Sept. 8, 1970 D. H. JORDAN 3,526,978

ELEVATOR MOTOR REVERSING VALVE CONTROL SYSTEM

Filed March 1, 1968 2 Sheets-Sheet 1

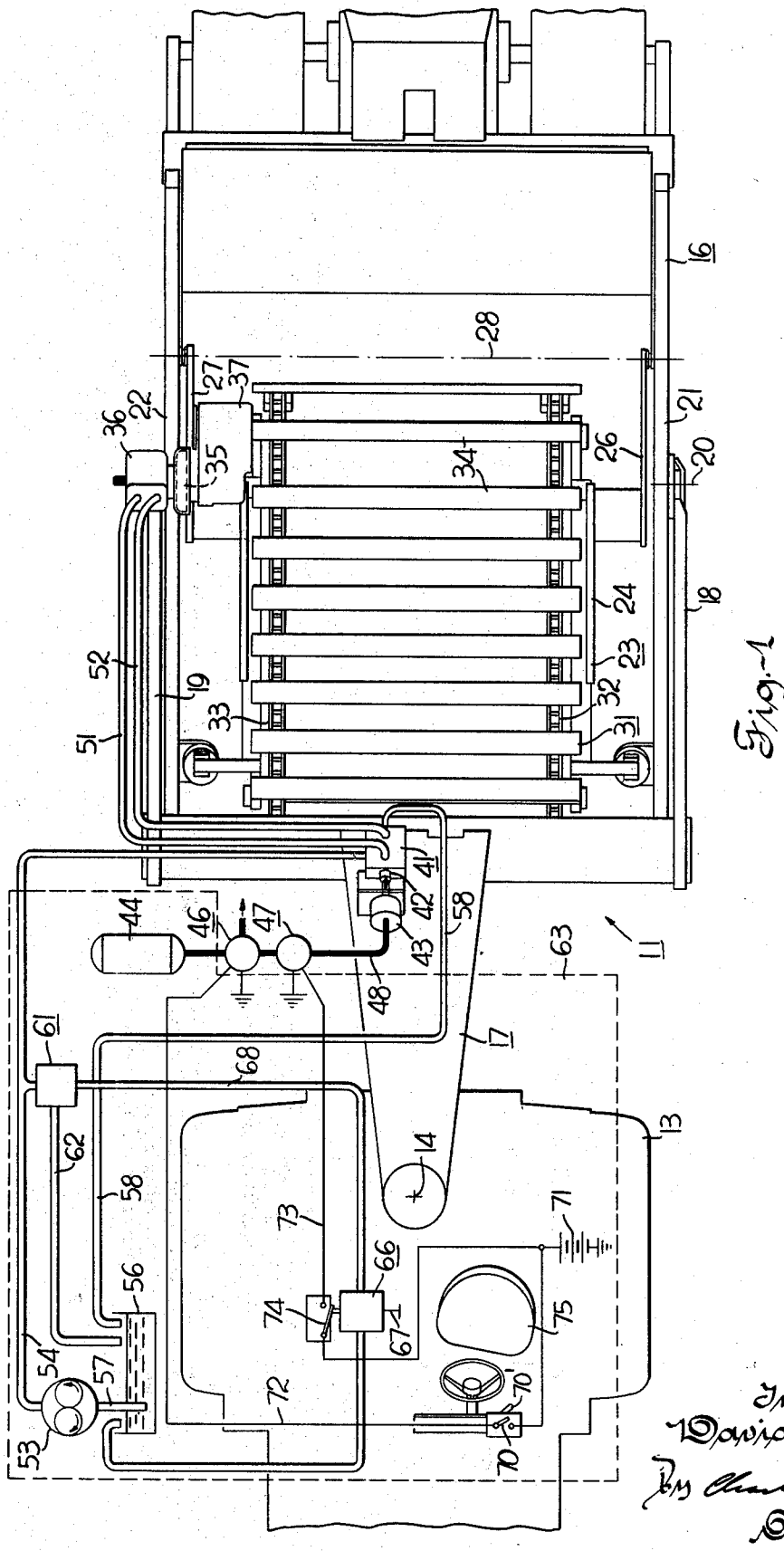


Fig. 1

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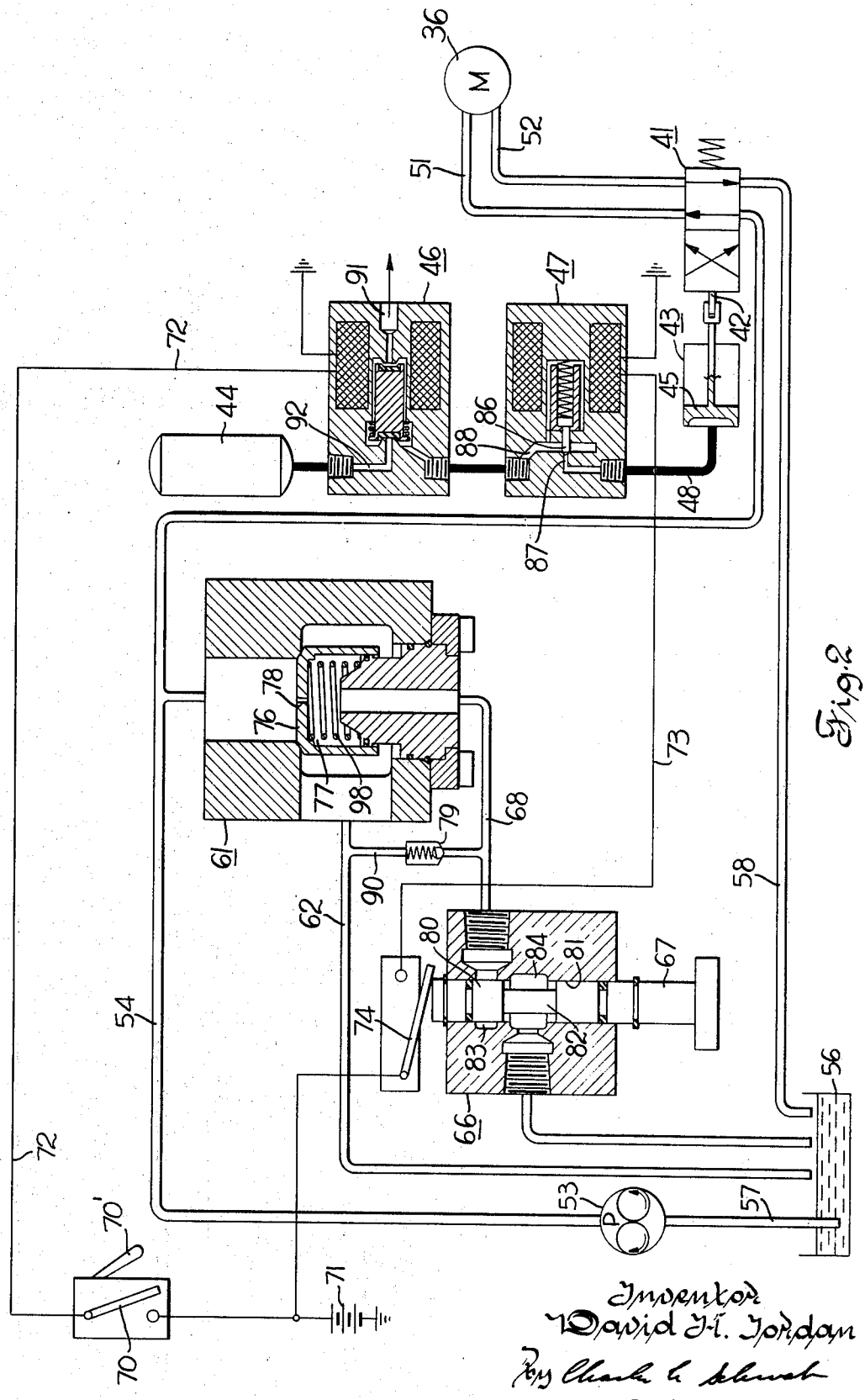


Fig. 2

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ELEVATOR MOTOR REVERSING VALVE CONTROL SYSTEM

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ABSTRACT OF THE DISCLOSURE

A control system for a hydraulic motor driving the elevating mechanism of a motor scraper which avoids excessive pressures when reversing the direction of operation. This is achieved by delaying the delivery of high pressure fluid to the motor for reverse operation thereof for a sufficient time to permit the elevating mechanism to substantially stop movement in its initial direction.

This invention relates to a control system for the hydraulic motor driving and elevating mechanism of an earth mover and more particularly relates to providing means in such control system for delaying the delivery of reverse direction pressure fluid to the hydaulic motor when it is desired to reverse the operation of the elevating mechanism.

Heretofore it has been possible to reverse the delivery of pressure fluid to the hydraulic motor driving the scraper elevating mechanism very quickly and this has resulted in excessive pressures in the hydraulic motor and associated hydraulic system components because the motor and elevating mechanism will continue to operate in the same direction that it was traveling initially due to the inertia of the elevating mechanism and its drive means. Accordingly, the present invention is concerned with the provision of means to permit the elevating mechanism to slow down to a substantial degree before subjecting the hydraulic motor to reverse pressure fluid flow.

It is a further object of this invention to provide means in the hydraulic control system for the hydraulic motor driving the elevating mechanism of an earthmover to prevent delivery of high pressure fluid to the hydraulic motor for a predetermined period of time during the conditioning of the control system from one direction of operation to the other.

It is a further object of this invention to provide a control system of the type hereinbefore outlined wherein a plurality of manual control elements must be operated by the earthmover operator in order to reverse the direction of the elevating mechanism.

It is a further object of this invention to provide means in the elevating mechanism control system which retards shifting movement of the reversing valve from one operating position to another.

These and other objects and advantages of this invention will be apparent to those familiar with the art when the following description is read in conjunction with the drawings in which:

FIG. 1 is a top view of an earthmover in which the present invention is incorporated; and

FIG. 2 is a schematic showing of the control system of the present invention with some parts shown in section.

Referring to FIG. 1, the earthmover **11** includes a two-wheel tractor unit **13** articulatively connected on a vertical steering axis **14** to the draft frame **17** of a two-wheel scraper unit **16**. The draft frame **17** has a pair of rearwardly extending legs **18, 19** pivotally connected on a transverse axis **20** to the side walls **21, 22** of the scraper unit **16**. An elevating mechanism **23** is provided in the forward end of the scraper **16**, the forward end of which is disposed above the cutting edge, not shown. The elevating mechanism **23** includes a frame **24** which extends upwardly and rearwardly and has rearwardly extending arms **26, 27** pivotally connected to side walls **21, 22**, respectively, for vertical swinging movement about a transverse axis **28**. The elevating mechanism **23** also includes a conveyor **31** which includes a pair of chains **32, 33** and a plurality of transverse slats **34** secured to the chains. The endless conveyor **31** is driven by a hydraulic motor **36** through a speed reducer **37** and sprockets, not shown, engaging the chains **32, 33**. A flywheel **35** is provided on the motor output shaft to minimize pressure rises in the motor when the conveyor encounters large objects such as boulders. A control system is provided for the hydraulic motor **36** which includes a delayed action reversing valve **41** having a shiftable flow control member **42** which is operated by an air actuator **43**. Air is supplied from a suitable source such as storage tank **44** to the air actuator **43** through conduit **48** under the control of electrically operated valves in the form of solenoid valves **46, 47**.

A pair of motor conduits **51, 52** interconnect the reversing valve **41** and the hydraulic motor **36**. Pressure fluid is supplied to the reversing valve by a hydraulic pump **53** through supply conduit **54**. The pump **53** draws hydraulic fluid from reservoir **56** through its intake conduit **57** and an exhaust conduit **58** connects the reversing valve **41** to the reservoir **56**.

The reversing valve **41** has only forward and reverse operating positions, and in order to stop operation of the elevating mechanism a dumping valve **61** is provided in a bypass passageway or conduit **62**, extending between the supply conduit **54** and reservoir **56**. The dumping valve **61** is operated by a pilot valve **66** in pilot conduit **68** which has a manually shiftable control member **67** disposed in a bore **81**. The electric energy for operating solenoid valves **46, 47** is supplied by a battery **71** which is connected to the solenoid valves **46, 47** through circuits **72, 73**, respectively. Operation of solenoid valve **46** is controlled by manually operable switch **70** in circuit **72** and solenoid valve **47** is controlled by the manually operated pilot valve switch **74** in circuit **73**. The switch lever **70'** and valve element **67** constitute manual control members which are positioned on the tractor unit **13** at the operator's station **75**. The control system components within dash lines **63** are mounted on the tractor unit **13**, the dumping valve **61** being in close proximity to the pump and reservoir to minimize circulating flow power loss.

Referring to FIG. 2 the operation of the control system for the hydraulic motor **36** will now be described. In the illustrated condition of the control system, the reversing valve **41** is in its forward operating position, in which the elevating motor **36** drives the elevating mechanism **23** in a direction to load the earthmover. In this forward condition, the hydraulic pump **53** delivers fluid under pressure to motor conduit **51** by way of supply conduit **54** since the bypass passage **62** is blocked by the shiftable fluid flow control element **76** in dumping valve **61** which, as shown in FIG. 2, is in its closed position. The element **76** is prevented from shifting downwardly

to its open position by the pressure fluid in chamber **77** which enters through orifice **78**. Escape of fluid from chamber **77** is blocked by land **80** on spool member **67** of pilot valve **66**. The switch **74** is open and thus the normally closed, electrically operated valve **47** is closed preventing air delivery to actuator **43** even if reversing switch **70** should be closed.

If the elevating mechanism becomes overloaded to such an extent that the fluid pressure in the hydraulic passage **54** becomes excessive, a pilot relief valve **79** interposed in a passage **90** interconnecting pilot passage **68** and bypass passageway **62** will open. Upon opening of the pilot relief valve **79**, the pressure in chamber **77** will drop to such an extent that the flow control element **76** will move downwardly against the biasing action of spring **98** to its open position and relief flow from conduit **54** will pass to reservoir **56** through the bypass passageway **62**. Thus the dumping valve **61** in conjunction with pilot relief valve **90** acts as a relief valve for pump **53**.

On occasion, it is desirable to reverse the direction of the elevating mechanism **23**. To achieve a reverse direction, the operator first moves the manual control member **67** upwardly to place the reduced diameter portion **82** in bridging relation to ports **83**, **84**, of pilot valve **66**, thus opening the bypass passage **68** to reservoir. This will cause the chamber **77** to be placed at substantially reservoir pressure and the fluid delivery from the pump will pass back to the reservoir through the bypass passage **62** at a very low pressure. The pressure in the conduit **54** will not be sufficient to operate the motor **36** and thus the motor and the elevating mechanism will slow to a stop. The inertia of the elevating mechanism **23**, flywheel **35** and speed reducer **37** will tend to prevent the motor **36** from coming to an instantaneous stop. The upward movement of the manual control member **67** to its open position will close the switch **74** in the circuit **73** thus energizing solenoid valve **47** causing its armature and flow control element **86** carried thereby to be moved from its illustrated closed position to an open position in which passage **88** is unblocked. At this point the actuating chamber of actuator **43** is in communication with the atmosphere through exhaust port **91** in the deenergized solenoid valve **46**. In order to expand the air actuator **43** to shift the reversing valve to its reverse position, it is necessary for the operator to close switch **70** in circuit **72** thereby energizing solenoid valve **46** causing its armature to move to the right closing exhaust port **91** and opening passage **92** to place the source of air pressure **44** in communication with the actuator **43**. The actuator **43** will expand and shift the flow control element **42** of reversing valve **41** to its reverse operating position. The shifting movement of valve element **42** is relatively slow because of a restriction **87** provided in passage **88** in solenoid valve **47**. The restriction **87** insures slow movement of the reversing valve in both directions. As soon as the reversing valve has been shifted to its reverse position, the operator will move the control member **67** to its closed position thereby blocking the pilot passage **68** and closing the dumping valve **61**. At the same time switch **74** will be opened and valve element **86** closed thus trapping air in the expanded actuator **43**. With the bypass passage **62** closed, the pressure will build up in supply passage **54** and motor conduit **52** and the motor **36** will operate in its reverse direction.

When it is desired to stop operation of the elevating mechanism, the dumping valve is placed in its open position by movement of valve member **67** to its open position.

When it is desired to shift from reverse driving condition of the elevating mechanism to forward driving condition, the dumping valve **66** is placed in its open position to place the supply conduit **54** at a reduced pressure thereby stopping operation of the motor **36**. Switch **70** is opened to place solenoid valve **46** in its exhaust or deenergized position and thus air will escape from actuator **43** permitting its piston **45** to retract slowly as air passes through restriction **87**. The restriction is proportioned so the valve will shift from one operating position to another in about the same time as the elevating mechanism will coast to a stop. After the reversing valve has been shifted back to its forward position, the operator shifts manual control member **67** of pilot valve **66** to its closed position to close the dumping valve **61** and cause delivery of pressure fluid to motor conduit **51**.

From the foregoing description it is apparent that the control system for the motor will not quickly shift hyraulic pressure delivery from one motor conduit to the other. The delay is sufficient to permit the motor **36** and elevating mechanism to come to a stop when changing their direction of operation. This avoids excessive pressure buildup in the motor and other control system components. Even though a pressure relief is provided in the control system momentary excessive pressures can be created in the system in absence of the delay afforded by this invention. The circuit **73** forms an interlock between the reversing and dumping valves preventing operation of the actuator **43** when the flow control element **76** of dumping valve **61** is in its closed position.

The embodiments of the invention in which an exclusive property or privilege is claimed and are defined as follows:

1. In a control system for the hydraulic drive motor for operating an elevating mechanism of an earthmover in forward and reverse directions including a hydraulic pump and a hydraulic reservoir, the combination comprising:

a reversing valve shiftable between forward and reverse operating positions,

a supply conduit interconnecting said reversing valve and pump,

an exhaust conduit interconnecting said reversing valve and reservoir,

a pair of motor conduits interconnecting said reversing valve and motor,

a bypass passageway connected to said supply conduit intermediate said reversing valve and pump for bypassing hydraulic fluid to said reservoir,

a dumping valve in said bypass passageway including a fluid flow control element shiftable between open and closed positions in which said bypass passageway is open and closed, respectively,

first means for shifting said fluid flow control element including a first manual control member,

second means for operating said reversing valve including a second manual control member, and

third means preventing shifting of said reversing valve when said flow control element is in its closed position.

2. The invention of claim **1** wherein the direction of travel of said elevating mechanism is changed from forward to reverse only by placing said dumping valve flow control element in its open position and operating said manual control member and then placing said dumping valve flow control element in its closed position.

3. The invention of claim **2** wherein said second means includes an actuator operatively associated with said second manual control member and operable to shift said reversing valve and wherein said third means includes an interlock preventing operation of said actuator when said flow control element of said dumping valve is in its closed position.

4. The invention of claim **3** wherein said actuator is a fluid actuator connected to said reversing valve, wherein said second means includes a source of pressure fluid, a passage connecting said actuator and source and valve means in said passage and wherein said interlock operatively interconnects said first means and said valve means.

5. The invention of claim **4** wherein said valve means

is an electrically operated valve controlled by an electric circuit and wherein said interlock includes an electric switch in said circuit operated by said first manual control member.

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