US00RE37339B1

(19) **United States**
(12) **Reissued Patent**
Horton

(10) **Patent Number: US RE37,339 E**
(45) **Date of Reissued Patent: Aug. 28, 2001**

(54) **HYDRAULIC LATCH PIN ASSEMBLY FOR COUPLING A TOOL TO A CONSTRUCTION EQUIPMENT**

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(21) Appl. No.: **09/526,972**

(22) Filed: **Mar. 16, 2000**

Related U.S. Patent Documents

Reissue of:
(64) Patent No.: **5,966,850**
Issued: **Oct. 19, 1999**
Appl. No.: **08/947,441**
Filed: **Sep. 24, 1997**

U.S. Applications:

(63) Continuation of application No. 08/634,561, filed on Apr. 18, 1996, now Pat. No. 5,727,342.

(51) **Int. Cl.**[7] **E02F 3/96**
(52) **U.S. Cl.** **37/468**; 414/723
(58) **Field of Search** 37/463, 408–410; 414/723; 403/322, 321, 325, 319

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(57) **ABSTRACT**

The invention provides a coupling assembly and method for coupling a tool to a dipperstick, or arm, on an apparatus which has a hydraulic system for moving the tool. The coupling assembly includes a coupler body having link structure for pivotally coupling to the dipperstick. A latch member is movable between an engaged position for engaging the tool and a disengaged position for disengaging from the tool. A spring is arranged to provide a spring force to urge the latch member to the engaged position. A hydraulic motor has a part that is stationary relative to the coupler body and a movable part that can be extended relative to the stationary part when hydraulic pressure is applied to one end of the hydraulic motor. The movable part is coupled to the latch member such that extension of the movable part urges the latch member to the retracted position in opposition to the spring force.

50 Claims, 7 Drawing Sheets

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FIG. 1

FIG. 2

4
50
51
52
61
32
10
24
60
74
46
48
46
72
22
76
62
71
78
58
82
5
54
44
70
66
44
5
26
73
56
30
64
69
26
42
42
4

FIG. 3

46
46
26
26
32
72
80
60
48
62
66
70
74
56
34
34
28
38
82

FIG. 5

4A
48
51
52
61
32
24
10
60
74
48
62
46
46
76
80
71
56
70
58
78
73
82
54
44
44
5A
5A
30
66
64
69
26
42
42
4A

FIG. 3A

46
46
26
26
32
80
60
48
62
66
70
56
74
34
34
38
82
28

FIG. 5A

44
10
46
26
32
61
60
62
80
56
66
30
51
48
78
64
68
42
50
28
52
38
40
14
34

FIG. 4

44
10
46
26
52
61
32
60
51
62
80
78
56
66
68
42
48
64
52
38
28
40
14
34

FIG. 4A

WARNING LAMPS
INDICATOR AUDIO
INDICATOR LAMPS
POWER
BASE
146
144
148
111
110
108
122
118
114
120
116
112
102
51
48
56
58
73
104
86
93
90
88
92
94
96
98
100
18

FIG. 6

FIG. 6A

FIG. 6B

FIG. 6C

HYDRAULIC LATCH PIN ASSEMBLY FOR COUPLING A TOOL TO A CONSTRUCTION EQUIPMENT

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is a continuation of application Ser. No. 08/634,561, filed Apr. 18, 1996, now U.S. Pat. No. 5,727,342.

BACKGROUND OF THE INVENTION

The invention relates to tool couplers for excavation, demolition and construction equipment.

Some types of construction equipment, such as backhoes and excavators, have a movable dipperstick (also referred to as an arm) to which a variety of tools, such as, for example, buckets and grapples, can be attached. A hydraulic linkage allows the equipment operator to pivot the tool from the free end of the dipperstick. To simplify the process of changing tool attachments, a universal coupler can be fixed to the dipperstick linkage. A selected tool can then be removably attached to the coupler, a process that typically involves manually positioning at least one latch pin between the coupler and the tool.

There is a trend in the industry to use an actuated coupler on the end of the dipper stick for connecting and disconnecting a tool from the linkage. A great advantage of these systems is that the operator can actuate the coupler to connect or disconnect a tool without the assistance of another worker and without having to leave the cab of the vehicle.

One type of actuated coupler first engages a crossbar formed in the tool with hooks depending from the coupler, and then engages a latch pin (or a block or a wedge) with a mating receptacle formed in a collar on the tool. A double-action hydraulic cylinder in line with the latch pin is positioned so that the cylinder extends to push the latch pin into the receptacle. In disengaging the tool from the coupler, the operator retracts the rod into the cylinder body, pulling the pin out of the receptacle.

SUMMARY OF THE INVENTION

The invention provides a coupling assembly for coupling a tool to a dipperstick, or arm, on an apparatus which has a hydraulic system for moving the tool. The coupling assembly includes a coupler body having a frame that defines a central cavity, and also having link structure for pivotally coupling to the dipperstick. An actuator assembly positioned within the central cavity includes a latch pin movable between an extended position and a retracted position. In the extended position, an end of the latch pin projects rearward from an opening in a rear end of the frame for engaging an aperture or receptacle defined by the tool. In the retracted position, the end of the latch pin is disengaged from the tool receptacle and positioned substantially within the frame. The actuator assembly also includes a hydraulic latch cylinder that has a movable part, and a fixed part. The movable part is coupled to the latch pin by a latch pin coupling assembly, which is structured and arranged such that, when the movable part is extended from the fixed part, the latch pin moves to the retracted position.

According to another aspect of the invention, the latch pin coupling assembly includes a bias member structured and arranged to apply a bias force that urges the latch pin towards the extended position. When a threshold level of

hydraulic pressure is applied to the latch cylinder, the movable part of the cylinder overcomes the bias force and extends to move the latch pin to the retracted position and out of engagement with the tool.

Another feature of the invention is that the latch cylinder can be a single-action cylinder.

According to another feature of the invention, the latch cylinder can be positioned on an axis different from an axis defined by the latch pin, such as along side the latch pin. This feature provides a compact arrangement. The system is easily adaptable to any type of quick coupler type system due to the compactness and placement of the actuating cylinder.

According to another feature of the invention, the hydraulic pressure to the latch cylinder can be controlled by an electrically actuated valve assembly that hydraulically couples the dipperstick hydraulics to the latch cylinder. The valve assembly can include one or more solenoid valves that only allow hydraulic pressure to enter and remain in the latch cylinder when they are energized.

According to another feature of the invention, the valve assembly can be structured and arranged such that the dipperstick hydraulics must be approximately fully pressurized while extended to pressurize the latch cylinder.

According to another feature of the invention, the coupling assembly can also include a pin indicator that readily shows whether the latch pin is retracted. The indicator is located such that it can be viewed easily from the operator position.

According to another feature of the invention, a drop in hydraulic pressure in the latch cylinder below the threshold level allows the bias spring to push the coupling pin towards the extended position. An unexpected hydraulic pressure loss can be caused by a failure in the hydraulic system or by a failure in the valve assembly. The spring apply, hydraulic release system is safe in that it assures that an attached tool will not accidentally uncouple from the coupling assembly if there is a loss in hydraulic pressure in the latch cylinder.

The invention also provides a method of removing a tool from the coupler assembly having features as described above. An operator can remove a tool by the steps of applying hydraulic pressure to a latch cylinder that has a part fixed relative to the coupler body and a movable part rigidly coupled to the latch pin, extending the movable part from the fixed part, thereby urging the latch pin to the retracted position, engaging a cross member of the excavation tool with a hook structure depending and extending forward from the coupler body, rotating the coupler body toward the tool, aligning the latch pin with a mating receptacle formed in the excavation tool, reducing hydraulic pressure to the latch cylinder, and applying a bias force to the latch pin, urging the latch pin to the engaged position, thereby engaging the latch pin in the receptacle and securing the excavation tool to the coupler body.

According to another aspect of the invention, the method further includes the step of removing the tool from the coupler, including rotating the coupler body and the tool to a full forward position, again applying hydraulic pressure to the latch cylinder, again extending the movable part from the fixed part, thereby urging the latch pin to the retracted position and disengaging the latch pin from the receptacle, and disengaging the hook structure from the cross member of the excavation tool.

The latch cylinder extends using the more powerful head end to extract the latch pin, whereas coupling systems using an in-line dual-action cylinder and latch pin arrangement use

the less powerful rod end for this purpose. This feature of the invention is important when extracting a frozen pin, which can require substantially more force than inserting a free moving pin.

Since, the hydraulic system uses a single-action latch cylinder, it only requires one hydraulic line between the valve assembly and the latch cylinder. This is simple and inexpensive compared with coupling systems that use a dual-action cylinder, and that require two hydraulic connections.

The rod of the latch cylinder is normally in the retracted position during the tool working period. Because the latch cylinder is retracted, the rod of the latch cylinder is not subject to damage from rocks and sharp objects. Normally, the only time the rod is extended, and thereby exposed to the elements and contaminants, is when a tool is being attached or detached from the coupling assembly.

A feature of the invention is that if there is a loss of either electrical or hydraulic power, the latch pin will extend or "insert" automatically. If electrical power inadvertently gets to the solenoid valves, the tool has to be fully rolled forward and inward in order for the pressure to build up in the latch cylinder to retract the latch pin. In this position, the coupler hooks are fully engaged and the likelihood of the tool falling off is minimized. One cannot simply throw the switch and have the tool fall to the ground.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a perspective view of dipperstick with an attached coupling assembly, and a conventional bucket that can be attached to the coupling assembly.

FIG. **2** is a side view of a hydraulic coupling assembly shown coupling a conventional bucket to a dipperstick.

FIG. **3** is a top plan view of a coupling assembly, partially showing a bucket, with the latch pin in an unlatched, retracted position. FIG. **3**A is a similar view, partially broken away, showing the latch pin in a latched, extended position.

FIG. **4** is a section view through line **4**—**4** of FIG. **3**. FIG. **4**A is a similar section view through line **4**A—**4**A of FIG. **3**A.

FIG. **5** is a partial section view through line **5**—**5** of FIG. **3**. FIG. **5**A is a similar partial section view through line **5**A—**5**A of FIG. **3**A.

FIG. **6** is a schematic diagram of a hydraulic system and an electrical system according to the invention. FIGS. **6**A, **6**B and **6**C illustrate other embodiments of a valve assembly.

In the following detailed description of the invention, similar structures that are illustrated in different figures will be referred to with the same reference numerals.

It will also be noted that the figures are generally not drawn to scale.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIGS. **1** and **2**, a hydraulic coupler assembly **10** according to the invention is attached to a conventional dipperstick or arm **12**. Only a free end of dipperstick **12** is illustrated in FIGS. **1** and **2**. The other end of dipperstick **12** is pivotally coupled, typically via an intermediate articulation (not shown), to a base (not shown) that includes a hydraulic power system, and hydraulic and electric operator controls located in a cab. Coupler assembly **10** can be used for coupling the dipperstick **12** to any of a variety of tools, such as, for example, a conventional bucket **14**.

Dipperstick **12** linkage includes a bucket guide link **16** pivotally attached to the dipperstick **12**, a bucket cylinder **18** for actuating the coupling assembly **10** and the bucket **14**, and a bucket link **20**. Extending bucket cylinder **18** rotates coupling assembly **10**, and any tool attached to coupling assembly **10**, inwardly in a forward direction.

Referring now also to FIGS. **3**–**5**, coupling assembly **10** includes a frame **24** forming a central space **22**. Frame **24** includes side walls **26**, a bottom plate **28**, a coupler spreader plate **30** and a rear face plate **32**. Depending from side walls **26** are a pair of forward extending hooks **34** that are adapted to fit through an opening or recess **36** formed in a back sheet **38** of bucket **14** (see FIG. **1**). The hooks **34** can then engage a cross tube **40** to support a forward end of bucket **14**.

Coupling assembly **10** has a pair of dipper pivot fixtures **42**, located near a forward end of side walls **26** for coupling to dipperstick **12**. A pair of link pivot fixtures **44** for coupling to bucket link **20** are located closer to the rear end of the frame **26**. A pair of link pivot fixtures **46** are also provided at an alternate location.

Bucket **14** is adapted to be coupled to dipperstick **12** with coupling assembly **10**. As noted above, a recess **36** is formed in back sheet **38** of the bucket for receiving hooks **34**. Once cross tube **40** is engaged by hooks **34**, the bucket can be lifted off the ground by raising the dipperstick **12**. This connection provides a first point of connection between coupling assembly **10** and bucket **14**. To enable the bucket **14** to rotate by operation of the bucket hydraulic cylinder **18**, a receptacle **50** formed in a latch collar **51** fixed to a plate **52** on the rear end of bucket **14** engages one end of a movable latch pin **48**.

Latch pin **48** slides within the bore of a bushing **60** welded to rear face plate **32** within frame **24**. On the other side of plate **32** there is an approximately semicircular-shaped coupler crescent **61** that fits over the top of latch collar **51** when bucket **14** is attached to coupling assembly **10**.

The latch pin **48** is part of an actuator assembly **54** that also includes a coil spring **56**, or other type of compression spring, for pushing the latch pin **48** through bushing **60** into engagement with the receptacle **50**, and a single-action latch pin hydraulic cylinder **58** that acts opposite the spring **56** to disengage the latch pin **48** from the receptacle **50**. Spring **56** is positioned approximately in line with latch pin **48**, and latch cylinder **58** is positioned on a parallel axis along side latch pin **48** and spring **56**. This arrangement allows the cylinder **58** to "push" the pin **48** out to retract. The spring **56** urges the pin **48** toward an engaged position with receptacle **50** when hydraulic pressure in the latch cylinder **58** is insufficient to overcome the spring force of spring **56**. The latch pin **48** is normally in the engaged position because latch cylinder **58** is normally not pressurized.

Coil spring **56** is kept in position by a latch spring assembly that forms part of actuator assembly **54**. One end of coil spring **56** bears against a pin block **62** that is welded to latch pin **48**. Pin block **62** includes an annular groove to receive coil spring **56**. The other end of coil spring **56**, towards the front of coupler **10**, bears against a winged end plate **64** and thereby holds the winged end plate **64** within the "V" formed by coupler spreader plate **30**. A spring guide rod **66** is positioned within the coils of spring **56**. Spring guide rod **66** extends transversely through a hole formed in end plate **64** and is welded thereto. A forward end of spring guide rod **66** includes a notch **68** that is positioned against an angled top edge **69** of coupler spreader plate **30** and held in place by the spring force from spring **56**. The other end of spring guide rod **66** acts as a stop for latch pin **48** in the retracted position (see FIG. **4**).

The body **70** of latch cylinder **58** is fixed to pin block **62**. In the embodiment illustrated in FIGS. **3–5**, body **70** has screw threads formed on its outer surface and screws into mating threads formed in a through hole in pin block **62**, and is held in place by a set screw **71**. The cylinder's extensible rod, or piston **72**, extends through the hole in pin block **62**. When hydraulic pressure coupled into cylinder **58** through hydraulic fitting **73** is increased, cylinder **58** extends and the free end of piston **72** bears against push plate **74**, which is welded to bushing **60**.

Extension of cylinder **58** with sufficient force to overcome spring's **56** spring force thereby urges latch pin **48** to a retracted position since latch pin **48** is welded to pin block **62** and pin block **62** is fixed to cylinder body **70**. Release of pressure in cylinder **58** allows spring **56** to extend, urging pin block **62**, and thereby latch-pin **48**, toward a latched position wherein the latch pin **48** projects beyond rear face plate **32**.

Pin block **62** includes a cylindrical opening **76** that receives spring guide rod **66** when latch pin **48** is retracted by actuation of cylinder **58** (see FIG. **3**). As mentioned above, spring guide rod **66** stops latch pin **48** from retracting beyond a predetermined point. When latch pin **48** is fully retracted, the end of spring guide rod **66** is inside the cylindrical opening **76** in pin block **62** and projects beyond the corresponding end of spring **56**. In this position, a transverse assembly hole **78** formed in the end of spring guide rod **66** is aligned with a U-shaped slot **80** formed in pin block **66**. An assembly pin (not shown) can be placed in assembly hole **78**. When pressure in cylinder **58** is released, latch pin **48** can be manually moved to the latched position, thereby releasing spring guide rod **66** from cylindrical opening **76** in pin block **62**. Assembly pin in hole **78** keeps spring **56** compressed on spring guide rod **66**. With pin block **62** out of the way, the assembled latch spring assembly, comprised of spring guide rod **66**, spring **56**, and winged end plate **64**, can be removed as a unit from coupler **10**. The latch spring assembly can be installed in coupler **10** by a reverse procedure.

Coupler **10** is structured to allow an operator in the control cab of the construction equipment to visibly assess whether the latch pin **48** is in the latched or retracted position, even when a tool is attached to coupler **10**. Back sheet **38** of bucket **14** extends forward only to the attachment point of hooks **34**, which leaves the forward portion of bucket **14** open between back sheet **38** and cross tube **40**. Bottom plate **28** of frame **24** forms a U-shaped indicator slot **82** positioned between hooks **34**. Indicator slot **82** is positioned such that pin block **62** is visible through the opening in bucket **14** and through indicator slot **82** when latch pin **48** is in the retracted position. When latch pin **48** is in the latched position, the operator's line of sight to pin block **62** is blocked by back sheet **38**. Pin block **62** can be made more noticeable by painting it a bright color.

Referring now also to FIG. **6**, a hydraulic circuit **86** for operating latch cylinder **58** taps into the hydraulics of the excavator. A hydraulic pump **88** and a reservoir **90** are coupled to bucket cylinder **18** via a lever-operated, three-position, two-pole valve **92**. Pump **88**, reservoir **90** and valve **92** are located in the base **93** of the excavator. Hydraulic hoses **94**, **96** connect between valve **92** and the rod end **98** and cylinder end **100** of bucket cylinder, respectively. Hydraulic hose **96** has a T-connection leading to one port of a valve assembly **102**. The T-connection can be conveniently made at the hydraulic fitting for the cylinder side **100** of bucket cylinder **18**. The other port of valve assembly **102** connects via hydraulic hose **104** to fitting **73** in latch cylinder **58**. Valve assembly **102** can be strapped, bolted or otherwise attached to a fixed part of bucket cylinder **18** or to an upper portion of dipperstick **12**.

Valve assembly **102** includes two solenoid actuated valves **108**, **110**, each with a power connection controlled by a locking electrical toggle switch **111** located in the cab of the excavator. In an unlatch switch position the solenoids are energized and in a latch switch position the solenoids are shut off. When the solenoids are not energized (see FIG. **6**), springs **112**, **114** urge valves **108**, **110**, respectively to a position wherein a check valve portion **116** of valve **108** and a through portion **118** of valve **110** are connected in series between lines **96** and **104**. When valves **108**, **110** are energized (not shown), a through portion **120** of valve **108** and a check valve **122** portion of valve **110** are-placed in the circuit.

Check valve **116** blocks a hydraulic flow from bucket cylinder **18** to latch cylinder **58**, but is set to permit flow in the other direction when there is an over-pressure condition in the latch cylinder **58** relative to the cylinder side **100** of bucket cylinder **18**. Check valve **122**, on the other hand, blocks any back flow from latch cylinder **58** to bucket cylinder **18**, and is set to permit the latch cylinder **58** to be pressurized when the cylinder side **100** of bucket cylinder **18** is fully pressurized. With the cylinder side **100** fully pressurized, bucket cylinder **18** will be fully extended and the coupling assembly **10** will be rotated fully forward.

Referring now to FIG. **6**A, another embodiment of a valve assembly **102'** includes valve **108** in series with check valve **124** between lines **96** and **104**. Check valve **24** prevents back flow from line **104** to **96**. A drain line **126** normally connects between line **104** and reservoir **90** via through portion **128** of solenoid valve **130**. When valves **108** and **130** are energized, drain line **126** is blocked by check valve portion **132** of valve **130**, and through portion **120** is positioned in series connection with check valve **124** between lines **96** and **104**. Check valve **124**, similar to check valve portion **122**, is set to permit pressurization of line **104** and latch cylinder **58** when full hydraulic pressure is applied to extend bucket cylinder **18**.

Referring to FIG. **6**B, in a third embodiment, valve assembly **102"** is configured with solenoid valves **108** and **110**, similar to the arrangement of valve assembly **102**. In addition, a drain line **134** connects between valves **108** and **110**. Flow through drain line **134** to reservoir **90** is limited by an orifice **136** flow limiter.

Referring now to FIG. **6**C, a fourth embodiment of a valve assembly **102'''** includes solenoid valves **138** and **110**. In the normal, non-energized configuration shown in the drawing, cylinder **58** drains to reservoir **90** via through portion **118** of valve **110** and lower through portion **140** of valve **138**. When valves **110**, **138** are energized, pressure line **96** is coupled to cylinder **58** via upper through portion **142** of valve **138** and check valve portion **122** of valve **110**.

Valve assemblies **102'**, **102"** and **102'''** can be safer than valve assembly **102**, especially in high back pressure systems, because of the drain connections to reservoir **90**, however, the drain connections require an additional hydraulic hose.

Referring again to FIG. **6**, indicator lights **148** and an audible indicator **144**, such as a beeper sound device, located in the cab alert the operator that the switch **111** is in the energized, unlatch position. A warning lamp **146** mounted on the dipperstick **12** lights or flashes to help to alert surrounding personnel that the switch **111** is in the unlatch mode and that the latch pin **48** could be retracted. Of course,

audible indicator **144** can be configured to be audible outside the operator cab.

A single operator in the cab of the excavation equipment can detach a tool, such as bucket **14**, to the coupling assembly **10** and attach a new tool to the coupling assembly without any assistance, as described in detail below. Some particulars of the following recitation of steps for coupling and removing a tool are made with reference to the embodiment of valve assembly **102** illustrated in FIG. **6**. It will be understood that the embodiments of valve assemblies **102'**, **102"**, and **102'''** illustrated in FIGS. **6A**, **6B**, and **6C**, respectively, will function in much the same manner, and the operator will make essentially the same sequence of steps to attach or detach a tool.

To decouple a tool from coupling assembly **10**, the latch pin **48** must be moved to the retracted position. The operator first throws switch **111** in the cab to the unlatch position. The indicator lamps **148** and warning lamps **146** then light up, and the audible indicator **144** sounds. The solenoids becomes energized, which moves solenoid valves **108**, **110** in valve assembly **102** to their unlatch position. Check valve **116** is moved out of hydraulic circuit **89** and check valve **122** is moved into hydraulic circuit **89**. This, by itself, is insufficient to retract latch pin **48**. Check valve **122** is set to prevent passage of hydraulic fluid and thus prevent latch cylinder **58** from being pressurized until the pressure on the cylinder side **100** of bucket cylinder **18** is greater than a predetermined value.

In the illustrated embodiments, check valve **122** is set such that the coupling assembly **10** and attached tool **14** must be rotated fully forward and approximately full pressure must be applied in line **96** to bucket cylinder **18** to open check valve **122**. This assures that accidentally throwing switch **111** will not, by itself, be sufficient to retract latch pin **48**.

Once the pressure in latch cylinder **58** is great enough to overcome the spring force of spring **56**, latch cylinder **58** extends and thereby retracts latch pin **48**. The operator can confirm that the latch pin **48** is retracted if he sees the pin block **62** in the retracted position. While the switch **111** is still in the "tunlatch" position, the latch pin **48** will be held back retracted.

Alternatively, to bring the latch pin **48** to the retracted position, the operator can first rotate coupling assembly **10** forward, fully pressurize bucket cylinder **18**, and then throw switch **111** to the unlatch position.

At this point, solenoid valves **108**, **110** are still energized and in the unlatch position, and check valve **122** retains pressure in latch cylinder **58**. The operator can then use free hands to maneuver the vehicle to disengage the hooks **34** from cross member **40** to uncouple the tool.

If the equipment is to remain idle for a period of time, the operator throws toggle switch **111** to the latch position, de-energizing the solenoid valves in valve assembly **102**, and lowers hydraulic pressure in line **96**. This allows pressure to drop in latch cylinder **58** such that spring **56** urges latch pin **48** to the engaged, or latched position, thereby bringing the piston **72** of cylinder **58** to a protected position retracted into cylinder body **70**.

To attach a new tool, with the latch pin **48** still in the retracted position and the valves in the valve assembly **102** still energized, the operator adjusts pressure in the bucket cylinder **18** and maneuvers the coupling assembly **10** to insert hooks **34** into the recess **36** of the new tool and engage cross tube **40**. The operator then lifts the tool off the ground, and rolls coupling assembly **10** forward by extending bucket cylinder **18**. Coupler crescent **61** engages an upper side of latch collar **51**, thus bringing latch pin **48** into alignment with receptacle **50** on bucket **14**. The operator knows that the coupler crescent **61** has engaged latch collar **51** when he sees the bucket **14** visibly begins to roll forward. Less than full pressurization of the bucket cylinder **18** is typically required to bring the coupling assembly to this position.

The operator then throws switch **111** to the latch position. This de-energizes solenoid valves **108**, **110** and moves check valve **122** out of hydraulic circuit **86** and check valve **116** into hydraulic circuit **86**. Check valve **116** is set to open at a low differential pressure, such that hydraulic pressure will be released from the latch cylinder **58** when the back pressure in bucket cylinder **18** is much less than full pressure but great enough to rotate coupling assembly forward so that the coupling crescent engages the tool latch collar **50**.

When the hydraulic pressure in latch cylinder **58** is released, spring **56** moves latch pin **48** into the engaged position with receptacle **50**. The position of pin block **62** gives the operator a visible signal that the pin **48** is latched and the tool secured. Check valve **116** thereafter prevents the latch pin assembly from being inadvertently pressurized.

Other embodiments of the invention are within the scope of the following claims.

What is claimed is:

1. An assembly for urging a latch member of tool coupler into and out of engagement with a tool that is detachable from the tool coupler, comprising:

a hydraulic motor on the tool coupler, the hydraulic motor having a stationary part and a movable part that extends from the stationary part when hydraulic pressure is applied to one end of the hydraulic motor;

a latch coupling assembly coupling between a latch member and the movable part of the hydraulic motor, structured and arranged to urge the latch member to a disengaged position when the movable part is extended;

a valve assembly operably coupled to the one end of the hydraulic motor, including a first position operably coupling the one end of the hydraulic motor to a fluid drain line to allow fluid to flow through the fluid drain line to a drain from the hydraulic motor while preventing fluid flow toward the hydraulic motor, whereby the one end of the hydraulic motor can be depressurized with the valve assembly in the first position, and a second position operably coupling the one end of the hydraulic motor to a fluid pressure line so as to allow fluid flow only in a direction from the valve assembly toward the hydraulic motor, whereby the hydraulic motor can be pressurized by applying hydraulic pressure to the fluid pressure line with the valve assembly in the second position; and

a valve control operating the valve assembly into one or the other of the first and second positions.

2. The assembly of claim **1**, wherein the valve assembly comprises:

a first movable valve being structured and arranged to prevent fluid flow from the fluid pressure line to the one end of the hydraulic motor when the valve assembly is in the first position and to allow fluid flow from the fluid pressure line to the hydraulic motor when the valve assembly is in the second position; and

a second movable valve being positioned in the fluid drain line so as to allow fluid flow away from the hydraulic motor through the fluid drain line when the valve assembly is in the first position and to prevent fluid flow

away from the hydraulic motor through the fluid drain line when the valve assembly is in the second position.

3. The assembly of claim **2**, wherein the valve assembly further comprises a non-return valve being positioned in the fluid pressure line in series with the first movable valve so as to permit fluid flow therethrough only in a direction toward the hydraulic motor.

4. The assembly of claim **3**, wherein the non-return valve is positioned in the fluid pressure line between the one end of the hydraulic motor and the first movable valve.

5. The assembly of claim **3**, wherein the non-return valve is fixed in position in the fluid pressure line.

6. The assembly of claim **1**, wherein:

the coupling between the valve assembly and the one end of the hydraulic motor comprises a single fluid line;

the valve assembly comprises a movable first valve connecting to the single fluid line and a movable second valve connecting between the first valve and the fluid pressure line and the fluid drain line;

the second valve couples the first valve to the fluid drain line and the first valve couples the second valve to the single fluid line when the valve assembly is in the first position, allowing fluid to flow in both directions through the single fluid line between the one end of the hydraulic motor and the fluid drain line; and

the second valve couples the first valve to the fluid pressure line and the first valve couples the second valve to the signal fluid line through a non-return valve portion when the valve assembly is in the first position, the non-return valve portion allowing fluid to flow through the single fluid line only in a direction from the fluid pressure line toward the hydraulic motor.

7. The assembly of claim **1**, wherein a spring is arranged to urge the latch member toward an engaged position, the hydraulic motor acting in opposition to the spring when extending the movable part.

8. The assembly of claim **1**, wherein the latch member comprises a latch pin, the latch pin being retracted in the tool coupler in the disengaged position and extending from the tool coupler in an engaged position.

9. The assembly of claim **1**, wherein the valve assembly comprises solenoid actuated valves that are de-energized in the first position and energized in the second position.

10. The assembly of claim **1**, further comprising the tool coupler, the tool coupler comprising:

a coupler body relative to which the stationary part of the hydraulic motor is stationary; and

the latch member being movable between an engaged position for engaging the tool, and a disengaged position for disengaging from the tool.

11. The assembly of claim **1**, wherein the latch member comprises a latch pin, the latch pin being retracted in the tool coupler in the disengaged position and extending from the tool coupler in an engaged position.

12. The coupling assembly of claim **11**, wherein the hydraulic motor is positioned on an axis different from an axis defined by the latch pin.

13. A quick-release coupling assembly for connecting a tool to an earth-working or construction equipment, comprising:

a coupler body, including link structure for pivotally coupling to an arm of the earth-working or construction equipment;

a latch member movable between an engaged position for engaging the tool, and a disengaged position for disengaging from the tool;

a spring structured and arranged to provide a spring force that urges the latch member to the engaged position;

a hydraulic motor having a stationary part relative to the coupler body and a movable part that can be extended relative to the stationary part when hydraulic pressure is applied to one end of the hydraulic motor, the movable part being coupled to the latch member such that extension of the movable part urges the latch member to the disengaged position in opposition to the spring force; and

a valve assembly operably coupled to the one end of the hydraulic motor, including a first position operably coupling the one end of the hydraulic motor to a fluid drain line to allow fluid to flow through the fluid drain line to a drain from the hydraulic motor while preventing fluid flow toward the hydraulic motor, whereby the one end of the hydraulic motor can be depressurized with the valve assembly in the first position, and a second position operably coupling the one end of the hydraulic motor to a fluid pressure line so as to allow fluid flow only in a direction from the valve assembly toward the hydraulic motor, whereby the hydraulic motor can be pressurized by applying hydraulic pressure to the fluid pressure line with the valve assembly in the second position; and

a valve control operating the valve assembly into one or the other of the first and second positions.

14. The coupling assembly of claim **13**, the valve assembly comprising solenoid actuated valves, the valve control being structured and arranged to energize the solenoid actuated valves to move the valve assembly from the first position to the second position, and to de-energize the solenoid actuated valves to return the valve assembly to the first position.

15. The coupling assembly of claim **13**, wherein the valve assembly comprises:

a first movable valve being structured and arranged to prevent fluid flow from the fluid pressure line to the one end of the hydraulic motor when the valve assembly is in the first position and to allow fluid flow from the fluid pressure line to the hydraulic motor when the valve assembly is in a second position; and

a second movable valve being positioned in the fluid drain line so as to allow fluid flow away from the hydraulic motor through the fluid drain line when the valve assembly is in the first position and to prevent fluid flow away from the hydraulic motor through the fluid drain line when the valve assembly is in the second position.

16. The coupling assembly of claim **15**, wherein the valve assembly further comprises a non-return valve being positioned in the fluid pressure line in series with the first movable valve so as to permit fluid flow therethrough only in a direction toward the hydraulic motor.

17. The coupling assembly of claim **16**, wherein the non-return valve is fixed in position in the fluid pressure line.

18. The coupling assembly of claim **13**, wherein:

the coupling between the valve assembly and the one end of the hydraulic motor comprises a single fluid line;

the valve assembly comprises a movable first valve connecting to the single fluid line and a movable second valve connecting between the first valve and the fluid pressure line and the fluid drain line;

the second valve couples the first valve to the fluid drain line and the first valve couples the second valve to the single fluid line when the valve assembly is in the first position, allowing fluid to flow in both directions

through the single fluid line between the one end of the hydraulic motor and the fluid drain line; and

the second valve couples the first valve to the fluid pressure line and the first valve couples the second valve to the single fluid line through a non-return valve portion when the valve assembly is in the first position, the non-return valve portion allowing fluid to flow through the single fluid line only in a direction from the fluid pressure line toward the hydraulic motor.

19. An earth-working or construction equipment adapted for the rapid connection and disconnection of a tool, the equipment comprising:

a coupler adapted for engaging the tool, including a coupler body, a latch member movable between an engaged position for engaging the tool and a disengaged position for disengaging from the tool, a spring structured and arranged to provide a spring force that urges the latch member to the engaged position, and a first hydraulic motor having a stationary part that is stationary relative to the coupler body and a movable part that can be extended relative to the stationary part when hydraulic pressure is applied to one end of the first hydraulic motor, the movable part being coupled to the latch member such that extension of the movable part urges the latch member to the disengaged position in opposition to the spring force;

a linkage adapted for engaging the coupler body;

a valve assembly operably coupled to the one end of the hydraulic motor, including a first position operably coupling the one end of the hydraulic motor to a fluid drain line to allow fluid to flow through the fluid drain line to a drain from the hydraulic motor while preventing fluid flow toward the hydraulic motor, whereby the one end of the hydraulic motor can be depressurized with the valve assembly in the first position, and a second position operably coupling the one end of the hydraulic motor to a fluid pressure line so as to allow fluid flow only in a direction from the valve assembly toward the hydraulic motor, whereby the hydraulic motor can be pressurized by applying hydraulic pressure to the fluid pressure line with the valve assembly in the second position; and

a valve control operating the valve assembly into one or the other of the first and second positions.

20. The equipment of claim **19**, wherein the valve assembly comprises:

a first movable valve being structured and arranged to prevent fluid flow from the fluid pressure line to the one end of the hydraulic motor when the valve assembly is in the first position and to allow fluid flow from the fluid pressure line to the hydraulic motor when the valve assembly is in a second position; and

a second movable valve being positioned in the fluid drain line so as to allow fluid flow away from the hydraulic motor through the fluid drain line when the valve assembly is in the first position and to prevent fluid flow away from the hydraulic motor through the fluid drain line when the valve assembly is in the second position.

21. The equipment of claim **20**, wherein the valve assembly further comprises a non-return valve bieng positioned in the fluid pressure line in series with the first movable valve so as to permit fluid flow therethrough only in a direction toward the hydraulic motor.

22. The equipment of claim **21**, wherein the non-return valve is fixed in position in the fluid pressure line.

23. The equipment of claim **19**, wherein:

the coupling between the valve assembly and the one end of the hydraulic motor comprises a single fluid line;

the valve assembly comprises a movable first valve connecting to the single fluid line and a movable second valve connecting between the first valve and the fluid pressure line and the fluid drain line;

the second valve couples the first valve to the fluid drain line and the first valve couples the second valve to the single fluid line when the valve assembly is in the first position, allowing fluid to flow in both directions through the single fluid line between the one end of the hydraulic motor and the fluid drain line; and

the second valve couples the first valve to the fluid pressure line and the first valve couples the second valve to the single fluid line through a non-return valve portion when the valve assembly is in the first position, the non-return valve portion allowing fluid to flow through the single fluid line only in a direction from the fluid pressure line toward the hydraulic motor.

24. The equipment of claim **19**, wherein the latch member comprises a latch pin, the latch pin being extracted in the tool coupler in the disengaged position and extending from the tool coupler in the engaged position.

25. The equipment of claim **19**, wherein the linkage includes a pivot axis and a second hydraulic motor, an end of the second hydraulic motor being coupled to the coupler body to rotate the coupler body around the pivot axis, and wherein the fluid pressure line is operably coupled to one end of the second hydraulic motor to provide hydraulic pressure to the one end of the first hydraulic motor when pressure is applied to the one end of the second hydraulic motor and the valve assembly is in the second position.

26. An assembly for urging a latch member of a tool coupler into an extended position for securing a tool to the coupler and into a retracted position for releasing the tool from the coupler, the tool being detachable from the tool coupler, the assembly comprising:

a hydraulic motor on the coupler, the hydraulic motor having a stationary part and a movable part that extends from the stationary part when hydraulic pressure is applied to one end of the hydraulic motor;

a latch coupling assembly coupling between a latch member and the movable part of the hydraulic motor, structured and arranged to urge the latch member to a retracted position when the movable part is extended;

a valve assembly operably coupled to the one end of the hydraulic motor, including a first position operably coupling the one end of the hydraulic motor to a fluid drain line to allow fluid to flow through the fluid drain line to a drain from the hydraulic motor while preventing fluid flow toward the hydraulic motor, whereby the one end of the hydraulic motor can be depressurized with the valve assembly in the first position, and a second position operably coupling the one end of the hydraulic motor to a fluid pressure line so as to allow fluid flow only in a direction from the valve assembly toward the hydraulic motor, whereby the hydraulic motor can be pressurized by applying hydraulic pressure to the fluid pressure line with the valve assembly in the second position; and

a valve control operating the valve assembly into one or the other of the first and second positions.

27. The assembly of claim 26, wherein the valve assembly comprises:

a first movable valve being structured and arranged to prevent fluid flow from the fluid pressure line to the one

end of the hydraulic motor when the valve assembly is in the first position and to allow fluid flow from the fluid pressure line to the hydraulic motor when the valve assembly is in a second position; and

a second movable valve being positioned in the fluid drain line so as to allow fluid flow away from the hydraulic motor through the drain line when the valve assembly is in the first position and to prevent fluid flow away from the hydraulic motor through the drain line when the valve assembly is in the second position.

28. The assembly of claim 27, wherein the valve assembly further comprises a non-return valve being positioned in the fluid pressure line in series with the first movable valve so as to permit fluid flow therethrough only in a direction toward the hydraulic motor.

29. The assembly of claim 28, wherein the non-return valve is positioned in the fluid pressure line between the one end of the hydraulic motor and the first movable valve.

30. The assembly of claim 28, wherein the non-return valve is fixed in position in the fluid pressure line.

31. The assembly of claim 26, wherein:

the coupling between the valve assembly and the one end of the hydraulic motor comprises a single fluid line;

the valve assembly comprises a movable first valve connecting to the single fluid line and a movable second valve connecting between the first valve and the fluid pressure line and the fluid drain line;

the second valve couples the first valve to the drain line and the first valve couples the second valve to the single fluid line when the valve assembly is in the first position, allowing fluid to flow in both directions through the single fluid line between the one end of the hydraulic motor and the fluid drain line; and

the second valve couples the first valve to the fluid pressure line and the first valve couples the second valve to the single fluid line through a non-return valve portion when the valve assembly is in the first position, the non-return valve portion allowing fluid to flow through the single fluid line only in a direction from the fluid pressure line toward the hydraulic motor.

32. The assembly of claim 26, wherein a spring is arranged to urge the latch member toward an extended position, the hydraulic motor acting in opposition to the spring when extending the movable part.

33. The assembly of claim 26, wherein the latch member comprises a pin.

34. The assembly of claim 26, wherein the valve assembly comprises solenoid actuated valves that are de-energized in the first position and energized in the second position.

35. The assembly of claim 26, further comprising the tool coupler, the tool coupler comprising:

a coupler body relative to which the stationary part of the hydraulic motor is stationary; and

the latch member being movable between an extended position for securing the tool, and a retracted position for releasing the tool.

36. A quick-release coupling assembly for connecting a tool to an earth-working or construction equipment, comprising:

a coupler body, including link structure for pivotally coupling to an arm of the earth-working or construction equipment;

a latch member movable between an extended position for securing the tool, and a retracted position for releasing the tool;

a spring structured and arranged to provide a spring force that urges the latch member to the extended position;

a hydraulic motor having a stationary part relative to the coupler body and a movable part that can be extended relative to the stationary part when hydraulic pressure is applied to one end of the hydraulic motor, the movable part being coupled to the latch member such that extension of the movable part urges the latch member to the retracted position in opposition to the spring force; and

a valve assembly operably coupled to the one end of the hydraulic motor, including a first position operably coupling the one end of the hydraulic motor to a fluid drain line to allow fluid to flow through the fluid drain line to a drain from the hydraulic motor while preventing fluid flow toward the hydraulic motor, whereby the one end of the hydraulic motor can be depressurized with the valve assembly in the first position, and a second position operably coupling the one end of the hydraulic motor to a fluid pressure line so as to allow fluid flow only in a direction from the valve assembly toward the hydraulic motor, whereby the hydraulic motor can be pressurized by applying hydraulic pressure to the fluid pressure line with the valve assembly in the second position; and

a valve control operating the valve assembly into one or the other of the first and second positions.

37. The coupling assembly of claim 36, the valve assembly comprising solenoid actuated valves, the valve control being structured and arranged to energize the solenoid actuated valves to move the valve assembly from the first position to the second position, and to de-energize the solenoid actuated valves to return the valve assembly to the first position.

38. The coupling assembly of claim 36, wherein the valve assembly comprises:

a first movable valve being structured and arranged to prevent fluid flow from the fluid pressure line to the one end of the hydraulic motor when the valve assembly is in the first position and to allow fluid flow from the fluid pressure line to the hydraulic motor when the valve assembly is in a second position; and

a second movable valve being positioned in the fluid drain line so as to allow fluid flow away from the hydraulic motor through the drain line when the valve assembly is in the first position and to prevent fluid flow away from the hydraulic motor through the drain line when the valve assembly is in the second position.

39. The coupling assembly of claim 38, wherein the valve assembly further comprises a non-return valve being positioned in the fluid pressure line in series with the first movable valve so as to permit fluid flow therethrough only in a direction toward the hydraulic motor.

40. The coupling assembly of claim 39, wherein the non-return valve is fixed in position in the fluid pressure line.

41. The coupling assembly of claim 36, wherein:

the coupling between the valve assembly and the one end of the hydraulic motor comprises a single fluid line;

the valve assembly comprises a movable first valve connecting to the single fluid line and a movable second valve connecting between the first valve and the fluid pressure line and the fluid drain line;

the second valve couples the first valve to the drain line and the first valve couples the second valve to the single fluid line when the valve assembly is in the first position, allowing fluid to flow in both directions through the single fluid line between the one end of the hydraulic motor and the fluid drain line; and

the second valve couples the first valve to the fluid pressure line and the first valve couples the second

valve to the single fluid line through a non-return valve portion when the valve assembly is in the first position, the non-return valve portion allowing fluid to flow through the single fluid line only in a direction from the fluid pressure line toward the hydraulic motor.

42. The assembly of claim 36, wherein the latch member comprises a pin.

43. The coupling assembly of claim 42, wherein the hydraulic motor is positioned on an axis different form an axis defined by the latch pin.

44. An earth-working equipment or the like adapted for the rapid connection and disconnection of a tool, the equipment comprising:

a coupler adapted for engaging the tool, including a coupler body, a latch member movable between an extended position for securing the tool to the coupler and a retracted position for releasing the tool, a spring structured and arranged to provide a spring force that urges the latch member to the extended position, and a first hydraulic motor having a stationary part relative to the coupler body and a movable part that can be extended relative to the stationary part when hydraulic pressure is applied to one end of the first hydraulic motor, the movable part being coupled to the latch member such that extension of the movable part urges the latch member to the retracted position in opposition to the spring force;

a linkage adapted for engaging the coupler body;

a valve assembly operably coupled to the one end of the hydraulic motor, including a first position operably coupling the one end of the hydraulic motor to a fluid drain line to allow fluid to flow through the fluid drain line to a drain from the hydraulic motor while preventing fluid flow toward the hydraulic motor, whereby the one end of the hydraulic motor can be depressurized with the valve assembly in the first position, and a second position operably coupling the one end of the hydraulic motor to a fluid pressure line so as to allow fluid flow only in a direction from the valve assembly toward the hydraulic motor, whereby the hydraulic motor can be pressurized by applying hydraulic pressure to the fluid pressure line with the valve assembly in the second position; and

a valve control operating the valve assembly into one or the other of the first and second positions.

45. The equipment of claim 44, wherein the valve assembly comprises:

a first movable valve being structured and arranged to prevent fluid flow from the fluid pressure line to the one end of the hydraulic motor when the valve assembly is in the first position and to allow fluid flow from the fluid pressure line to the hydraulic motor when the valve assembly is in a second position; and

a second movable valve being positioned in the fluid drain line so as to allow fluid flow away from the hydraulic motor through the drain line when the valve assembly is in the first position and to prevent fluid flow away from the hydraulic motor through the drain line when the valve assembly is in the second position.

46. The equipment of claim 45, wherein the valve assembly further comprises a non-return valve being positioned in the fluid pressure line in series with the first movable valve so as to permit fluid flow therethrough only in a direction toward the hydraulic motor.

47. The equipment of claim 46, wherein the non-return valve is fixed in position in the fluid pressure line.

48. The equipment of claim 44, wherein:

the coupling between the valve assembly and the one end of the hydraulic motor comprises a single fluid line;

the valve assembly comprises a movable first valve connecting to the single fluid line and a movable second valve connecting between the first valve and the fluid pressure line and the fluid drain line;

the second valve couples the first valve to the drain line and the first valve couples the second valve to the single fluid line when the valve assembly is in the first position, allowing fluid to flow in both directions through the single fluid line between the one end of the hydraulic motor and the fluid drain line; and

the second valve couples the first valve to the fluid pressure line and the first valve couples the second valve to the single fluid line through a non-return valve portion when the valve assembly is in the first position, the non-return valve portion allowing fluid to flow through the single fluid line only in a direction from the fluid pressure line toward the hydraulic motor.

49. The equipment of claim 44, wherein the latch member comprises a pin.

50. The equipment of claim 44, wherein the linkage includes a pivot axis and a second hydraulic motor, an end of the second hydraulic motor being coupled to the coupler body to rotate the coupler body around the pivot axis, and wherein the fluid pressure line is operably coupled to one end of the second hydraulic motor to provide hydraulic pressure to the one end of the first hydraulic motor when pressure is applied to the one end of the second hydraulic motor and the valve assembly is in the second position.

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