rod ends of auxiliary bowl lift jacks 142 are vented while high-pressure fluid from pump 147 is supplied to the opposite ends thereof through branched conduit 163 to lower the auxiliary bowl 129 to the original load position and to retract the elevator 134.

Considering now an important feature of the invention, an additional conduit 166 connects conduit 164 with the head end of jacks 138 through a check valve 167 which is arranged to block any fluid flow from the jack 138 back toward conduit 164. The effect of the connection formed by conduit 166 and check valve 167 is to automatically pivot the upper end of the elevator 122 to its most upward and forward position prior to the operation of the elevator if the elevator is not already raised to this point by previous manual operation of elevator position control valve 157. Thus, the elevator 122 is always raised to the position at which it will create minimum interference with the ejection operation, irrespective of whether or not the operator deliberately positions the elevator in this way through manual control.

To avoid any difficulties from premature operation of the elevator jacks 136 where some resistance to lifting of the elevator 122 may be encountered, a sequencing valve assembly 168 may be connected between conduit 164 and the elevator jacks. Sequencing valve 168 has a body 169 with an inlet 171 to which conduit 164 connects and an outlet 172 communicated with the elevator jacks 136. Parallel fluid passages 173 and 174 are formed within valve body 169 between the inlet 171 and outlet 172. Passage 173 provides for the return of fluid from the head end of elevator jacks 136 and contains a check valve 176 arranged to limit flow to a direction from the head end of jacks 136 to conduit 164. A slidable spool 179 has a first position blocking fluid flow through the parallel passage 174 and has a pilot end 181 of reduced diameter exposed to the fluid pressure within passage 173 which acts thereon in such a manner as to tend to hold the spool in the position in which passage 174 is closed. Spool 179 is biased so that driving fluid from conduit 164 cannot actuate the elevator jacks 136 until such time as this pressure reaches a predetermined value sufficient to move the spool 179 against the action of the spring. Spring 182 is selected to fix this pressure at a level above that needed for actuation of the jacks 138 which pivot elevator 122 upward thereby ensuring that the elevator is lifted prior to operation of the elevator 134.

Thus, many modifications are possible within the scope of the invention and it is not intended to limit the invention except as defined in the following claims.

We claim:

1. A scraper of the class having a bowl with an opening at the forward end and a cutting edge thereat, and having a movable elevator at said opening for loading material into said bowl, further comprising:

a. a fluid pressure operated motor driving said elevator, and

b. a fluid pressure inlet and outlet;

c. a fluid pressure operated jack coupled to said bowl and to said elevator to shift the upper end of said elevator forwardly relative thereto; and

d. a driving fluid conduit including pressure responsive means coupling said jack to said motor inlet to actuate said jack to shift the upper end of said elevator forwardly in response to pressure in the strike-off plate; and

e. a fluid pressure operated jack coupled to said bowl and to said elevator to shift the upper end of said elevator forwardly relative thereto; and

f. a driving fluid conduit including pressure responsive means coupling said jack to said motor inlet to actuate said jack to shift the upper end of said elevator forwardly in response to pressure in the strike-off plate.
2. The combination defined in claim 1 wherein said pressure responsive means comprises a valve of the class which opens in response to a predetermined pressure level, said valve being in said fluid conduit between said motor inlet and said jack.

3. The combination defined in claim 2 wherein said scraper has a powered ejector and wherein said jack is communicated with a fluid reservoir when said valve is in the closed position thereof, said combination further including a blocker valve, said blocker valve being in a fluid conduit between said jack and said reservoir.

4. The combination defined in claim 2 further comprising:
a manual control operatively connected with said valve for selectively opening said valve independently of said fluid pressure at said motor inlet.

5. The combination defined in claim 1 wherein the upper portion of said elevator is coupled to said bowl through an angled arm having the central portion thereof pivoted to said elevator and through a link pivotably coupled to said bowl and to a first end of said arm and wherein said fluid pressure operated jack is coupled to the opposite end of said angled arm.

6. In a scraper of the class having a bowl with an opening for receiving material and having an elevator disposed thereat for loading material into said bowl, mechanism for coupling said elevator to said bowl comprising:
a lower link coupling the lower portion of said elevator to said bowl and being pivotally coupled to each thereof;
an angled arm having the angle thereof pivoted to an upper portion of said elevator;
a link coupling a first end of said angled arm to said bowl and being pivotally coupled to each thereof; and
a fluid pressure operated jack coupling the opposite end of said arm to said bowl and being pivotably coupled to each thereof whereby actuation of said jack forcibly pivots said elevator relative to said bowl.