United States Patent

Hallman et al.

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[54] BUCKET LOADER CONTROL SYSTEM

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[52] **U.S. Cl.** **214/762**

[51] **Int. Cl.** **B66f 9/00**

[58] **Field of Search** 214/138, 762, 771

[56] **References Cited**

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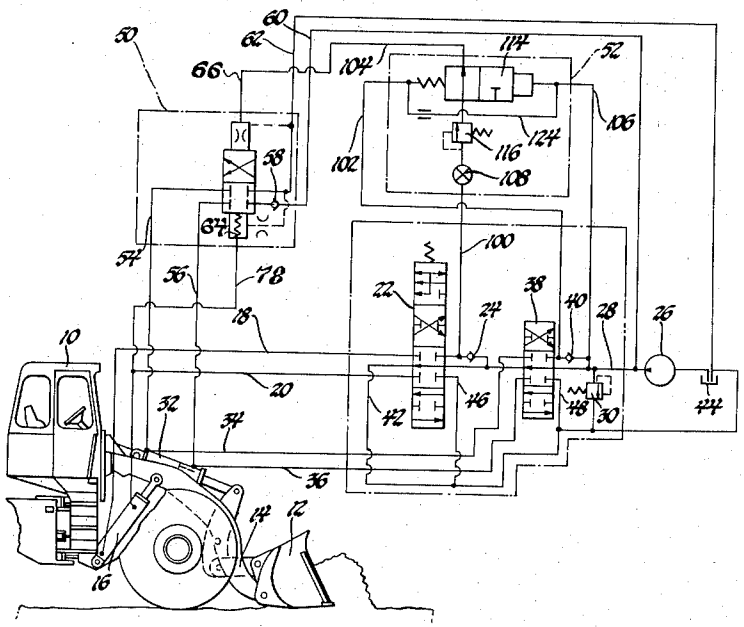
[57] **ABSTRACT**

A material handling bucket loader with hydraulic boom lifting and bucket curling has an automatic control for bucket curling during the loading operation to assure filling of the bucket. The pressure developed in the boom lift system is utilized to open a normally closed curl valve when the load on the boom reaches a predetermined value which is manually adjustable. Manual override of the automatic curl valve is achieved by sensing the flow which occurs when the manual curl valve is operated and by shifting a shuttle valve in response to such flow.

3 Claims, 4 Drawing Figures



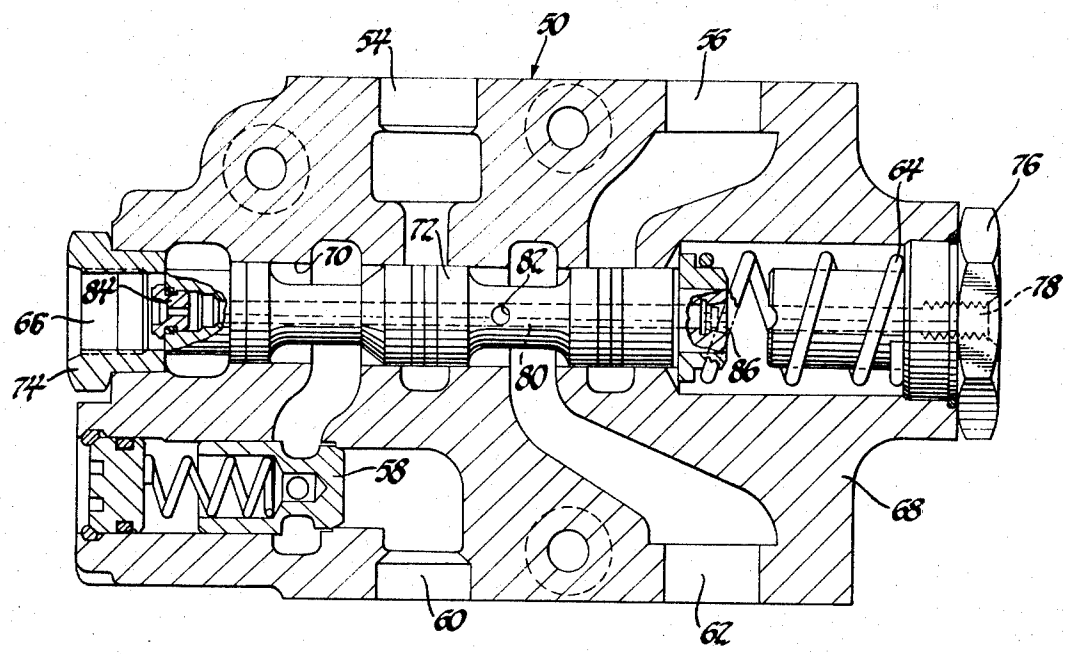


Fig. 1

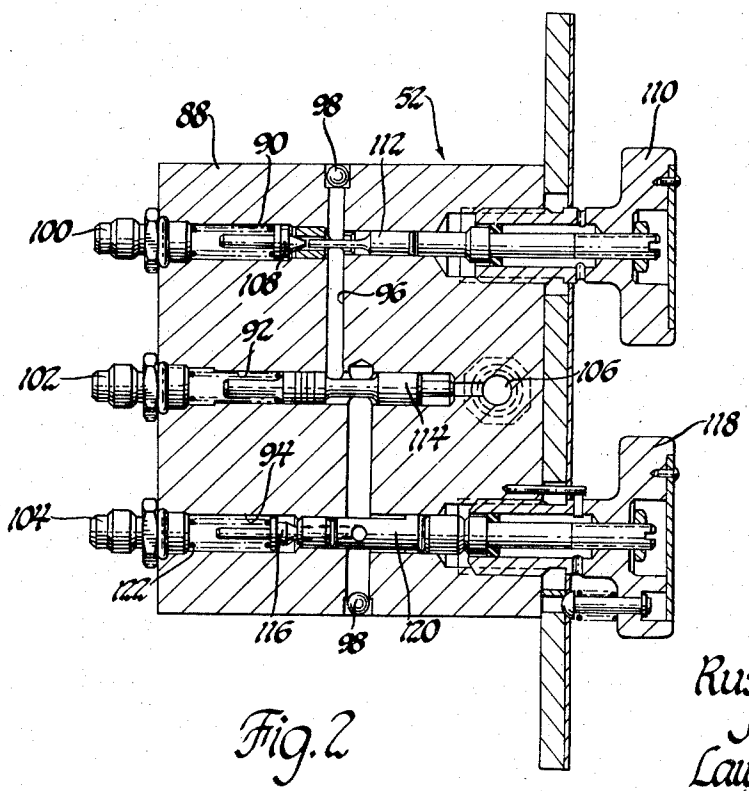


Fig. 2

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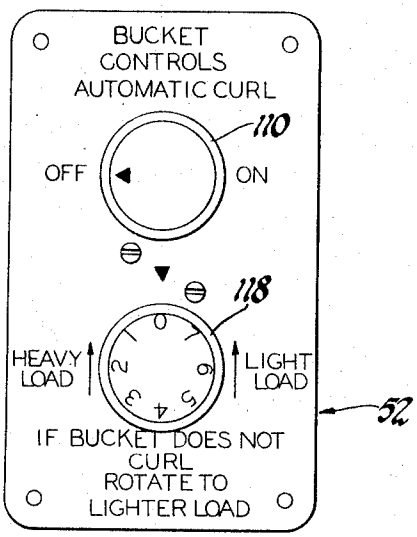

Fig. 3

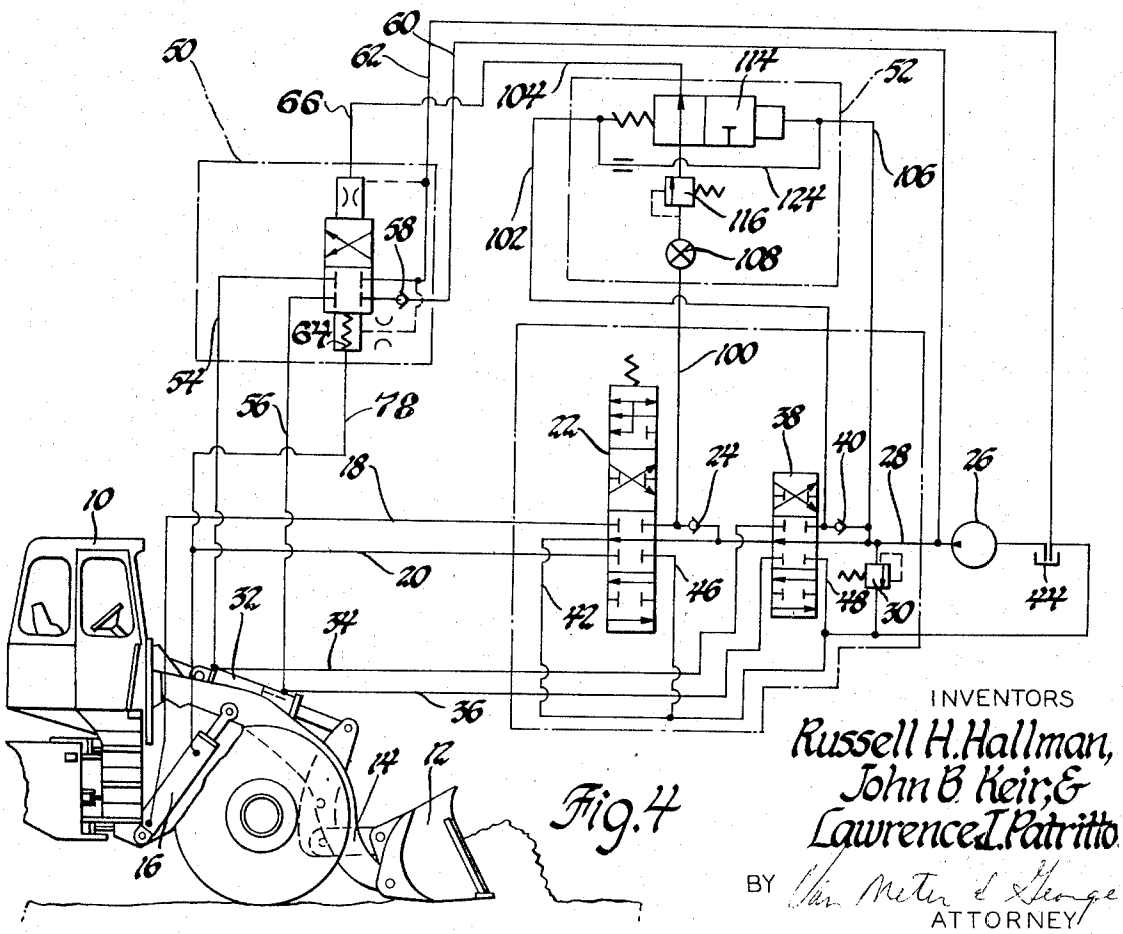

Fig. 4

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BUCKET LOADER CONTROL SYSTEM

The widely used front end loader for picking up bulk material from piles or from banks presents a disadvantage in that inherently the operator is unable to see the bulk material going into the bucket. Loading is accomplished by driving the vehicle with the bucket facing the material and while crowding the pile or bank simultaneously curling the bucket upwardly and lifting the boom which carries the bucket. If the bucket is curled too fast in relation to the lifting operation an insufficient full is obtained, and if it is curled too slowly, the operating time cycle is delayed by the amount of time wasted in crowding a filled bucket against the pile or bank.

The object of the present invention is to provide an automatic bucket curling system which will curl the bucket simultaneously with the lifting of the boom in such a manner that the bucket will automatically start to curl when a predetermined but adjustable force is required to lift the boom.

The invention consists in a hydraulic control system for a bucket loader having a lift-lower valve with a cylinder controlled thereby to lift the bucket, and a curl-dump valve with a cylinder controlled thereby to curl or dump the bucket with the provision therein of an automatic, normally closed, curl valve connected in parallel with the curl-dump valve together with a means which form a pressure responsive actuator for the automatic curl valve and a connection from the lift-lower valve to that actuator for causing the bucket to curl automatically when the load to be lifted reaches a predetermined amount.

IN THE DRAWINGS

FIG. 1 is a cross sectional view of an automatic curl valve incorporated in a preferred form of the present invention.

FIG. 2 is a cross sectional view of a selector valve also incorporated in a preferred form of the present invention.

FIG. 3 is a front view of the selector valve of FIG. 2.

FIG. 4 is a schematic circuit drawing showing a preferred form of the present invention.

The bucket loader or tractor-shovel **10** illustrated in FIG. 4 has the conventional front end bucket **12** mounted on a boom **14**. The conventional hydraulic means for operating the boom and bucket are indicated diagrammatically at the lift-lower cylinder **16** which is manually controlled through lines **18** and **20** by a lift-lower valve **22** with an anti-drop check valve **24** which receives pressure fluid from a pump **26** through the supply line **28** which is monitored by an overload relief valve **30**. The bucket **12** has the usual hydraulic operating system comprising the curl-dump cylinder **32** which is manually controlled through lines **34** and **36** by a curl-dump valve **38** having the anti-drop check valve **40** supplied from the line **28**. The line **28** extends in series through valves **38** and **22** to an unloading return line **42** going back to the reservoir **44** from which the pump **26** withdraws hydraulic fluid and to which the valves **22** and **38** are connected by return lines **46** and **48**.

To these conventional elements of the hydraulic operating system, the present invention adds the automatic curl valve indicated by the dot-dash rectangle **50** and the selector valve indicated by the dot-dash rectangle **52** together with the appropriate connecting lines to the remainder of the system. The automatic curl valve **50** is a normally closed four-way valve which is connected in parallel with curl-dump valve **38** to the cylinder **32** by the lines **54–56**. It has an anti-drop check valve **58**, a supply line **60** connected to the supply line **28** and a return line **62** going to the sump **44**. Valve **50** may be opened against its bias spring **64** by a control pressure delivered through a line **66**.

The valve **50** is illustrated in detail in FIG. 1 where the body **68** has a main bore **70** receiving a sliding spool **72**. Four passages in the body **68** lead to the bore **70** and carry the numbers **54**, **56**, **60** and **62**, they being extensions of the lines correspondingly indicated in FIG. 4. The bore **70** is closed at its ends by bushings **74** and **76** which form the terminals of lines **66** and **78** respectively. Line **78** leads to the lowering end of the cylinder **16** via line **20**. Spool **72** has a through passage **80** which is in communication via a hole **82** with the return line **62** and also communicates with both ends of the bore **70** via restriction plugs **84** and **86**.

FIG. 1 shows the valve **50** in its normally closed position with the spool **72** urged to the left by the biasing spring **64**. The admission of pressure fluid through the line **66** at the left end in sufficient volume to feed the restrictor **84** and in addition overcome the spring bias shifts the spool **72** to the right. This normally happens only during the boom lifting phase as will later be described. However, should it occur at other times when opening of the valve **50** would not be desirable, pressure may be admitted through connection **78** to return spool **72** to its left-hand closed position.

The selector valve **52** is illustrated in FIGS. 2 and 3 wherein the body **88** contains three bores **90**, **92** and **94** which are connected by a staggered passage **96** closed at its ends by ball plugs **98**. The left ends of the bores **90**, **92** and **94** are provided with connections to lines **100**, **102** and **104** respectively, while the right end of bore **92** has a line connection **106** leading from the side of the body **88**. Bore **90** contains a spring loaded poppet **108** which may be manually opened or closed by means of a threaded knob **110** and lift pin **112**. Bore **92** contains a shuttle valve **114** spring biased to the right. When pressure is admitted through line **106**, shuttle valve **114** will shift to the left closing the staggered passage **96**. Bore **94** contains a spring loaded pressure responsive relief valve **116**. Its pressure setting may be varied by means of a threaded knob **118** which adjusts the position of the tubular valve seat **120** and thus varies the compression of the spring **122**.

Referring to FIG. 4, the line **100** which is the inlet line to the selector valve **52** leads from the downstream side of the anti-drop check valve **24** in the lift-lower valve **22**. Line **102** leads from the downstream side of the anti-drop check valve **40** in the curl-dump valve **38**. Line **104**, which is the output line from the selector valve **52**, connects with line **66** of the automatic curl valve **50**. Line **106** connects at the upstream side of check valve **40**. A restricted shunt **124**, not shown in FIG. 2, extends between lines **102** and **106**.

In operation, the driver of the vehicle positions the boom and bucket as shown in FIG. 4 and crowds the same into the pile or bank from which material is to be loaded. As the crowding slows down or ceases completely, valve **22** is operated to lift the boom. The weight of the material in the bucket develops pressure in the line **18** which is transmitted through line **100** to the selector valve **52**. With knob **110** turned to the on position and valve **108** open, and with valve **38** in neutral position, this pressure acts on relief valve **116**. Depending upon the adjustment of valve **116** and the density of the material being loaded, this pressure may open valve **116** and be transmitted through lines **104** and **66** to the left end of valve **50** in FIG. 1, to shift the spool **72** to the right. With the proper setting of the knob **118**, which is readily determined by trial, the opening of valve **50** actuates the cylinder **32** in a direction to curl the bucket and as lifting and crowding continues, the bucket is filled for transport and dump.

Dumping may take place in the usual manner by actuation of valve **38**. The bucket may be also curled under manual control at any time during the lift-load cycle by merely actuating the manual valve **38**. The flow which occurs through anti-drop check valve **40** creates a small pressure drop and this pressure drop is sensed through the lines **102** and **106** at the opposite ends of the shuttle valve **114**. This valve may be located either between the valves **108** and **116** as shown in FIG. 2, or beyond the valve **116** as shown in FIG. 4, and whenever it is actuated the passage between the inlet and outlet of selector valve **52** is closed. If at that time the automatic curl valve **50** is open, then this closure of shuttle valve **114** permits automatic curl valve **50** also to close. Thus, the operator has the continuing ability to override the automatic curl function at will and by the normal means and manner of exercising control of the bucket.

We claim:

1. In a hydraulic control system for a bucket loader having a lift-lower valve with a cylinder controlled thereby to lift and

lower the bucket, and a curl-dump valve with a cylinder controlled thereby to curl or dump the bucket, the improvement comprising an automatic normally closed curl valve connected in parallel with the curl-dump valve, means forming a pressure responsive actuator for the automatic curl valve, a connection from the lift-lower valve to that actuator for causing the bucket to curl automatically when the load to be lifted reaches the predetermined amount and means for disabling the automatic curl valve whenever the curl-dump valve is operated.

2. A system as defined in claim 1 wherein the last named means includes a shuttle valve responsive to flow to the bucket cylinder through the curl-dump valve.

3. A system as defined in claim 2 in which the curl-dump valve includes a check valve for preventing back flow from the bucket cylinder and the shuttle valve is connected to respond to the pressure drop across the check valve.

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