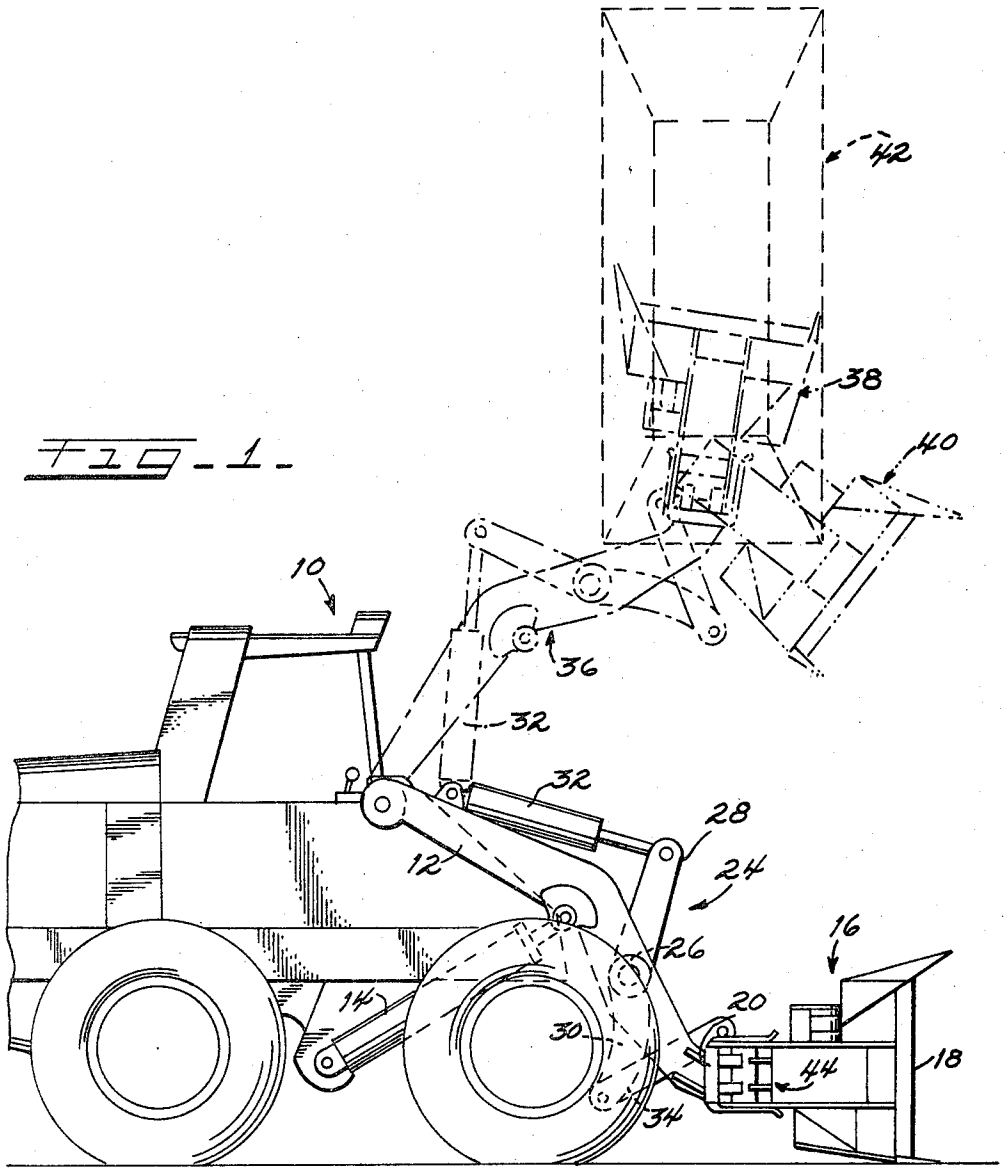
Sept. 24, 1968 K. SALNA ET AL 3,402,841

SIDE-DUMPING FRONT END LOADER

Filed Sept. 13, 1965 6 Sheets-Sheet 1

Fig. 1



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SIDE-DUMPING FRONT END LOADER

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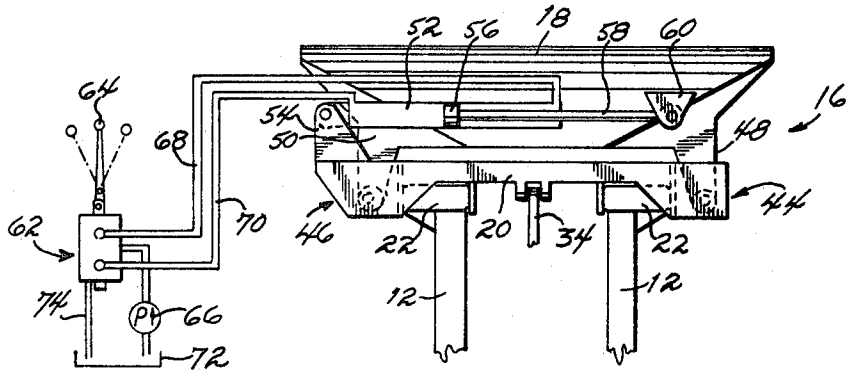


FIG. 2

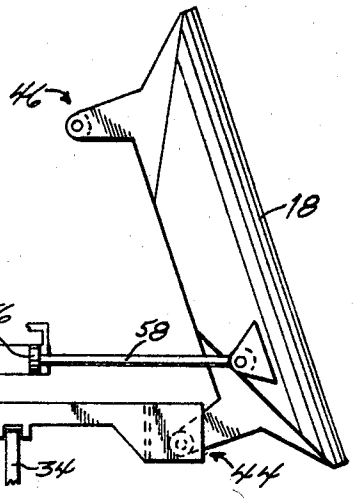


FIG. 3

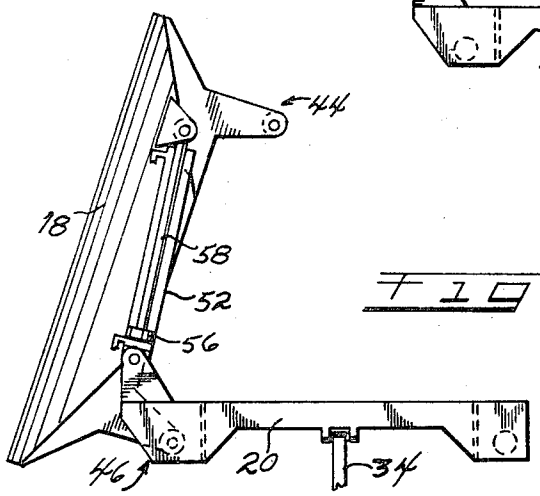


FIG. 4

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SIDE-DUMPING FRONT END LOADER

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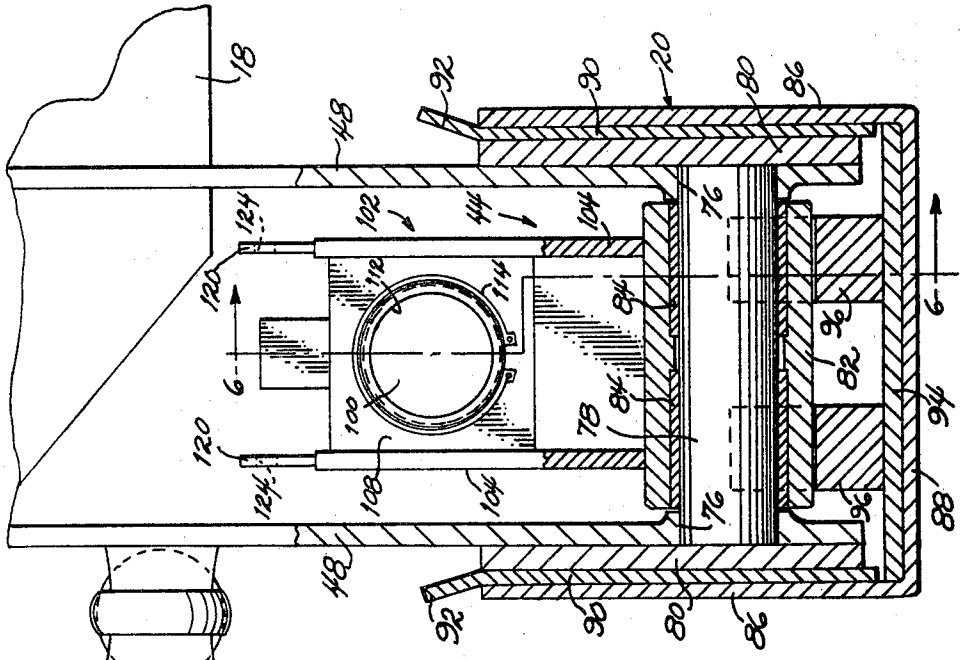


FIG - 5 -

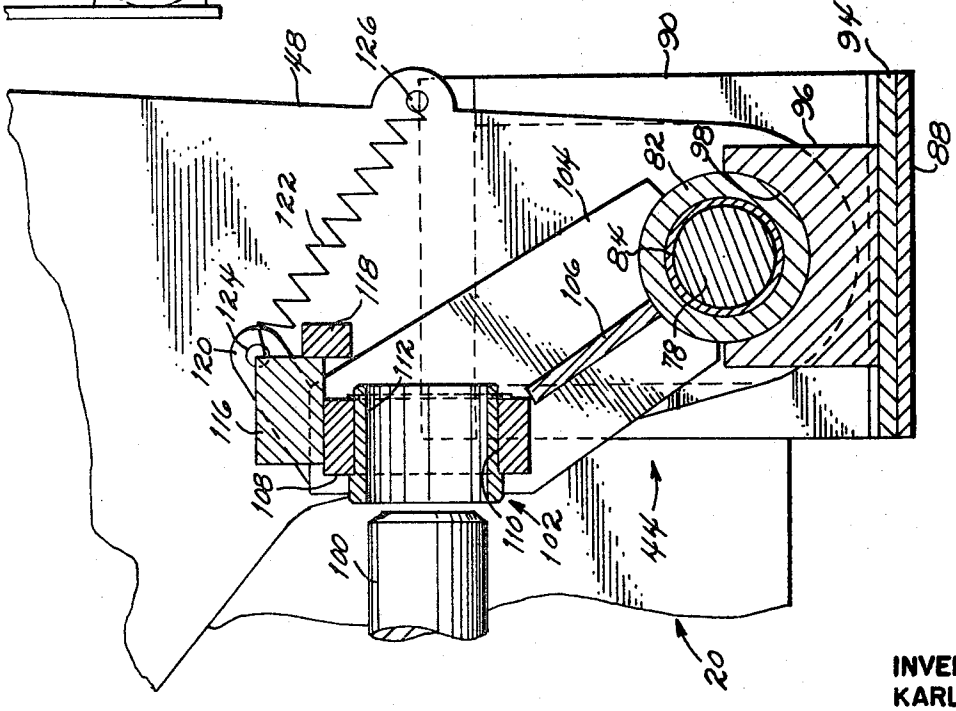


FIG - 6 -

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SIDE-DUMPING FRONT END LOADER

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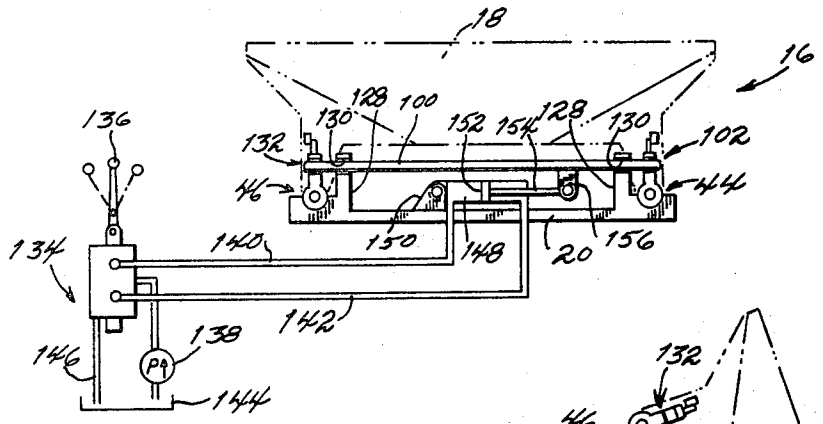


FIG. 7

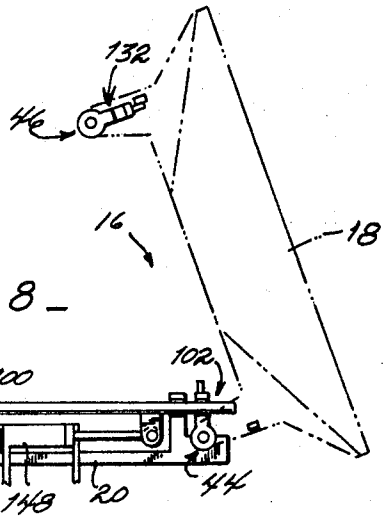


FIG. 8

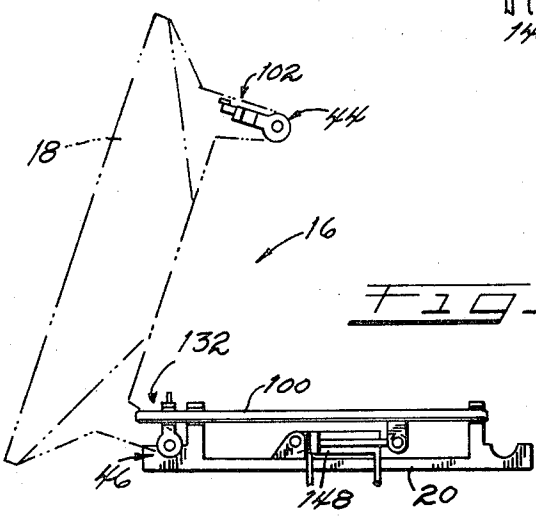


FIG. 9

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SIDE-DUMPING FRONT END LOADER

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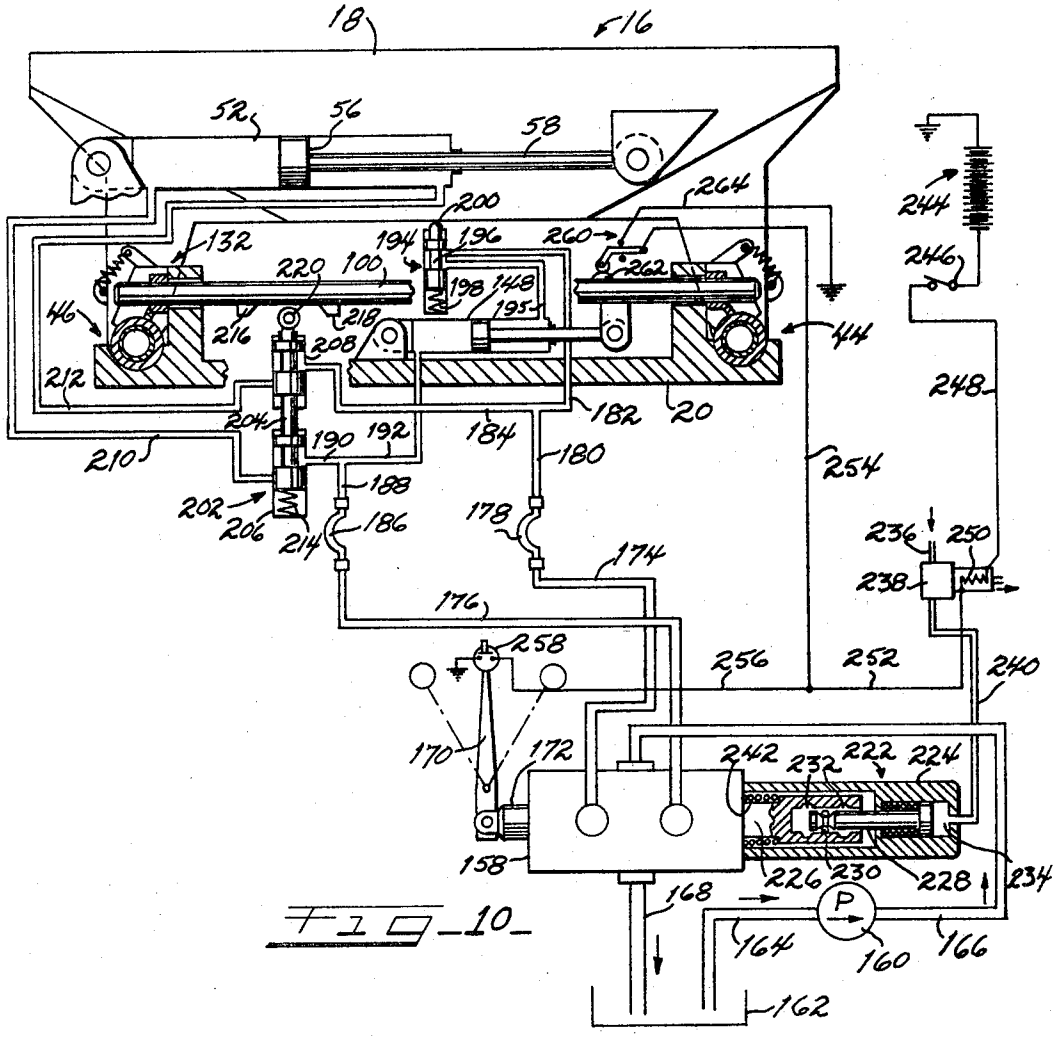


FIG. 10

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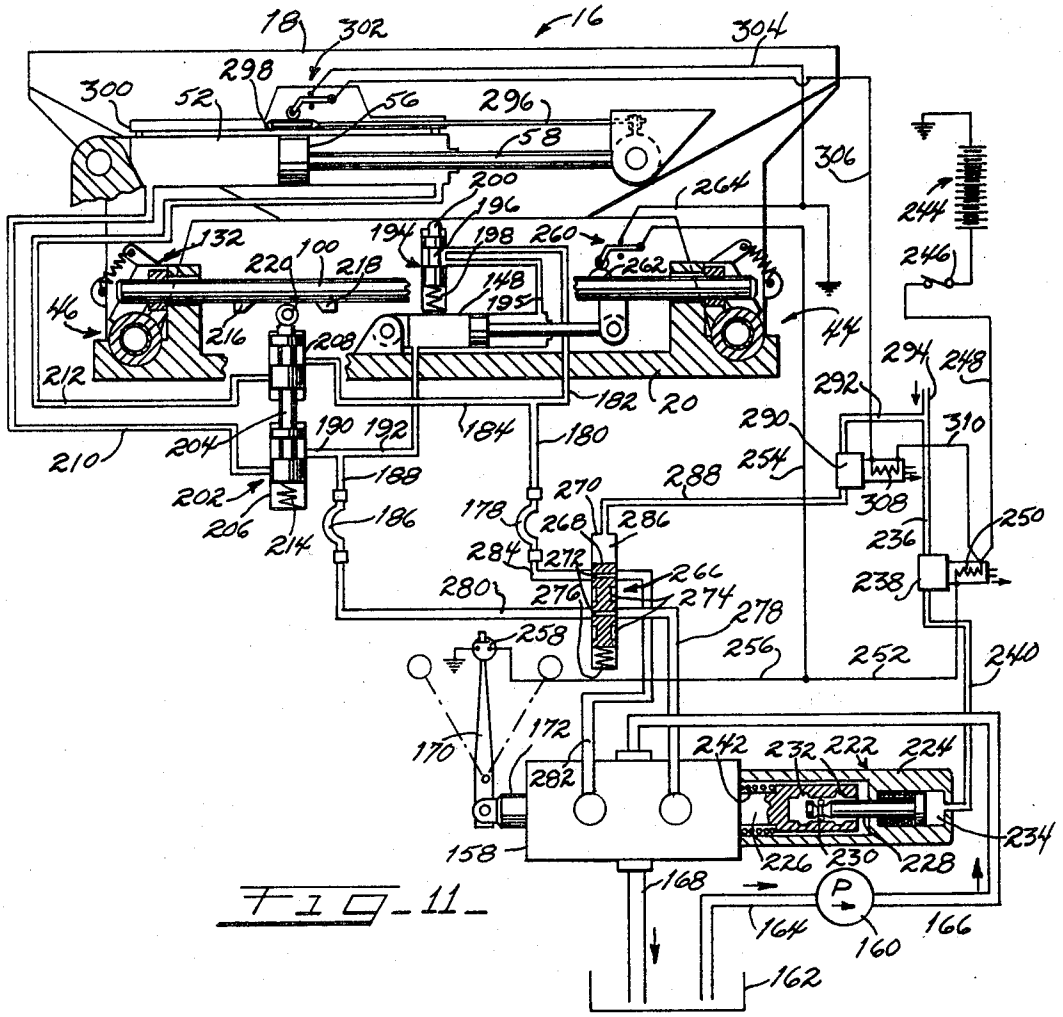


FIG. 11

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United States Patent Office 3,402,841 Patented Sept. 24, 1968

3,402,841

SIDE-DUMPING FRONT END LOADER

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Filed Sept. 13, 1965, Ser. No. 486,612
11 Claims. (Cl. 214—768)

ABSTRACT OF THE DISCLOSURE

A bucket attachment for a tractor loader vehicle with a pair of pivot assemblies on the bucket adapted to be selectively locked to a bucket carrier for side dumping and digging operations, and with a control system providing interlock features and bucket dumping and return speed control.

Summary of the invention

This invention relates to construction equipment and more particularly relates to a front-loading, side-dumping attachment for use with a construction vehicle.

It is an object of this invention to provide a side dumping bucket attachment for a construction vehicle which employs a single extensible hydraulic motor mounted to achieve either dumping about one side upon extension of the motor or dumping about the opposite side upon retraction of the motor.

Another object is to provide a side-dumping bucket which is releasably attached on either side of the bucket carrier of a vehicle by means of pivot assemblies whereby dumping to either side is achieved by releasing one assembly from the carrier while locking the remaining assembly with the carrier.

Another object is to provide a pivot assembly for mounting a side-dumping bucket on the bucket carrier of a vehicle wherein the assembly includes a roller element pivotally mounted within a bearing member which in turn releasably engages a saddle member on the carrier to define a substantially longitudinally extending pivot axis.

Another important object is to provide a side-dumping bucket attachment for a construction vehicle in which pivot assemblies releasably mount either side of a bucket to a carrier and in which a single locking member is movable between a first position locking both assemblies to the carrier and at least one operating position releasing one assembly while locking the other assembly.

Another significant object is to provide a hydraulic control circuit for a construction vehicle incorporating a bucket mounted for side-dumping about a carrier and a locking member movable to positions locking or releasing the bucket with the carrier in which the control circuit includes a sensing element to preclude operation of the locking member when the bucket is in a side-dumping position.

Still another object is to provide a hydraulic control circuit for a side-dumping bucket mounted on a carrier in which a member is movable between a position locking the bucket with the carrier and a position releasing the bucket for side-dumping wherein the control circuit responds to the released position of the member to actuate means for dumping the bucket.

Another object is to provide a hydraulic control system for a side-dumping bucket mounted on a movable carrier of a vehicle in which a member is movable between a position locking the bucket with the carrier and a position releasing the bucket for side-dumping whereby operation of the means for dumping the bucket is terminated upon movement of the member to the locking position.

Still another object is to provide a multiple speed hydraulic circuit for controlling the hydraulic motor used in dumping a bucket to the side of a bucket carrier in which a valve is operable to one position limiting fluid flow to the motor responsive to the bucket being cradled with the carrier and to another position permitting full fluid flow to the motor responsive to the bucket being in a side-dumping position.

Another object is to provide a hydraulic circuit for controlling the operation of a side-dumping bucket attachment which will effect an initial slow speed side dumping of the bucket through a predetermined angular movement of the bucket with respect to a bucket carrier, followed by a full speed dumping to the side, subsequent full speed return of the bucket to the predetermined angle, and then slow speed return until the bucket reaches its cradled position on the carrier.

Description of the drawings

The above and other objects of the present invention will become apparent to those skilled in the art when the following specification is read in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a side elevation view of a construction vehicle embodying a front-loading, side-dumping bucket attachment incorporating features of the present invention;

FIGURE 2 is a rear elevation view showing the attachment of the present invention with the bucket cardled on the carrier and with a schematic diagram of the hydraulic control circuit for the bucket actuating motor;

FIGURE 3 is a rear elevation view similar to FIGURE 2 showing the bucket pivoted relative to the carrier for right side-dumping;

FIGURE 4 is a rear elevation view similar to FIGURE 2 showing the bucket pivoted for left side-dumping;

FIGURE 5 is a greatly enlarged view, partially in cross section, of the pivot assembly for mounting the bucket to the carrier of the persent invention;

FIGURE 6 is a cross sectional view, taken along the line **6—6** of FIGURE 5, showing details of the pivot assembly;

FIGURE 7 is a rear elevation view showing the locking member in the center position and with a schematic diagram of the hydraulic circuit controlling the actuating motor for the locking member;

FIGURE 8 is a rear elevation view similar to FIGURE 7 showing the position of the locking member for right side-dumping;

FIGURE 9 is a rear elevation view similar to FIGURE 7 showing the position of the locking member for left side-dumpng;

FIGURE 10 is a rear elevation view, partially in cross section, of a bucket attachment incorporating features of the present invention and showing a schematic diagram of the hydraulic control circuit;

FIGURE 11 is a rear elevation view, similar to FIGURE 10 and partially in cross section, showing a schematic diagram of a modified hydraulic control circuit for the present invention.

Description of the preferred embodiments

Referring now to the drawings and particularly FIGURE 1 a tractor loader construction vehicle is designated generally by the reference numeral **10**. A pair of boom arms **12** are transversely spaced-apart and pivotally attached to the front end of the vehicle **10** for swinging movement in vertical planes. A pair of extensible hydraulic rams **14** are each pivotally attached at one end to the vehicle **10** and at their other end to the boom arms **12**. Selective extension and retraction of the rams **14** under influence of a conventional hydraulic control

system (not shown) will respectively raise and lower the boom arms **12** relative to the vehicle **10**. A front-loading, side-dumping bucket attachment **16** is mounted on the free ends of the boom arms **12** for pivotal movement about a transverse axis. The bucket attachment **16** comprises a digging bucket **18** mounted on a bucket carrier **20** in a manner to be presently described.

As shown in FIGURE 2, the bucket carrier **20** is pivotally mounted to the boom arms **12** by means of pivot pins **22** which are aligned along a transverse axis.

Angular adjustment of the bucket attachment **16** about the pins **22** is controlled through operation of a rocker arm assembly **24**, indicated generally in FIGURE 1. The rocker arm assembly **24** comprises a transversely extending pin **26** pivotally connected between the pair of boom arms **12**. A pair of levers **28** and **30** are rigidly attached to the pin member **26** and extend in opposite radial directions therefrom. An extensible hydraulic ram **32** is pivotally connected at one end to the vehicle **10** and at its other end to the free end of lever **28**. A connecting link **34** is pivotally connected at one end to the free end of lever **30** and at its other end to the bucket carrier **20**. Selective extension and retraction of ram **32** under influence of an hydraulic control system (not shown) will pivot backward and forward, respectively, the bucket attachment **16** relative to the boom arms **12**.

In the solid line illustration in FIGURE 1 the bucket attachment **16** is in the proper attitude for a digging operation. With the boom arms **12** in the raised position as indicated by the broken line illustration at **36**, the bucket **18** will be in the carry position indicated at **38**. While the boom arms are in the raised position retraction of ram **32** will effect a forward-dumping operation and the bucket will be in the position indicated at **40**. The position of the bucket for a side-dumping operation is indicated at **42**.

Turning now to FIGURE 2 the bucket attachment **16** is shown with the bucket **18** cradled on the bucket carrier **20**. The bucket **18** is broadly conventional and opens upwardly to receive material to be loaded. A releasable pivotal connection between the bucket **18** and carrier **20** is afforded by pivot assembly **44** on the right side and pivot assembly **46** on the left side. A pair of brackets **48** are rigidly secured to the underside of the bucket **18** at spaced-apart positions and depend downwardly therefrom to support the pivot assembly **44**. Similarly, a pair of brackets **50** are rigidly secured to the left side of the bucket **18** at spaced-apart positions and depend downwardly therefrom to support the pivot assembly **46**. As will presently be described each of the pivot assembiles **44** and **46** provide a pivotal support for dumping of the bucket **18** to a selected side of the vehicle.

To achieve a side-dumping operation an extensible hydraulic motor of ram **52** is provided. The ram **52** is pivotally connected at its head end to a bracket **54** which in turn is rigidly secured to the left side of the bucket carrier **20**. A conventional piston **56** and rod **58** are slidably mounted in the ram **52**. The free end of the rod **58** is pivotally connected to a bracket **60** secured to the right side of the bucket **18**. With the bucket cradled on the carrier the piston **56** will be centered along the longitudinal axis of ram **52**.

Selective extension and retraction of hydraulic ram **52** is effected through operation of hydraulic control valve **62**. The control valve **62** may be an open-center spool valve type and its construction and operation will be well known to those skilled in the art. Suffice it to say that manipulation of control handle **64** will operate valve **62** to direct hydraulic fluid received from pump **66** into a selected one of the conduits **68** and **70**. The pump **66** withdraws fluid from reservoir **72** while return fluid is directed from valve **62** into reservoir **72** through conduit **74**. Conduit **70** is in fluid communication with the head end of ram **52** while conduit **68** is in fluid communication with the rod end of ram **52**. When valve **62** directs fluid under pressure into conduit **70** and the head end of ram **52**, the rod **58** will extend outwardly, while fluid in the rod end of ram **52** will return through conduit **68**. Similarly, when valve **62** directs fluid into conduit **68** and the rod end of ram **52** the rod **58** will retract, and return fluid will flow through conduit **70**.

FIGURE 3 illustrates the position of bucket **18** during a right side-dumping operation. In this situation the left pivot assembly **46** is released from carrier **20** while the right pivot assembly **44** is locked thereto in a manner to be presently described. As the ram **52** extends, the bucket **18** will pivot clockwise about the lateral axis defined by the right pivot assembly **44**. The bucket is then returned to its cradled position on the carrier **20** by retracting ram **52** until piston **56** reaches its center position.

FIGURE 4 illustrates the position of the bucket **18** during a left side-dumping operation. In this situation the right pivot assembly **44** is released from the carrier **20** while the left pivot assembly **46** is locked thereto. As the ram **52** is retracted further from its center position the bucket **18** will pivot counterclockwise about the lateral axis defined by the left pivot assembly **46**. To return the bucket to its cradled position on the carrier the ram **52** is extended until the piston **56** again reaches its center position.

FIGURES 5 and 6 show details of the right pivot assembly **44**. It is understood that the construction of the left pivot assembly **46** is similar to that of assembly **44**. As shown in FIGURE 5 the pivot assembly **44** is supported by the pair of spaced-apart brackets **48** which are rigidly secured to and depend downwardly from the bucket **18**. An aperture **76** is provided in the lowermost end of each bracket **48**. A cylindrical roller member **78** is aligned through the apertures **76** and is secured to the brackets **48**. A pair of reinforcing plates **80** are provided whereby each plate overlies a respective end of roller member **78** and is secured to the outer surface of a respective bracket member **48**. A tubular housing **82** is concentric with the roller member **78** and is positioned intermediate the brackets **48**. A pair of bearing inserts **84** are secured to the inner surface of housing **82** and provided a pivotal bearing surface in contact with the roller member **78**. During a right side-dumping operation the roller **78** will pivot clockwise, as viewed in FIGURE 6, with respect to housing **82** and carrier **20**.

The bucket carrier **20** is essentially U-shaped and consists of a pair of spaced-apart side members **86** which in turn are rigidly secured to a bottom member **88**. A guide plate **90** is rigidly secured to the inner surface of each side member **86** and has an arcuate portion **92** at its upper extremity. The guide plates **90** provide a guideway to position the pivot assembly **44** in correct alignment on bucket carrier **20**. The inner surface of each of the plates **92** provides a sliding contact with a respective reinforcing plate **80** as the pivot assembly **44** is moved into and out of relationship with the carrier **20**.

A reinforcing plate **94** is provided on the upper surface of bottom member **88**. A pair of spaced-apart saddle members **96** are rigidly secured to the reinforcing plate **94**. As shown in FIGURE 6 each of the saddle members has a concave portion **98** which interfits with the outer surface of the housing **82** and thus provides support for the pivot assembly **44**. The housing **82** moves into and out of contact with the saddle members **96** as the pivot assembly **44** moves to and from the carrier **20**.

The pivot assembly **44** is locked with and released from the bucket carrier **20** through interfitting operation of the male locking member **100** with the female locking assembly **102**. As will presently be described the male locking member **100** is slidably carried on the bucket carrier **20** for a transverse reciprocating movement. The female locking assembly **102** is supported by the pivot assembly **44** by means of a pair of spaced-apart frame members **104** which are rigidly secured to the housing **82**. A support plate **106** is rigidly secured between the frame members **104**. The housing **108** of the locking assembly **102** is rig-

idly secured between the uppermost ends of the frame members **104**. An aperture **110** is provided in the housing **108** concentric with the axis of male locking member **100**. A sleeve member **112** is inserted in the aperture **110** and is rigidly secured to the housing **108** by means of lock ring **114**. The locking member **100** moves into sliding contact with the inner surface of sleeve member **112**. When the locking member **100** is moved within the sleeve member **112** translatory movement of the pivot assembly **44** with respect to the carrier **20** is prevented.

A stop member **116** is rigidly secured to the uppermost side of housing **108**. The stop member **116** abuts against a brace element **118** rigidly secured between the brackets **48**. A pair of ear portions **120** project upwardly from the upper extremity of the frame members **104**. A pair of tension springs **122** are mounted between apertures **124** provided in each ear portion **120** and apertures **126** provided in each bracket **48**. The springs **122** urge the pivot assembly **44** clockwise around the roller member **78** until the stop member **116** contacts the brace element **118**. This functions to position the locking assembly **102** in alignment with the locking member **100** when the pivot assembly **44** is moved within the carrier **20**. During a left side-dumping operation the springs **122** will retain the pivot assembly **44** in the position shown in FIGURE 6 during its movement away from the carrier.

FIGURES 7–9 illustrate details of the locking member **100** mounted on the carrier **20** along with the related hydraulic control circuit. A pair of transversely spaced-apart lock support members **128** are rigidly secured to and extend upwardly from the carrier **20**. A pair of aligned guide apertures **130** are provided in the upper margins of the support members **28** in alignment with the corresponding apertures of the right locking assembly **102** and left locking assembly **132**.

The locking member **100** is slidably mounted within the guide apertures **130** and is of sufficient length so that a respective end thereof extends through a corresponding locking assembly **102** and **132** when the locking member is in the center position as shown in FIGURE 7. In this position the member **100** functions to lock both pivot assemblies **44** and **46** against translatory motion with respect to carrier **20**. The attachment **16** may now be used for operations such as front-loading, carrying, and front-dumping.

Transverse reciprocating motion of the locking member **100** is effected through operation of hydraulic control valve **134**. The control valve **134** may be an open-center spool valve type and its construction and operation will be well known to those skilled in the art. Suffice it to say that upon manipulation of the control handle **136** the valve **134** will direct hydraulic fluid under pressure from pump **138** into a selected one of the conduits **140** and **142**. The pump **138** withdraws fluid from reservoir **144** while the valve **134** returns fluid to the reservoir through conduit **146**.

A lock actuating ram **148** is pivotally connected at its head end to a bracket **150** rigidly secured to the bucket carrier **20**. Piston **152** and rod **154** are slidably carried within the cylinder of the ram **148**. The free end of the rod **154** is connected to a bracket **156** which in turn is connected to the locking member **100**. With the locking member in the center position as shown in FIGURE 7 the piston **152** will be midway through its stroke in the ram **148**.

The conduit **140** is in fluid communication with the head end of ram **148** while the conduit **142** is in fluid communication with the rod end of ram **148**. Fluid under pressure in conduit **140** will extend ram **148** while return fluid will flow through conduit **142**. Fluid under pressure in conduit **142** will retract ram **148** and return fluid will flow through conduit **140**.

For a right side-dumping operation the locking member **100** is moved to the right-lock position in which the left pivot assembly **46** is released from carrier **20** while right pivot assembly **44** remains in the locked position. To accomplish this, valve **134** is manipulated to extend ram **148** in the manner described above. Locking member **100** will now be moved to the position illustrated in FIGURE 8. The left end of member **100** will move out of interlocking contact with left locking assembly **132** while the right end of member **100** will extend further through the right locking assembly **102**. The bucket attachment **16** may now be operated in the manner described in connection with FIGURE 3 for a right side-dumping operation.

For a left side-dumping operation locking member **100** is moved to the left-lock position in which the right pivot assembly **44** is released from its locking contact with carrier **20** while left pivot assembly **46** remains in the locked position. To accomplish this, valve **134** is manipulated to retract ram **148** in the manner described above. Locking member **100** will move into the position illustrated in FIGURE 9. The right end of member **100** will move out of its interlocking contact with locking assembly **102** while the left end of member **100** will extend further through the locking assembly **132**. The bucket attachment **16** may now be operated for left side-dumping in the manner described in connection with FIGURE 4.

FIGURE 10 illustrates details of the hydraulic control system for operating the bucket attachment **16**. The control system is exceptional in providing safety features such that operation of the lock actuating ram **148** is precluded when the bucket is not in its cradled position on the carrier. This assures that the locking member **100** will not move out of either of its right- or left-lock positions as shown in FIGURES 8 and 9 when the bucket is in a side-dumping position. Thus the bucket **18** will not accidentally drop from the carrier upon an incorrect manipulation of the control valve. The hydraulic control system also will provide a safety interlock feature such that hydraulic fluid can only be directed to the dumping ram **52** when the locking member **100** is in either of the right- or left-lock positions. This assures that operation of ram **52** will nnot occur when the locking member **100** is in the center position, which would otherwise place an undue stress on the dumping ram and fluid conduits.

Other novel features of the hydraulic control system include an air-actuated detent release mechanism which will allow the spool of the hydraulic control valve to return to the neutral position after the locking member **100** has returned to its center position. This will discontinue operation of the lock actuating ram **148** after the bucket has returned to its cradled position from a side dump operation. This functions to automatically center the locking member and prevent its movement to the extreme opposite side.

As shown in FIGURE 10 a convention open-center spool valve type control valve **158** may be provided. Hydraulic pump **160** receives fluid from reservoir **162** through conduit **164** and delivers fluid under pressure through conduit **166** into valve **158**. Return fluid from valve **158** is delivered to reservoir **162** through conduit **168**. Manipulation of control handle **170** will move spool **172** to a right or left position thereby directing fluid into a selected one of the conduits **174** and **176**. Conduit **174** is connected through flexible hose **178** to conduit **180** which in turn is in connection with branch conduits **182** and **184**. Conduit **176** is connected through flexible hose **186** to conduit **188** which in turn is in connection with branch conduits **190** and **192**.

Safety control valve **194** is in series connection with branch conduit **182**, conduit **195** and the rod end of lock actuating ram **148**. The head end of ram **148** is connected with branch conduit **192**. The control valve **194** comprises a spool **196** slidable between a first position blocking fluid communication between conduit **182** and conduit **195** and a second position permitting fluid flow between said conduits. A spring **198** normally urges the spool **196** to the first position. When the bucket is in the

cradled position, its bottom side will contact the protruding end **200** of the spool, thereby moving it into the second position as shown in FIGURE 10 to permit operation of ram **148**.

A safety interlock valve **202** is provided to permit operation of ram **52** only when the locking member **100** is in either of the right- or left-lock positions. The valve **202** comprises a spool **204** slidable within first housing **206** and second housing **208**. The first housing **206** is in series connection with branch conduit **190**, conduit **210**, and the head end of ram **52**. Similarly, second housing **208** is in series connection with branch conduit **184**, conduit **212**, and the rod end of ram **52**.

The spool **204** is slidable between a first position permitting fluid flow from conduit **190** into conduit **210**, and from conduit **184** into conduit **212**, and is slidable to the second position shown in FIGURE 10 in which fluid flow into conduits **210** and **212** is prevented. Spring **214** normally urges spool **204** to the second position. A pair of spaced-apart camming surfaces **216** and **218** are secured to locking member **100**. A cam follower **220** is mounted on the end of spool **204** which protrudes through housing **208**. When the locking member **100** is moved to the left-lock position, cam surface **218** will engage cam follower **220** and move spool **204** into the first position to permit operation of ram **52**. Similarly, with locking member **100** in the right-lock position, cam surface **216** will engage cam follower **220** and also move spool **204** into the first position. In any position of locking member **100** other than the right- or left-lock positions, spool **204** will be in the second position to prevent operation of ram **52**.

This invention also contemplates an automatic control device incorporating detent mechanism **222** operating in conjunction with valve **158** to terminate operation of actuating ram **148** when the locking member **100** returns to the center position from either the right- or left-lock positions. The detent mechaninsm **22** is broadly conventional and the construction and operation will be well known to those skilled in the art. The detent mechanism **222** comprises a housing **224** enclosing the protruding end portion **226** of spool **172**. A detent plunger **228** is slidable within the housing **224** and carries a detent spring **230** which releasably engages either one of a pair of grooves **232** formed within the end portion **226**. The piston shaped end of plunger **228** is slidable within a chamber **234** provided in the housing **224**. Air under pressure is supplied to chamber **234** through air hose **236**, normally closed solenoid valve **238**, and air hose **240**.

The operation of the detent mechanism **222** is as follows. Upon movement of the control handle **170** from the neutral position to either of the right or left positions the spool **172** will move respectively into a left or right operating position. Either of the grooves **232** will now engage the detent spring **230**, thus holding spool **172** in the operating position. The operator may override the detent mechanism by manipulating the handle **170** back to the neutral position. Air under pressure in chamber **234** will also release the detent mechanism by moving the plunger **228** which in turn will urge the spring **230** out of the groove **232**. The spool **172** wil now be returned to the neutral position through operation of spring **242**, thereby discontinuing flow through the conduits **174** and **176**.

The solenoid valve **238** may be operated manually; movement of locking member **100** to the center position will also operate valve **238**. A source of electric power, such as battery **244**, is connected through on-off switch **246**, conductor **248**, solenoid coil **250**, conductor **252**, and then through the branch conductors **254** and **256**. The branch conductor **256** in turn is connected to a hand operated normally opened micro-switch **258** mounted on control handle **170**. Manual operation of switch **258** completes an electrical circuit to ground to energize coil **250**, thereby opening solenoid **238** and releasing detent mechanism **222**.

Branch conductor **254** is connected with a normally opened limit switch **260**. A camming surface **262** is mounted on locking member **100** so that limit switch **260** is closed when the locking member is in the center position as illustrated in FIGURE 10. The closing of switch **260** completes an electric circuit to ground through conductor **264**, thus energizing coil **250** and opening valve **238**. This will release detent mechanism **222** in the manner described above.

In operation, assuming that the bucket **18** is initially cradled against the carrier **20** and that a right side-dumping operation is desired, the operator will manipulate control valve **158** to direct hydraulic fluid under pressure into conduit **176**, hose **186**, and conduit **188**. Because interlock valve **202** is in its closed position, fluid will be diverted into branch conduit **192** and the head end of actuating ram **148**, which will move locking member **100** to the right-lock position. Return fluid will flow through conduit **195** and safety control valve **194**, which remains open due to its contact with bucket **18**, and thence through conduits **182**, **180**, **178**, **174** and into valve **158** for return to the reservoir **162**.

As the locking member **100** reaches its extreme right position, cam **216** will actuate interlock valve **202** into the open position. Fluid in conduit **188** will now be permitted to flow into branch conduit **190**, valve **202**, conduit **210**, and the head end of ram **52**. Piston **56** and rod **58** will extend to rotate bucket **18** about pivot assembly **44**. With the left end of locking member **100** moved out of interlocking relationship with locking assembly **132**, the left pivot assembly **46** will thus be free to pivot away from carrier **20**.

After the bucket begins its pivoting action, safety valve **194** will return to its first or normally closed position, thus preventing flow through conduit **195** and forming a "hydraulic lock" in actuating ram **148**. The locking member **100** will therefore remain in the right-lock position during the entire side-dumping operation.

After the material is unloaded from bucket **18** the operator will manipulate control valve **158** to direct fluid under pressure into conduit **174**. At the same time detent mechanism **222** will operate to hold spool **172** in the operating position. The operator will thus be free to manipulate other controls on the vehicle. Fluid from conduit **174** will flow into hose **178**, conduits **180** and **184**, the open interlock valve **202**, conduit **212** and the rod end of ram **52** for retraction of piston **56** and rod **58**. The bucket **18** will now rotate about pivot assembly **44** toward its cradled position on the carrier **20**. When the bucket reaches the cradled position in which the pivot assembly **46** is in contact with the carrier **20**, valve **194** will move to the open position thus allowing fluid flow from conduit **180** into conduits **182**, **195** and actuating ram **148**. Ram **148** will move locking member **100** to the left toward its center position.

When the locking member **100** reaches its center position, it is desirable that it remain in such position to lock both pivot assemblies **44** and **46** with the carrier until further manipulation of control valve **158**. To provide this function, cam **262** closes limit switch **260** when locking member **100** reaches its center position. This in turn energizes valve **138** for releasing detent mechanism **222**, thus permitting spool **172** to return to its neutral position in which no fluid is delivered to the rams. Simultaneous with movement of locking member **100** from the right-lock position cam **216** will disengage from cam follower **220** thus allowing interlock valve **202** to return to its closed position to prevent operation of ram **52**.

The operation of the bucket attachment **16** for a left-dump operation is similar to that described above. Briefly, control valve **158** is manipulated to direct hydraulic fluid into conduit **174** through safety valve **194** and into actuating ram **148** to move locking member **100** to the left-lock position. Interlock valve **202** will now be cammed open so that fluid will flow into the rod end of ram **52** for retraction thereof and counterclockwise pivoting of

bucket 18 about pivot assembly 46. Safety valve 194 will now close and form a "hydraulic lock" in actuating ram 148 to prevent movement of locking member 100 from the left-lock position.

To return bucket 18 to its cradled position from the left-dump position the operator manipulates control valve 158 to direct fluid into conduit 176, through interlock valve 202, and into ram 52 for extension thereof. When the bucket 18 reaches its cradled position valve 194 will open thus allowing fluid to flow into the head end of actuating ram 148 for movement of locking member 100 to its center position. Upon reaching its center position the locking member will close limit switch 260 thereby operating detent mechanism 222 in the manner described above to allow spool 172 to return to its neutral position and terminate operation of the rams.

As the bucket is returning from either the left or right side-dump position the hand-operated microswitch 258 may also be operated to position bucket 18 in any desired angle relative to bucket carrier 20. This will permit the bucket attachment 16 to be used for "angle dozing" in which the bucket 18 is used in the manner of a dozer blade. Similarly, the operator may actuate switch 258 to terminate side dumping when the bucket reaches a desired side angle position with respect to the carrier 20. After the operator has manipulated control handle 170 to operate control valve 158 and direct hydraulic fluid into one of the conduits 174 or 176 for side-dumping, the detent mechanism 222 will releasably hold spool 172 in its operating position. After the ram 52 has pivoted bucket 18 to the desired position, the operator manipulates switch 258 which in turn energizes coil 250 to open solenoid valve 238. Air under pressure in chamber 234 will now act on plunger 228 for releasing the detent spring 230 and allowing spool 172 to return to its neutral position.

A modified form of the present invention is illustrated in FIGURE 11 in which a speed control valve 266 is provided in the control circuit. Upon initial operation of the ram 52 for side-dumping the heavy mass of the bucket and its contents would create shock forces if the full force of the fluid is directed into the ram. Also, as the bucket is dropping from the dump to the cradled position impact forces would arise when the bucket hits the carrier at a high speed. To prevent these objectionable forces, the speed control valve 266 is provided to restrict or limit fluid flow to and from the ram 52 when the bucket 18 is near its cradled position.

The valve 266 comprises a spool 268 slidable within a housing 270. A pair of spaced-apart transversely extending orifices 272 and a pair of spaced annular grooves 274 are provided on the spool 268. A spring 276 normally urges the spool 268 to an upper position in the housing whereby each of the grooves 27 permit free fluid communication between a respective pair of conduits 278 and 280 to effect right side-dumping and between conduits 282 and 284 for left side-dumping. A chamber 286 is provided at the upper end of housing 270 and is in series connection with air hose 288, normally closed solenoid valve 290 air hose 292, and the source of air pressure (not shown) through air hose 294. When valve 290 is opened, air pressure will be delivered to chamber 286 to urge spool 268 to the lower position in housing 270 as illustrated in FIGURE 11. This will position spool 268 so that each of the orifices 272 will restrict fluid flow between a respective pair of conduits 282, 284 and 278, 280.

Operation of solenoid valve 290 is responsive to the position of the bucket 18 with respect to the carrier 20, which position is sensed by means of control rod 296 which is rigidly attached at one end to the end of rod 58. A camming surface 298 having a predetermined length is provided at the free end of control rod 296 and is slidably mounted within a tube 300 which in turn is rigidly secured to the ram 52. A normally open limit switch 302 is secured to the tube 300. The camming surface 298 is in operating contact with the switch 302 and is positioned so that the switch is closed when the bucket is cradled on the carrier. With switch 302 closed, an electric circuit will be completed from ground through conductor 304, conductor 306, solenoid coil 308, conductor 310, conductor 248, switch 246, and the source of electric power 244.

As the ram 52 is operated so that the rod 58 is extended or retracted for side-dumping, the camming surface 298 will slide to the right or left, respectively, within the tube 300. The length of camming surface 298 is selected so that the switch 302 is actuated when the bucket is pivoted to a predetermined angular relationship with carrier 20. As an example, the camming surface 298 may be constructed so that the switch 302 will open after the pivot assembly 46 exceeds one foot in distance from carrier 20 during a right dumping operation, and when the pivot assembly 44 exceeds one foot in distance from carrier 20 during a left dumping operation. As the bucket returns toward the carrier after a dumping operation, the switch 302 will close when the pivot assemblies 44 and 46 again come within the one foot distance from the carrier.

In operation, assuming that the bucket is initially in its cradle position on the carrier, and that right side-dumping is desired, the operator will manipulate the valve 158 to direct fluid under pressure into conduit 278. Since in the cradled position the camming surface 298 closes the limit switch 302, solenoid valve 290 will be energized so that air pressure will operate the speed control valve 266 to its restricted position as shown in FIGURE 11. Fluid will flow from conduit 278 at a reduced rate through the orifice 272 into conduit 280. The actuating ram 148 will now operate in the manner previously described to move locking member 100 to the right-lock position. Safety interlock valve 202 will now be cammed open so that fluid under pressure will be directed to the head end of ram 52 for a slow-speed extension of rod 58. As this occurs and the bucket starts to pivot to the right the camming surface 298 will move out of contact with switch 302, thus opening the electrical circuit and deenergizing valve 290 for terminating the air supply to valve 266. Valve 266 will now operate to permit full fluid flow from valve 158 into conduits 278 and 280, safety interlock valve 202, and ram 52 for a faster dumping action for the bucket 18.

After the material has been dumped from bucket 18, the operator will manipulate control valve 158 to direct fluid under pressure into conduit 282. At this time, the speed control valve 216 is in its upper position permitting full fluid flow into conduit 284. Fluid will now flow into interlock valve 202, which remains open, and the rod end of ram 52 for pivoting the bucket toward its cradled position at the fast speed. As the pivot assembly 46 nears the carrier 20, camming surface 298 will actuate limit switch 302 thus energizing valve 290 and operating speed control valve 266 to the restricted position for slow speed operation of ram 52. The operation of the speed control circuit for a left side-dumping operation is similar to that described above for the right side-dumping operation.

In view of the foregoing description, there has been provided herewith a new and improved front-loading, side-dumping bucket attachment for a construction vehicle. Through the arrangement of the invention, selective side-dumping is achieved by operation of the novel pivot assemblies and locking member under control of a hydraulic circuit providing safety interlock features and automatic or manual bucket positioning. Although the arrangement presented herein is at present considered to be preferred, it is to be understood that variations and modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A side-dumping bucket attachment for use with a loader vehicle having a movable boom, the attachment including the combination of: a bucket carrier mounted

on the boom for pivotal movement about a transverse axis, a pair of transversely spaced-apart roller members mounted on the bucket; a pair of bearing members, each bearing member being mounted on a respective roller member for pivotal movement about a longitudinal axis; and a locking member mounted on the carrier and movable between a first position locking each bearing member with the carrier, a second position locking a selective one of the bearing members with the carrier while releasing the other bearing member, and a third position locking the other bearing member with the carrier while releasing the one bearing member; and means to move the locking member between the first, second and third positions.

2. A side-dumping bucket attachment for use with a loader vehicle having a movable boom, the attachment including the combination of: a bucket; first and second transversely spaced-apart roller members mounted on the bucket, each roller member being aligned along a substantially longitudinal axis; first and second bearing members, each bearing member being mounted on a respective roller member for pivotal movement about the axis; a bracket secured to each bearing member, each bracket being provided with an aperture having its axis extending transversely; a locking member mounted on the carrier in alignment with the apertures and having two ends, the locking member being slidable between a first position wherein each end engages a respective aperture, a second position wherein one end is withdrawn from its respective aperture, and a third position wherein the other end is withdrawn from its respective aperture; and power means to move the locking member between the first, second and third positions.

3. A hydraulic control system for use in a vehicle having a bucket pivotally mounted on a bucket carrier for side-dumping, hydraulic motor means to dump the bucket, a source of fluid under pressure, and a locking member movable between a first position preventing the bucket from dumping and at least one operating position releasing the bucket for side-dumping, the control system including the combination of: first valve means connecting the source of fluid with the motor means responsive to movement of the locking member to the operating position; hydraulic actuating means to move the locking member between the first position and the operating position; and second valve means to connect the actuating means with the source of fluid pressure responsive to a nondumping position of the bucket relative to the carrier, the second valve means further operating responsive to a side-dumping position of the bucket to hydraulically lock the actuating means to prevent movement of the locking member.

4. A hydraulic control system for use in a loader vehicle having a bucket mounted on a carrier for front loading and lateral dumping, a source of fluid under pressure, and a locking member movable between a first position locking the bucket with the carrier and a second position releasing the bucket for lateral dumping, the control system including the combination of: control valve means in fluid connection with the source of fluid; hydraulic motor means to laterally dump the bucket; hydraulic actuating means to move the locking member between the first and second positions; safety valve means to connect the actuating means with the control valve means in response to a nondumping position of the bucket, the safety valve means further operating to preclude discharge of fluid from the actuating means responsive to a dumping position of the bucket; and interlock valve means to connect the hydraulic motor means with the control valve means when the locking member is in the second position.

5. A hydraulic control system for use in a loader vehicle having a bucket mounted on a bucket carrier for front loading about a transverse axis and for side-dumping about a pair of transversely spaced-apart longitudinally extending lateral axes and having a locking member movable between a first position preventing side-dumping of the bucket and second and third positions allowing side-dumping of the bucket about a respective lateral axis, the combination including: a source of fluid under pressure; hydraulic actuating means having first and second ports, the actuating means being operably connected with the locking member whereby fluid under pressure in the first or second ports will move the locking member to the respective second or third positions while exhausting fluid through the respective second or first ports; control means having first and second conduits connected with the respective first and second ports, the control means connecting the source of fluid pressure with a selected first or second conduit; hydraulic motor means having third and fourth ports, the motor means being operably connected with the bucket whereby fluid under pressure in the third or fourth ports will dump the bucket about a respective longitudinal axis while exhausting fluid through the respective fourth or third port; other means to prevent fluid flow through the second port responsive to a side-dumping position of the bucket; and additional means operating responsive to the second and third positions of the locking member to fluidly connect the first conduit with the third port and the second conduit with the fourth port, the additional means further being responsive to the first position of the locking member to prevent fluid flow from the conduits to the hydraulic motor means.

6. A hydraulic control system for use in a loader vehicle having a bucket mounted on a bucket carrier for front loading about a transverse axis and for side-dumping about either of a pair of transversely spaced-apart longitudinally extending lateral axes, the combination including: a source of fluid under pressure; a locking member movable between a first position locking the bucket with the carrier to prevent side-dumping, a second position releasing the bucket to allow side-dumping about one lateral axis, and a third position releasing the bucket to allow side-dumping about the other lateral axis; hydraulic actuating means to move the locking member between the first, second and third positions; means to inactivate the actuating means responsive to a side-dumping position of the bucket; control valve means having a spool normally urged to a neutral position and selectively movable to first and second positions connecting the source of fluid with the actuating means to move the locking member to a respective second and third position; means to releasably hold the spool in the first and second positions; and other means to release the spool from the first and second positions responsive to the locking member being in the first position.

7. A hydraulic control system for use in a loader vehicle having a bucket mounted on a bucket carrier for front loading and for lateral dumping about at least one longitudinal axis and having a locking member movable between a first position locking the bucket with the carrier and a second position releasing the bucket for side dumping, the combination including: a source of fluid under pressure; hydraulic actuating means to move the locking member between the first and second positions; hydraulic motor means to dump the bucket about the longitudinal axis; control valve means having a spool normally urged to a neutral position and selectively movable to a first position connecting the source of fluid with the actuating means and hydraulic motor means to move the locking member to the second position and to dump the bucket about the lateral axis; detent means to releasably hold the spool in the first position and other means to selectively release the detent means to allow the spool to be urged to the neutral position.

8. A hydraulic control system as defined in claim 7 in which the other means includes: manually operated switch means; air operated means to release the detent means; a source of air under pressure; and, means connecting the source of air with the air operated means responsive to operation of the switch means.

9. A hydraulic control system for use in a loader vehicle having a bucket mounted on a bucket carrier for front loading and for lateral pivoting about at least one longitudinal axis, the combination including: hydraulic motor means to pivot the bucket between a neutral position in which the bucket is cradled with the carrier and an operating position in which the bucket is laterally pivoted about the axis; a source of fluid under pressure; hydraulic circuit means to selectively connect the source of fluid with the motor means; speed control valve means having a spool movable between a first position presenting a restriction in the circuit means to limit fluid flow therethrough and a second position allowing full fluid flow in the circuit; and other means sensing the lateral pivoting position of the bucket to actuate the spool to the first position responsive to pivoting of the bucket within a predetermined angle with respect to the carrier and to actuate the spool to the second position responsive to pivoting of the bucket beyond the predetermined angle.

10. In a hydraulic control system for use with a loader vehicle having a bucket mounted on a bucket carrier for front loading and for lateral dumping about at least one longitudinal axis, the combination including: hydraulic motor means operably connected with the bucket and having a piston movable between a neutral position in which the bucket is cradled with the carrier and an operating position in which the bucket is laterally dumped about the axis; a source of fluid under pressure; hydraulic circuit means to selectively connect the source of fluid with the motor means; valve means in the circuit means operable in a first condition to restrict fluid flow to the motor means and in a second condition to allow full fluid flow to the motor means; camming means mounted for movement with the piston to a first location in which the piston is within a predetermined distance from the neutral position and a second location in which the piston is beyond the predetermined distance from the neutral position; and switch means to actuate the valve means to the first condition responsive to movement of the camming surface to the first location and to the second condition responsive to movement of the camming surface to the second location.

11. A hydraulic control system for use in a loader vehicle having a bucket mounted on a bucket carrier for front loading and for lateral dumping about at least one longitudinal axis, the combination including: hydraulic power means to laterally pivot the bucket about the axis between a cradled position against the carrier and an operating position for lateral dumping; a source of fluid under pressure; hydraulic circuit means to selectively connect the source of fluid with the power means, the circuit means including a first conduit to direct fluid to the power means for lateral dumping and to return fluid therefrom for returning the bucket to its cradled position, and a second conduit to direct fluid to the power means for returning the bucket to its cradled position and to return fluid therefrom for lateral dumping; a valve having a spool movable between first and second positions, the spool having a pair of orifices with a restricted cross-sectional area to limit fluid flow therethrough, each orifice being positioned in a respective conduit when the spool is in the first position, the spool further having a pair of passageways with a cross-sectional area larger than the area of the orifices, each passageway being positioned in a respective conduit when the spool is in the second position; and sensing means to move the spool to the first position responsive to the bucket being in the cradled position, the sensing means further operating to move the spool to the second position responsive to the bucket being in the operating position.

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