An earth moving scraper comprising an open, rectangular frame supported at its rear end by wheels and having a tongue at its front end for connection with a tractor. A bucket having a blade across the lower edge of its open front end is pivotally mounted on the frame for swinging between a generally horizontal, loading position and a generally vertical, unloading position. The sides of the frame are hinged intermediate their ends to permit the bucket to be raised above the surface of the soil upon breaking of the hinge. A reciprocating actuator is connected between the bucket and the frame for swinging the bucket between horizontal and vertical positions, and another reciprocating actuator connects the sides of the frame on opposite sides of the hinge for selectively breaking it to raise the bucket and blade above loading position. In one embodiment of the scraper, the opening into the bucket is adapted to be closed by a gate while, in another embodiment, this opening is adapted to be partially closed by an apron. Each of the gate and apron are swung between open and flow restricting positions by means of still another reciprocating actuator connected between it and the frame. Hydraulic systems for operating the actuators include means which prevent these components from moving between their alternative positions in other than a desired sequence.
FIG. 11

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EARTH MOVING SCRAPER AND ACTUATOR SYSTEM THEREFORE

This invention is a continuation of my copending application, Ser. No. 714,830, Filed Mar. 21, 1968, entitled "Earth Moving Scraper," and now abandoned.

This invention relates generally to earth moving scrapers of the type having a bucket for receiving soil severed by a blade as the frame on which the bucket and blade are carried is moved over the surface of the soil. In one of its aspects, this invention relates an improved hydraulic system for controlling the movement of the various components of the scraper, including the bucket and blade as well as a means for retaining soil in the bucket during transport and releasing it at a suitable place of disposal. In another of its objects, it relates to improvements in such means for so retaining and releasing the soil.

In a typical scraper of this type, the blade is lowered to dispose its cutting edge at a desired level beneath the surface of the soil, and the bucket is positioned behind the blade to receive the soil severed by the blade as the frame is moved forwardly over such surface. When the bucket is loaded to the desired extent, the blade and bucket are raised above the surface and the opening into the bucket above the blade is at least partially restricted by a gate or the like so as to retain the load in the bucket during transport. In order to unload the bucket, the gate is removed from across the soil to permit the soil in the forward end of the bucket to fall freely therefrom, and the remainder of the load is either swept or dumped out of the rear end of the bucket. In the latter case, the bucket is tilted relative to the frame to cause the soil to flow out of it under the influence of gravity.

In one such scraper, the blade is fixed to the lower front edge of a bucket, and the frame is constructed of hingedly connected parts which are movable between generally aligned positions to raise the bucket and blade above the surface of the soil, and angularly disposed positions to lower them onto such surfaces. The bucket is pivotedly supported by the frame for swinging between a generally horizontal position for loading purposes and a forwardly tilted position for unloading purposes.

The means for restricting the opening into the gate may comprise a gate adapted to be moved to a fully closed position during transport, or an apron for only partially closing the opening into the bucket. In its partially closed position, the apron not only retains soil in the transport position of the bucket, but also increases the pressure of the soil entering the opening so as to assist in forcing the soil into the bucket in its loading position.

With conventional hydraulic systems for operating the various components of scrapers of this type, it is necessary for the operator to select each such component to be actuated in a desired sequence. For example, in order to prepare the scraper for loading, the gate or apron must be in open position and the bucket lowered a sufficient distance to cause the blade to penetrate the soil to the desired depth. During loading, it may be necessary to raise or lower the blade so as to adjust the level to which the soil is scraped. When loading is completed, the blade must be raised above the ground and the gate or apron closed for transport purposes. Then, when the scraper is to be unloaded, the gate or apron must be fully opened and the bucket swung to its tilted, unloaded position.

In the use of scrapers having such systems, the operator must attain a certain degree of proficiency in operating the actuators in the desired sequence. The failure to do so leads to malfunction of and/or damage to the scraper. For example, should the blade be lowered before the bucket is swung from its unloading position to its loading position, the blade may be broken or bent. Also, in the event the gate is not closed as the blade is raised upon loading of the bucket, loose soil may be left on the surface. This is not only objectionable because of the loss of part of the load, but also because the remaining rough surface is an obstacle to the travel of the scraper on subsequent trips. Still further, in order for the apron to function properly during loading of the bucket, it must be moved to its position for partially closing the opening into the bucket at least as soon as the bucket is lowered.

Also, in the dusty environments in which equipment of this type is used, it is often difficult, if not impossible, for the operator to observe the positions of all of the components. This is especially true of the blade, which may not be fully raised or fully lowered. Also, of course, the bucket may not be fully leveled at the time the blade is lowered.

An object of this invention is to provide a scraper of this type having an hydraulic system for operating the various components of the scraper which obviates one or more of these and other problems.

Another object is to provide such an hydraulic system which prevents actuation of the components in improper sequence.

A further object is to provide such a system which is of simplified construction comprising a minimum of check valves, relief valves, and other parts sequencing parts intermediate the control valves and actuators.

Yet another object is to provide a scraper of this type having a system which will at least minimize the requirement that the operator observe the positions of such components during use of the scraper.

Yet another object is to provide a scraper of this type having an apron which is of simplified construction and operation.

Yet a further object is to provide a scraper of this type having a gate which is of simplified construction and operation.

In the drawings, wherein like reference characters are designated by like parts.

FIG. 1 is a perspective view of an earth moving scraper constructed in accordance with the present invention, with the bucket and blade thereof in loading position and a gate closing the open end of the bucket;

FIG. 2 is a top plan view of the scraper of FIG. 1;

FIG. 3 is a side view of the scraper, on an enlarged scale, with the bucket and blade in loading positions, as in FIG. 1, but with the gate in open position;

FIG. 4 is a partial side view of the scraper similar to FIG. 3 but with the bucket and blade raised to transport position and the gate closed;

FIG. 5 is another partial view of the scraper, but with the bucket tilted to unloading position and the gate in open position;

FIG. 6 is a side view of another scraper constructed in accordance with the present invention, and having its components arranged as in the scraper of FIGS. 1 to 5 and positioned as in FIG. 4, except for an apron shown in a position partially closing the opening into the bucket;

FIG. 7 is a top plan view, on a reduced scale, of the scraper of FIG. 6;

FIG. 8 is a partial longitudinal sectional view of the scraper of FIGS. 6 and 7, as seen along broken line 8—8 of FIG. 7, and with the bucket tilted upwardly to unloading position and the apron raised to fully open the front end of the bucket;

FIGS. 9 to 11 are diagrammatic illustrations of an hydraulic system for operating the components of the scraper of FIGS. 1 to 5 in desired sequence, and showing the positions of the actuators for the components when the scraper is the unloading position of FIG. 5, the loading position of FIG. 3, and the transport position of FIG. 4, respectively;

FIG. 12 is a diagrammatic illustration of an alternative hydraulic system for operating the components of the scraper.
of FIGS. 1 to 5 in desired sequence, and showing the positions of the actuators for the components when the scraper is in the transport position of FIG. 4; and FIG. 13 is a diagrammatic illustration of an hydraulic system for operating the components of the scraper of FIGS. 6 to 8 in desired sequence, and showing the positions of the actuators for the components when the scraper is in the transport position of FIG. 6.

Referring now to the details of the above described drawings, each of the scramers shown in FIGS. 1 to 5 and 6 to 8, comprises an open rectangular frame 20 having longitudinally extending side members 21 and laterally extending end members 22 and 23. A tongue 24 extends forwardly from a central portion of the front end frame member 22 for connection in a well known manner to a tractor or the like for pulling the frame forwardly over the surface of the soil. Obviously, however, the scraper may instead be self-motivated.

Each of the side frame members 21 has a forward end 21a pivotally connected to a rearward end 21b by means of a pin 22 interconnecting their ends. A plate 25 depending from each of the rear members 21b mounts an axle 26 for a wheel having a pneumatic tire 27 supporting the rear end of the frame.

A bucket 28 having side walls 29, a rear wall 30, and a bottom 31 is swingably supported from the front side frame members 21a by means of pins 32. More particularly, a pin 32 extends outwardly from the forward end of each side 29 of the bucket for mounting within the adjacent frame member 21a generally intermediate the front end member 22 and the pivot pins 21c. In one position, the bucket is generally horizontally level for loading purposes, and in the other position, it is tilted for unloading purposes.

As shown in FIGS. 1 and 3, when the front and rear frame members 21a and 21b are generally aligned with one another, and the bucket is in the generally horizontal position, the bottom 31 of the bucket rests on the surface of the soil. However, when the hinge is "broken" at 21c, as shown in FIG. 5, the bucket is raised above the surface to permit it to swing into its tilted position without interference with the surface.

As can be seen from the drawings, a cutting blade 33 is fixed across the front edge of the bottom wall 31 of the bucket. More particularly, the blade 33 extends downwardly at a small angle so that the cutting edge on its outer end will penetrate the soil when the bucket is resting on its surface.

The members 21a and 21b of each side of the frame are moved between their angled and generally aligned positions by means of reciprocal actuators 34 pivotally connected at its opposite ends to the bottom side of member 21a and the plate 25 of the bottom side of the member 21b. Thus, as will be obvious from the drawings, when the actuator is extended, frame members 21a and 21b on opposite sides of the frame are moved into their generally aligned positions to lower the bucket, when horizontal, onto the surface of the soil for loading purposes. On the other hand, when the actuator is retracted to "break" the hinge connection, the pivot pins 21c are raised to in turn raise the bucket 28 above the surface.

The bucket is swung between its loading and unloading positions by means of a pair of reciprocating actuators 35 each of which is pivotally connected at its opposite ends to a side 29 of the bucket and the upper side of the adjacent frame member 21a. Thus, when the actuator is retracted, the bucket is moved to its generally horizontal, loading position. On the other hand, when the actuator is extended, the pivot pins on the forward end thereof is swung about the pivot pins 32 so as to move the bucket in its generally vertical, unloading position.

Plates 21d are welded or otherwise secured to the side frame members 21a to form walls for extension between the front end frame member 21a to the open front end of the bucket 28, at least when the bucket is in loading or horizontal position. More particularly, these walls are disposed laterally within the sides 29 of the bucket to permit the bucket to be tilted up to its unloading position, as shown in FIG. 5. The walls 21d also extend above as well as below the side frame members 21a to form substantial continuations of the upper edges of the side walls 29 of the bucket and the bottom 30 and blade 33 at the bottom of the bucket. Thus, these walls 36 facilitate loading of the bucket with soil generally forwardly of the open end of the bucket as soil moves through the opening between the front end frame member 22 and the blade 33.

In the scraper illustrated in FIGS. 1 to 5, the opening into the bucket 28 is adapted to be opened and closed by means of a gate 36 comprising upper and lower gate portions 36a and 36b, respectively, connected by a laterally extending hinge 36c. As can be seen from FIGS. 1 and 2, this gate extends laterally between the walls 36a and 36b and is movable from an open position, in which the lower end of bottom gate section 36a is substantially adjacent the front frame member 22, (FIG. 5) and a closed position in which the lower end of gate portion 36a is adjacent the forward cutting edge of blade 33, when the bucket 28 is in loading position (FIG. 4). More particularly, in this closed position of the gate, the upper edge of the upper gate portion 36a is somewhat above the front frame member 11 so that the gate 36 extends vertically between the opening between front frame member 22 and the blade 33.

The upper gate portion 36a is supported by a pair of links 37 pivotally connected to plates 38 mounted on the upper side of the bucket 28, at least when the bucket is in loading or horizontal position.

A reciprocating actuator 41 pivotally connected between the plate 38 generally beneath the pivotal connection thereto of the links 37 and the pivotal connection of the free ends of the links 37 to the upper gate portion 36a. As will be apparent from the drawings, the links 37 and arms 39 guide the gate sections for movement between opened and closed positions during movement of the actuator.

In the scraper illustrated in FIGS. 6 to 8, the opening into the bucket is adapted to be only partially closed by means of an apron 42 which, similarly to the gate 36, extends laterally between side walls 21d of the frame member. As distinguished from the gate 36, the apron 42 is of rigid construction, including angularly disposed upper and lower walls 42a and 42b. More particularly, arms 43 extend rearwardly from opposite ends of the apron for connection to pins 44 which are journeled within the side walls 21d of the frame. As can be seen from a comparison of FIGS. 6 and 8, swinging of the arms 43 downwardly in a counterclockwise direction will move the apron 42 from open to partially closed position, while swinging of the arms upwardly in the opposite direction would move the apron from partially closed to fully opened position.

Each of the arms 43 is swung by a link 45 extending from the pin and pivotally connected to an end of a reciprocating actuator 46. The actuator is pivotally mounted at its opposite end to frame member 21a by a pin 47. More particularly, the pins 44 extend through the walls 21d for connection to the apron on the inner side of such wall and to the links 45 on the outer side of such walls. As will be obvious in the drawings, upon retraction of the actuator 46, the arms 43 are swung upwardly to open the apron and, upon extension of the actuator, the arms are swung downwardly to move the apron 42 to partially closed position.

The hydraulic system illustrated in FIGS. 9 to 11 has two control circuits, one having lines 50, 51 and the other lines 52, 53 for connection with suitable control valves (not shown) connected to the pressure and reservoir or exhaust sides of a source of hydraulic fluid. As well known in the art, valves of this type not only permit pressure fluid to be introduced into one such line of each circuit and exhausted from the other, but also have an intermediate position in which both lines are connected.

As shown in FIGS. 9 to 11, the line 50 is connected by a line 54 to line 55 which, in turn, connects with the rod end of each of the blade actuators 34. More particularly, there is a check valve 56 in the line 54 which permits flow from the line 50
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toward the line 55. The line 51, on the other hand, is connected to a line 57 which, in turn, connects with the actuators 34, the piston end of each such actuator 34.

Another line 58 connects the line 50 with the line 59 connecting with the piston end of each of the bucket actuators 35. The rear end of each actuator 35 is connected by a line 60 to a line 61 in which check valve 62 is disposed. The line 61 connects with the line 57 which, as previously described, connects with line 51. As can be seen from the drawings, the check valve opens in response flow in a direction toward line 55.

Line 52 of the other circuit connects with the piston end of gate actuator 41, and line 53 thereof connects with the rod end of such actuator. Line 52 also connects with a line 63 which, in turn, connects with line 57 which, as previously mentioned, connects to the piston ends of actuators 34. A check valve 64 in line 63 permits the flow in a direction toward the line 52. The line 53 also connects with a line 65 connecting with line 55 which, as previously described, connects with the rod ends of the actuators 34. There is also a check valve 66 in line 65 which permits flow in a direction toward the line 55.

A pressure relief valve 67 is connected in a line 68 which connects line 50 with line 55 in parallel with the line 54. As indicated, this pressure relief valve permits flow toward the line 50 when the pressure of hydraulic fluid in the line 55 reaches a predetermined pressure setting. As well known in the art, a pressure relief valve of this type acts as a check valve in preventing flow from the line 50 to the line 55 so as to reduce the pressure of the fluid in the line 55 which, as previously mentioned, connects to the piston ends of actuators 34.

There is also a bypass line 69 connecting one of the actuators 34 with the check valve 62 for unseating it. As shown in the drawings, line 69 connects with the cylinder of actuator 34 to the right of the piston therein when the piston is retracted in the cylinder. Thus, the line 69 is adapted to be uncovered to deliver pressure fluid from line 55 to the check valve 62 toward the end of the retracting stroke of the actuator 34.

Turning now to a description of the function of this hydraulic system in the operation of the scraper of FIGS. 1 to 5, the pistons of the various actuators will be located as shown in FIG. 9 when the scraper is in the transport position of FIG. 5.

To locate the components of the scraper for loading, the operator manipulates the control valve leading to lines 50, 51 so as to cause pressure fluid to enter line 51 and be exhausted to the reservoir through line 50. As previously described, the line 51 connects with the piston ends of each of the actuators 34 so that pressure fluid therein urges the actuator toward extended positions, which, of course, exerts a pressure on the fluid within the rod ends of these actuators, and thus within the bucket connected thereto. As previously noted, and as can be seen from the drawings, the line 55 connects with exhaust line 50 through line 68 in which the pressure relief valve 67 is disposed. Thus, each of the actuators 34 is prevented from shifting to extended position until the pressure relief valve 67 has been opened.

At the same time, the fluid pressure in line 51 passes through line 61 and past the check valve 62 into the line 60 leading to the rod ends of the actuators 35. The line 59 connecting with the piston ends of these actuators is connected directly to exhaust line 50, so that actuators 35 are retracted, thereby swinging the bucket 28 from its tilted to its horizontal position.

It is only after the actuators 35 have been fully retracted that sufficient pressure will have built up in the line 57 and thus in the line 55 to overcome the setting of the pressure relief valve 67. Thus, in accordance with one of the objects of this invention, the bucket must be lowered to the loading position before the blade can be lowered against the surface of the soil.

When the bucket and blade are thus positioned for loading, the elevation of the cutting blade relative to the surface of the soil may be controlled without changing the positions of the other components of the scraper. Thus, for example, the control valve leading the line 50, 51 may be manipulated so as to cause pressure fluid to enter line 50 and be exhausted through line 51 so as to urge the actuators toward retracted positions, and thus to raise the blade somewhat. This manipulation of the control valve leading to the lines 50, 51 does not cause movement of the bucket, because, since the actuators 34 are extended, pressure fluid on the rod side of each of the actuators 35 is prevented by check valve 62 from return into the line 51.

When loading is completed, the actuators for the various components of the scraper will be in the positions shown in FIG. 10. In order to move them to the transport position of FIG. 4, the control valve connecting with the lines 52, 53 is manipulated to admit pressure fluid to the line 53 and exhaust it from the line 52. As will be apparent from FIG. 10, pressure fluid within the line 53 will be applied past check valve 66 in line 65 and through the line 55 to the rod sides of the actuators 34. At the same time, fluid on the piston ends of actuators 34 is free to pass through the line 57, into the line 63, and past the check valve 64 into exhaust line 52, so that the actuators 34 are retracted to raise the blade 33.

As will be apparent from FIG. 10, pressure fluid in line 53 will also retract the actuator 41 so as to close the gate across the opening to the bucket. More particularly, this occurs as the actuators 34 are retracted to raise the blade, so that there is little or no spilling of soil from the loaded bucket 28.

When the actuators 34 are retracted, pressure fluid in line 55 will enter bypass 69 so as to open check valve 62 and thus permit fluid on the rod ends of actuators 35 to exhaust into line 52. Pressure fluid in line 55 bypasses relief valve 67 so as to pass through line 59 into the piston ends of the actuators 35.

However, the relief valve 67 is set to open at a pressure lower than that required to move the pistons in actuators 35 to extended positions. Thus, as will be understood, considerable fluid pressure is required to so actuate the actuators inasmuch as the load in the bucket is on the right hand side of the pivotal connection of the bucket to the frame. Thus, and again in accordance with one of the objects of this invention, the bucket can be tilted only after the blade has been raised.

The control valve leading to lines 50, 51 is then manipulated to admit fluid pressure to line 50 and exhaust it through line 51. Thus, pressure fluid in line 50 is connected by lines 58 and 59 to the piston ends of the actuators 35 and through the check valve 56 to the rod ends of actuators 34. Since the actuators 34 are already fully extended, pressure fluid in the bypass line 69 opens the check valve 62 and thus permits fluid on the rod ends of the actuators 35 to flow through line 60 and 61 into line 57 and thus into exhaust line 51, whereby the bucket is swung to its tilted position. Thus, the operator is assured that the bucket will not be tilted into unloading position until the frame and thus the blade has been fully raised, because it is only when the actuators 34 are fully retracted that pressure fluid from line 50 and within bypass line 69 can open the check valve 62.

The gate 36 may be raised either before or after raising of the blade and tilting of the bucket. In any case, this is accomplished merely by manipulation of the control valve leading to lines 52, 53 so as to admit pressure fluid through line 52 in order to extend the actuator 41. Due to the check valves 64 and 66, this has no influence on the other components of the scraper.

The alternative hydraulic system illustrated in FIG. 12 is identical in many respects to that of FIGS. 9 to 11. One difference lies in a third circuit comprising a pair of lines 70, 71 leading from a third control valve. As can be seen from FIG. 12, line 70 connects with the line 60 which, in turn, connects to the rod ends of the bucket actuators 35. Line 71, on the other hand, connects with line 59 connecting with the piston ends of the actuators 35.

The line 70 is also connected to the line 51 by a line having a check valve 72 therein which opens in response to flow from the line 51 to the line 70. The line 71, on the other hand, is connected to the line 50 by a line in which a pressure relief valve 73 is disposed.

Assuming that the various components of the scraper are in the transport positions illustrated in FIG. 4, they may be moved to loading position in the same way that they are so
moved with the system of FIGS. 9 to 11. That is, he manipulates the control valve leading the lines 50.51 so as to admit pressure fluid to line 51 and exhaust it through line 50. This, of course, directs hydraulic fluid into line 57 and thus to the piston ends of blade actuators 34 for urging them to extended positions. However, fluid on the rod ends of the actuators 34 is prevented by the pressure relief valve 67 from exhausting into line 50.

At the same time, pressure fluid within line 51 will flow through check valve 72 and into line 70, which in turn is connected to line 60 leading to the rod ends of bucket actuators 35. The fluid on the piston ends of the actuators 35 flows through line 59 into the line 71 and thus to the pressure relief valve 73. This latter valve is set to open at a lower pressure than the pressure relief valve 67 so that it will first open to permit the actuators 35 to be retracted for moving the bucket to its level or loading position. Then, when the actuators 35 are fully retracted, pressure within the line 51 will rise further so as to open the relief valve 67 and thereby permit the actuators 34 to be extended and the blade lowered. Thus, in this system, as in the system of FIGS. 9 to 11, the operator is assured that the bucket will be moved to horizontal or loading position before the blade is lowered.

In this system, as compared with the system of FIGS. 9 to 12, the bucket may be tilted before the blade is fully raised. Thus, in order to spread soil load in the bucket, pressure fluid in line 50 can be used to raise the blade somewhat and pressure fluid in line 71 then used to tilt the bucket to a desired extent.

In order to dump the load, the control valve leading to lines 52,53 is manipulated to admit pressure fluid to line 53 and exhaust it from line 52 for retracting the actuator 41 so as to close the gate. As in the system of FIGS. 9 to 11, this pressure fluid in line 53 will also move the blade to raised position. That is, pressure fluid flows past the check valve 66 into the line 55 leading to the actuators 34, which fluid in the piston ends of the actuators 34 is exhausted through line 57 and past check valve 64 into the exhaust line 62. At the same time, there is no way for fluid pressure to extend the actuators 35 so as to tilt the bucket into its unloading position.

In order to swing the bucket into its tilted, unloading position, the control valve leading to line 70,71 must be manipulated so as to admit pressure fluid to the line 71 and exhaust it from line 70. This, of course, introduces pressure fluid through line 59 into the piston ends of bucket actuators 35, while exhausting fluid from the rod ends of these actuators through the line 60 into the line 70 so as to extend the actuators 35 in order to tilt the bucket.

The hydraulic system for use in operating the various components of the embodiment of the scraper illustrated in FIGS. 6 to 8 is very similar to the system illustrated in FIG. 11. It differs therefrom, however, in that the actuator 46 for the apron 42 is moved between fully open and partially closed position in a different cycle than is the gate of the scraper of FIGS. 1 to 5. The operation of the actuator 46 is also different in that it is extended to lower the apron to partially closed position (FIG. 6) and retracted to move the apron to fully opened position (FIG. 8).

Still further, the apron actuator 46 is operated in a manner to be described by means of the circuit comprising the line 70,71, rather than by means of a separate circuit. Thus, as shown in FIG. 13, a line 75 connects the piston end of the actuator 46 with the line 60, which in turn is connected to the line 70, while a line 76 connecting with the rod end of the actuator is connected to the line 59, which in turn is connected to the line 71.

Assuming that the scraper of FIGS. 6 to 8 is in the transport position illustrated in FIG. 8, and it is to be moved to loading position, pressure fluid is admitted through line 51 and exhausts through line 50. As described in connection with FIG. 12, this swings the bucket to a level position and then lowers the blade into loading position. As also described in connection with FIG. 12, this sequence is assured by the setting of relief valve 67 higher than that of relief valve 73.

Pressure fluid to line 51 also moves the apron 42 to its partly closed position for loading purposes. More particularly, the apron is so moved before the blade is lowered to its loading position, thereby assuring that the apron is partially closed at the time the loading operation begins. Thus, pressure fluid in line 51 bypasses valve 72 into line 70 and then flows into lines 60 and 75 to the piston end of the actuator 46 for urging the actuator 46 toward extended position. At the same time, fluid on the rod end of the actuator 46 is exhausted through line 76 into line 59 and then through line 71 to the relief valve 73. Since actuator 46 is thus connected in parallel with the actuator 35 for leveling the bucket, the apron will be partially closed before or at least at essentially the same time the blade is lowered.

The scraper is then moved to transport position by manipulation of the control valve leading to circuit comprising lines 50,51 to a position for introducing pressure fluid into the line 50 and exhausting it through line 51, which, of course, retracts the actuators 34 for raising the blade. As above noted, the apron is already in its partially closed position, and the reversal of the direction of flow of pressure fluid through the lines 50,51 does not affect it.

In order to unload the scraper, the control valve connecting with circuit comprising lines 70,71 is manipulated so as to introduce high pressure fluid into line 71 and exhaust it through line 70. This, of course, extends the actuators 35 so as to tilt the bucket to its unloading position. At the same time, pressure fluid in the line 71 will flow through lines 59 and 76 into the rod end of actuator 46 for the apron, while fluid on the piston end of such actuator will exhaust through lines 75 and 60 and into line 70. Due to the load in the bucket, a greater differential is required to extend the actuators 35 so that the actuator 46 is the first to move thereby assuring that the apron is open before the bucket is tilted to its unloading position.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. In an earth moving scraper having a bucket and an actuator having a piston movable within a cylinder between one end for swinging the bucket into a tilted unloading position and the opposite end for swinging the bucket into a substantially level loading position, and a blade and an actuator having a piston movable within a cylinder between one end for raising the blade into an unloading position and for lowering the blade into a loading position; the improvement comprising an hydraulic system for operating said actuators including a pressure source and an exhaust, first and second fluid lines, means for selectively connecting the first and second lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, a third fluid line connecting the first line with one end of the blade actuator cylinder, a fourth fluid line connecting the second line with the opposite end of the blade actuator cylinder, a sixth fluid line connecting the first line with one end of the bucket actuator cylinder, a seventh fluid line connecting the second line with the opposite end of the bucket actuator cylinder, a pressure relief valve in the fourth line adapted to open in response to a predetermined pressure in said opposite end of the blade actuator cylinder, so that with said connecting means in said position, source pressure will move the piston of the bucke t actuator to the opposite end of the cylinder thereof before it moves the piston of the blade actuator to the opposite end of its cylinder, a fifth fluid line.
bypassing the pressure relief valve, a check valve in the fifth line permitting flow only in a direction from the second line toward the one end of the blade actuator cylinder, a check valve in the sixth line normally preventing flow from the one end of the bucket actuator cylinder to the first line, said check valve having pressure responsive means for opening it, and an eighth fluid line connecting the blade actuator cylinder intermediate the connection therewith of the third and fourth lines with the pressure responsive means of the check valve, so that, with said connecting means in said second position, pressure in the one end of said blade actuator cylinder will act on the pressure responsive means when the piston in the blade actuator cylinder has moved in a direction toward said one end thereof to uncover the connection of said fourth line therewith.

2. In an earth moving scraper having a bucket and an actuator having a piston movable within a cylinder between one end for swinging the bucket into a tilted unloading position and the opposite end for swinging the bucket into a substantially level loading position, a blade and an actuator having a piston movable within a cylinder between one end for raising the blade into an unloading position and for lowering the blade into a loading position; and a closure member and an actuator having a piston movable within a cylinder between one end for moving the member to a position at least partially closing an opening into the bucket and the opposite end for moving the member to a position opening the opening into the bucket, an hydraulic system for operating said actuators including a pressure source and an exhaust, first and second fluid lines, means for selectively connecting the first and second lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, a third fluid line connecting the first line with one end of the blade actuator cylinder, a fourth fluid line connecting the second line with the opposite end of the blade actuator cylinder, a sixth fluid line connecting the first line with one end of the bucket actuator cylinder, a seventh fluid line connecting the second line with the opposite end of the bucket actuator cylinder, a first pressure relief valve in the fourth line adapted to open in response to a predetermined pressure in said opposite end of the blade actuator cylinder, a second fluid line bypassing the first pressure relief valve, a check valve in the fifth line permitting flow only in a direction from the second line toward one end of the blade actuator cylinder, a second pressure relief valve in the seventh line adapted to open in response to a lower predetermined pressure in said opposite end of the bucket actuator cylinder, so that, with said connecting means in said first position, the piston in the bucket actuator cylinder will be moved to the opposite end of its cylinder, eighth and ninth lines, means for selectively connecting the eighth and ninth lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, said connecting means in said first position, source pressure will move the piston of the bucket actuator to the opposite end of the cylinder thereof before it moves the piston of the blade actuator to the opposite end of its cylinder, a fifth fluid line bypassing the pressure relief valve, a check valve in the fifth line permitting flow only in a direction from the second line toward the one end of the blade actuator cylinder, a check valve in the sixth line preventing flow from the one end of the bucket actuator cylinder to the first line, said check valve having pressure responsive means for opening it, an eighth fluid line connecting the blade actuator cylinder intermediate the connection therewith of the third and fourth lines with the pressure responsive means of the check valve, so that, with said connecting means in said second position, pressure in the one end of said blade actuator cylinder will act on the pressure responsive means when the piston in the blade actuator cylinder has moved in a direction toward said one end thereof to uncover the connection of said eighth line therewith, ninth and tenth fluid lines, means selectively connecting the ninth and tenth lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, an eleventh line connecting the ninth line with one end of the cylinder of the closure member actuator, a twelfth line connecting the tenth line with the opposite end of the cylinder of the closure member actuator, a thirteenth line connecting the ninth line with said fourth line intermediate the opposite end of the cylinder of the blade actuator cylinder and said pressure relief valve, a fourteenth line connecting the tenth line with said first line, so that when said last-mentioned connecting means is in its first position, source pressure moves the pistons of the blade and closure member actuators to the opposite ends of the cylinders thereof.
end of the bucket actuator cylinder, a first pressure relief valve in the fourth line adapted to open in response to a predetermined pressure in said opposite end of the blade actuator cylinder, and a second pressure relief valve in the seventh line adapted to open in response to a lower predetermined pressure in said opposite end of the blade actuator cylinder, so that, with said connecting means in said first position, source pressure will move the piston of the bucket actuator to the opposite end of the cylinder thereof before it moves the piston of the blade actuator to the opposite end of its cylinder, a fifth fluid line bypassing the first pressure relief valve, a check valve in the fifth line permitting flow only in a direction from the second line toward one end of the blade actuator cylinder, eighth and ninth lines, means for selectively connecting the eighth and ninth lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, means connecting the eighth line with the seventh line intermediate the pressure relief valve in the seventh conduit and the bucket actuator cylinder, means connecting the ninth line with the sixth line, a check valve in the sixth line preventing flow in a direction from the ninth line to the first line, so that the piston in the bucket actuator cylinder may be moved in either direction independently of the piston in the blade actuator cylinder, a 10th and 11th fluid lines, means selectively connecting the 10th and 11th lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, a 12th line connecting the 10th line with one end of the cylinder of the closure member actuator, a 13th line connecting the 11th line with the opposite end of the cylinder of the closure member actuator, a 14th line connecting the 10th line with said fourth line intermediate the opposite end of the cylinder of the blade actuator and said pressure relief valve, a 15th line connecting the 11th line with said third line, so that when said last-mentioned connecting means is in its first position, source pressure moves the pistons of the blade and closure member actuators to the opposite ends of the cylinders thereof, a check valve in the 15th line preventing flow in a direction toward the third line, and a check valve in the 14th line preventing flow in a direction toward the 10th line.

5. In an earth moving scraper having a bucket and an actuator having a piston movable within a cylinder between one end for swinging the bucket into a tilted unloading position and the opposite end for swinging the bucket into a substantially level loading position, a blade and an actuator having a piston movable within a cylinder between one end for raising the blade into an unloading position and for lowering the blade into a loading position; a closure member and an actuator having a piston movable within a cylinder between one end for moving the member to a position at least partially closing an opening into the bucket and the opposite end for moving the member to a position opening the opening into the bucket; the improvement comprising, an hydraulic system for operating said actuators including a pressure source and an exhaust, first and second fluid lines, means for selectively connecting the first and second lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, a third fluid line connecting the first line with one end of the blade actuator cylinder, a fourth fluid line connecting the second line with the opposite end of the blade actuator cylinder, a sixth fluid line connecting the first line with one end of the bucket actuator cylinder, a seventh fluid line connecting the second line with the opposite end of the bucket actuator cylinder, a first pressure relief valve in the fourth line adapted to open in response to a predetermined pressure in said opposite end of the blade actuator cylinder, and a second pressure relief valve in the seventh line adapted to open in response to a lower predetermined pressure in said opposite end of the bucket actuator cylinder, so that, with said connecting means in said first position, source pressure will move the piston of the bucket actuator to the opposite end of the cylinder thereof before it moves the piston of the blade actuator to the opposite end of its cylinder, a fifth fluid line bypassing the first pressure relief valve, a check valve in the fifth line permitting flow only in a direction from the second line toward one end of the blade actuator cylinder, eighth and ninth lines, means for selectively connecting the eighth and ninth lines with the source and exhaust, respectively, in a first position, and with the exhaust and source, respectively, in a second position, means connecting the eighth line with the seventh line intermediate the pressure relief valve in the seventh conduit and the bucket actuator cylinder, means connecting the ninth line with the sixth line, so that the piston in the bucket actuator cylinder may be moved in either direction independently of the piston in the blade actuator cylinder, a 10th line connecting one end of the closure member actuator with the seventh line intermediate the pressure relief valve and the bucket actuator cylinder, an 11th line connecting with the sixth line intermediate the check valve in the sixth line and the connection of the sixth line with the bucket actuator cylinder, so that the closure member will be urged to open position when said bucket is urged to vertical position to closed position when said bucket is urged to horizontal position.

6. An earth moving scraper, comprising a frame adapted to be moved forwardly over the ground, a bucket supported on the frame for swinging between a generally horizontal position for loading purposes and a generally vertical position for dumping purposes, a blade with a cutting edge extending laterally across the front end of the bottom wall of the bucket, said frame including a front member extending laterally thereacross and having a lower edge forwardly and above the cutting edge of the blade in the loading position of the bucket, said frame having a substantially vertical position and the lower edge of the lower section is adjacent the lower edge of the front member of the frame, so as to provide a full opening into the bucket, a nd a second position in which said lower section is disposed in a generally horizontal position and its lower edge is adjacent the cutting edge of the blade, and in which said upper section is disposed in an inclined position with its upper edge above the lower edge of the front member of the frame, so as to fully close the opening into the bucket, and means for so swinging the gate between its first and second positions, comprising a link pivotally connected at one end to the scraper for swinging about a transverse axis forwardly of the gate and at the other end to the upper section of the gate, an arm pivotally connected at one end to each side wall of the frame for swinging about a transverse axis and fixed at its other end to the adjacent end of the lower gate section, and a reciprocator actuator pivotally connected at one end to the frame forwardly of the gate and at its other end to the pivotal connection of the link to the upper gate section.

7. An earth moving scraper of the character defined in claim 6, wherein the frame has a tongue extending forwardly from the front member thereof, and a plate mounted on the upper side of the tongue, the link being pivotally connected to the plate near its upper end, and the actuator being pivotally connected to the plate beneath the connection thereto of the link.