Nov. 28, 1967 F. J. SCHENKELBERGER 3,354,789

CONTROL SYSTEM

Filed Dec. 29, 1965 2 Sheets-Sheet 1

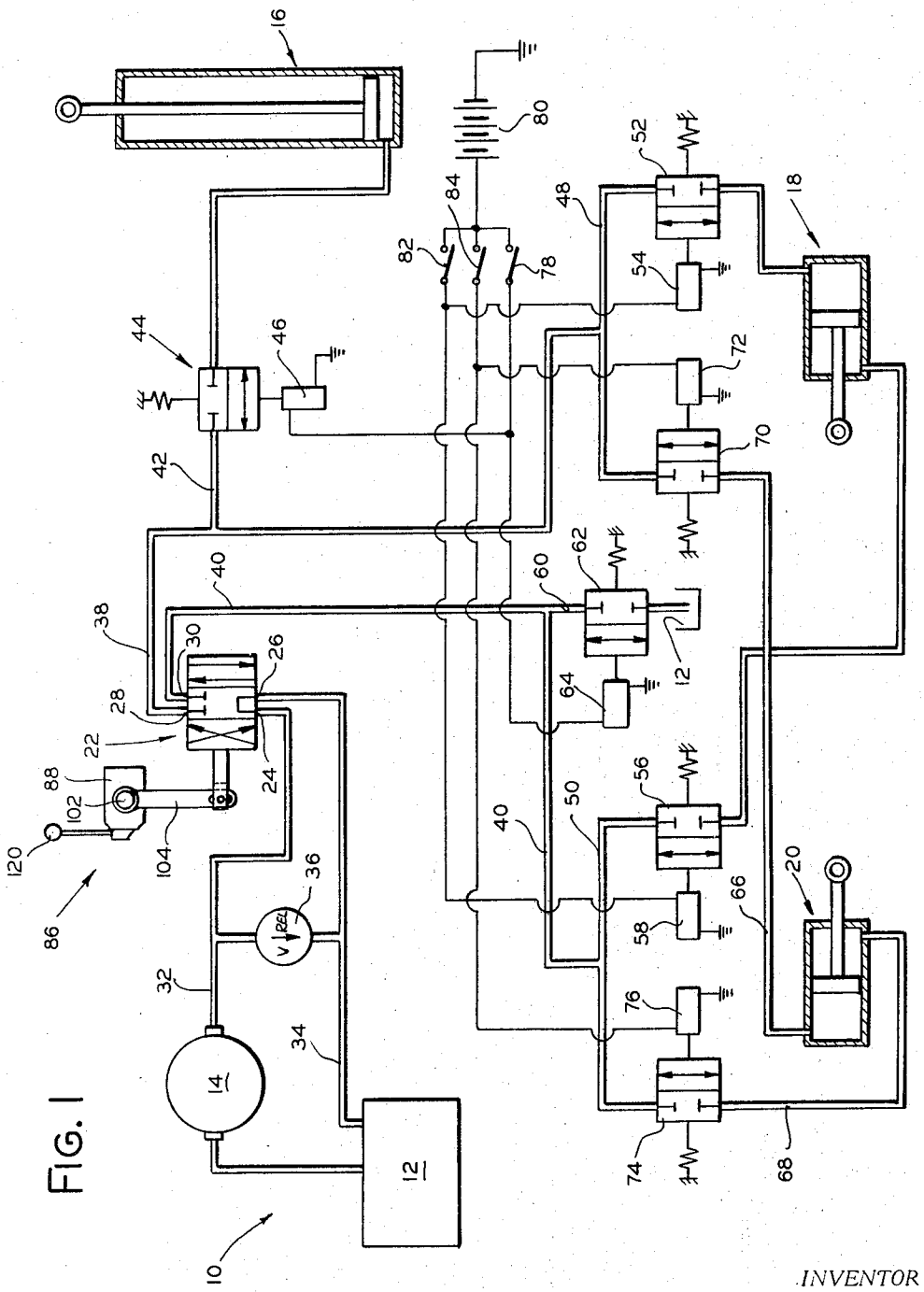


FIG. 1

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FIG. 3

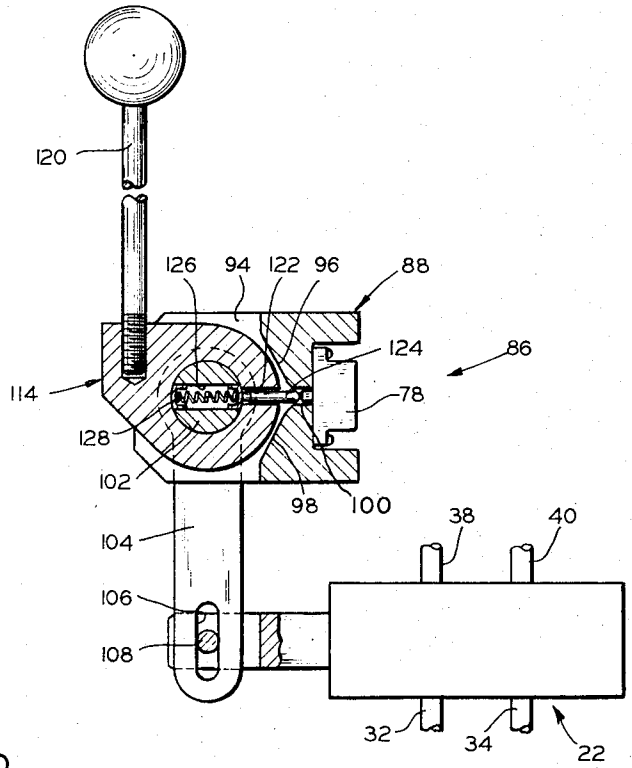
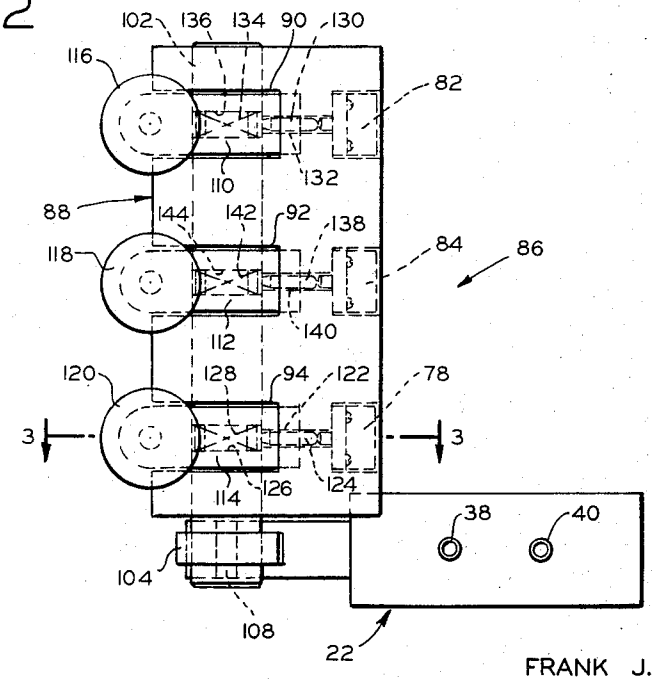


FIG. 2



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CONTROL SYSTEM

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7 Claims. (Cl. 91—413)

This invention relates to control systems, and more particularly to fluid control systems which are especially suited for use with fork lift trucks having a lift upright which is movable horizontaly as well as vertically and has tiltable fork arms.

In most lift trucks it is necessary to have a fluid conduit extend between the truck body and the lift upright to supply pressurized fluid to the fluid motor for elevating the lift upright. Also, it is necessary to have a pair of fluid conduits extend between the truck body and the lift upright to supply pressurized fluid to each double-acting fluid motor for tilting the fork arms or actuating an attachment, for example. If there are a number of such fluid motors carried by the lift upright, then the number of fluid conduits extending between the truck body and the lift upright becomes objectionable. This undesirable situation is further compounded in the type of lift truck in which the lift upright is movable horizontally relative to the truck body, since provision must be made for extension and retraction of the fluid conduits extending between the truck body and the lift upright. For an example of this type of lift truck see U.S. Patent No. 3,179,198. In view of the foregoing, it is a principal object of my invention to provide a control system in which it is necessary to have only two fluid conduits and an electric cable extending between the truck body and the lift upright regardless of the number of fluid motors carried by the lift upright.

A further object of my invention is to provide an improved control for use in conjunction with a control system.

In carrying out my invention in a preferred embodiment I provide a master control valve which is actuatable to direct pressurized fluid to one or the other of two main conduits. Solenoid operated valves are actuatable to connect either of two or more fluid motors to the main conduits. A control is connected to the main valve and to the solenoid operated valves so that actuation of the control first actuates the solenoid operated valves to connect one of the fluid motors to the main conduits and then operates the main valve to supply either one or the other of the main conduits with pressurized fluid.

The above and other objects, features and advantages of my invention will be more readily understood by persons skilled in the art when the following detailed description is taken in conjunction with the accompanying drawing wherein:

FIGURE 1 is a diagram showing my control circuit,

FIGURE 2 is a plan view of the operator control, and

FIGURE 3 is a cross section along the line 3—3 of FIG. 2.

Referring to FIG. 1, the reference numeral **10** denotes generally a control system for use with a fluid reservoir **12**, a fluid pump or other source of pressurized fluid **14** and a plurality of fluid motors including a single-acting motor **16** and double-acting fluid motors **18** and **20**.

Single-acting fluid motor **16** is carried by the lift upright of a fork-lift truck and is connected to the carriage thereof so that when pressurized fluid is supplied to motor **16** the carriage is raised. Double-acting fluid motor **18** is carried by the carriage of the lift upright and is connected to actuate mechanism for tilting the fork arms carried by the carriage. For an example of such mechanism see U.S. Patent No. 2,608,315. Fluid motor **20** is connected between the lift truck body and the lift upright so that actuation of fluid motor **20** causes the lift upright to extend or retract horizontally relative to the lift truck body. This arrangement of fluid motors is intended to be illustrative only, since other fluid motors could be utilized with control system **10** to actuate various attachments carried by the lift upright such as mechanism for shifting the fork arms from side to side or for actuating a rotating roll clamp. Further, control system **10** may be used with other combinations of single and double-acting fluid motors in applications other than forklift trucks.

Control system **10** includes a four-way open center valve **22** which serves as a master control valve. Valve **22** has an inlet port **24**, an outlet port **26**, a first fluid motor port **28** and a second fluid motor port **30**. A fluid conduit **32** connects inlet port **24** to reservoir **12** and includes pump **14** which draws fluid from reservoir **12** and supplies pressurized fluid to inlet port **24**. Outlet port **26** is connected to reservoir **12** by means of another fluid conduit **34**. Connected between conduits **32** and **34** is a fluid pressure relief valve **36** which opens when a predetermined high pressure is reached to connect conduit **32** directly with conduit **34**. Also, a pair of fluid conduits **38** and **40** are connected to fluid motor ports **28** and **30**, respectively.

A fluid conduit **42** connects single acting fluid motor **16** with conduit **38** and includes a normally closed on-off valve **44** which is connected to a solenoid **46** so that when solenoid **46** is energized valve **44** is actuated to open. Also, conduit **40** is connected to reservoir **12** by a fluid conduit **60** which includes a normally closed on-off valve **62** that is connected to a solenoid **64** so that energization of solenoid **64** actuates valve **62** to open.

Double-acting fluid motor **18** is connected at one end to conduit **38** by a fluid conduit **66** and is connected at other end to conduit **40** by a fluid conduit **50**. Conduit **48** includes a normally closed on-off valve **52** which is connected to a solenoid **54** so that when solenoid **54** is energized valve **52** is actuated to open. Similarly, conduit **50** includes a normaly closed on-off valve **56** which is connected to a solenoid **58** so that energization of solenoid **58** actuates valve **56** to open.

Double-acting fluid motor **20** is connected at one end to conduit **38** by a fluid conduit **66** and is connected at its other end to conduit **40** by a fluid conduit **68**. Conduit **66** includes a normaly closed on-off valve **70**. Valve **70** is connected to a solenoid **72** so that when solenoid **72** is energized valve **70** is actuated to open. Similarly, conduit **68** includes a normally closed on-off valve **74**. Attached to valve **74** is a solenoid **76** which, when energized, actuates valve **74** to open.

Turning now to a description of the electrical circuitry, it will be seen that solenoids **46** and **64** each have one side grounded and have the other side connected in parallel to one side of an on-off switch **78**. The other side of switch **78** is connected to one side of a battery **80**, the other side of the battery being connected to ground. Solenoids **54** and **58** have one side grounded and the other side connected in parallel to one side of an on-off switch **82**, the other side of which is connected to battery **80**. Likewise, solenoids **72** and **76** have one side grounded and the other side connected to one side of an on-off switch **84**, the other side of which is connected to battery **80**.

Control system **10** also includes an operator manipulated control **86** which actuates master control valve **22** and switches **78**, **82** and **84**. Referring now also to FIGS. 2 and 3, it will be seen that control **86** includes a body **88** with three parallel slots **90**, **92** and **94** therein. Each slot has a camming surface which includes a pair of inclined planes **96** and **98**. At the junction of the planes

is an opening 100 which accepts the actuator button of the switch mounted adjacent thereto. As will be noted switches 82, 84 and 78 are mounted behind slots 90, 92 and 94, respectively.

A shaft 102 is journaled in body 88 for rotation and extend across slots 90, 92 and 94, as shown. Fixed to shaft 102 and extending downwardly therefrom is a lever arm 104. Lever arm 104 is connected to valve 22 by means of a slot 106 in the lower end thereof which engages a pin 108 carried by valve 22. Thus, rotation of shaft 102 from the neutral position shown in FIG. 1 in a clockwise direction actuates valve 22 to connect inlet port 24 with fluid motor port 28 and to connect outlet port 26 with fluid motor port 30. Also, counterclockwise rotation of shaft 102 from the neutral position shown in FIG. 2 actuates valve 22 to connect inlet port 24 with fluid motor port 30 and to connect outlet port 26 with fluid motor port 28.

Three manually operable members 110, 112, and 114 are mounted for rotation on shaft 102 and are disposed in slots 90, 92 and 94, respectively. Members 110, 112 and 114 include upwardly extending handles 116, 118 and 120, respectively.

Member 114 includes an opening 122 therein. Slidably disposed in opening 122 is a pin 124 which extends radially of shaft 102. When member 114 and shaft 122 are in their respective neutral positions, pin 124 contacts the actuator button of switch 78 and at the same time is aligned with an opening 126 in which a compression spring 128 is disposed. Spring 128 tends to bias pin 124 radially outwardly so that in the position shown in FIG. 3 pin 124 pushes on the actuator button of switch 78 so that switch 78 is held open. Likewise, member 110 includes a pin 130 slidably disposed in an opening 132 therein and biased radially outwardly by a compression spring 134 disposed in an opening 136 in shaft 102. In the same manner as members 114 and 110, member 112 includes a pin 138 slidably disposed in an opening 140 therein, pin 138 being biased radially outwardly by a spring 142 disposed in an opening 144 in shaft 102. In every case it will be noted that openings 126, 136 and 144 are wider than the pins disposed adjacent them.

In order for persons skilled in the art to better understand my invention, I will now explain the operation of it. It will be assumed that valve 22 is in the neutral position shown in FIG. 1 and that members 110, 112 and 114 are in their neutral positions so that switches 78, 82 and 84 are held open. In this condition pressurized fluid being generated by pump 14 is returned to reservoir 12 by valve 22. Now it will be assumed that the operator wishes to direct pressurized fluid from pump 14 to fluid motor 16. In order to accomplish this the operator must manipulate handle 120 to rotate member 114 in a clockwise direction. Initial rotation of member 114 causes pin 124 to move away from engagement with the actuator button of switch 78, thus permitting switch 78 to close. Closure of switch 78 energizes solenoids 46 and 64. Energization of solenoid 46 actuates valve 44 to open and energization of solenoid 64 actuates valve 62 to open. Further clockwise rotation of member 114 casues pin 124 to move up inclined plane 98 with the result that pin 124 is forced radially inwardly into opening 126 so that the edge of pin 124 will engage the edge of opening 126 upon sufficient clockwise rotation of member 114. Thus, shaft 102 will then be connected to member 114 for conjoint rotation therewith. Continued clockwise rotation of member 114 will now cause shaft 102 to rotate with the result that valve 22 will be actuated to connect inlet port 24 to fluid motor port 28 and to connect outlet port 26 to fluid motor port 30. When this occurs pressurized fluid is directed through conduits 38 and 42, valve 44 now being open, to fluid motor 16. If the operator desires to permit fluid motor 16 to retract, then handle 120 is actuated in a counterclockwise direction, the initial operation of switch 78 to energize the solenoids and actuate the valves being the same, except that now valve 22 is actuated so that inlet port 24 is connected to fluid motor port 30 and outlet port 26 is connected to fluid motor port 28. Consequently, pressurized fluid from pump 14 is returned to reservior 12 through conduits 40 and 60 while fluid motor 16 is connected to reservoir 12 via conduits 42, 38 and 34.

Assuming now that the operator wishes to extend fluid motor 18, he will manipulate handle 116 to rotate member 110 in a clockwise direction, as viewed in FIGS. 1 and 3. Initial movement of pin 130 away from the actuator button of switch 82 permits switch 82 to close with the result that solenoids 54 and 58 are energized. Thus, valves 52 and 56 are actuated to open. Continued clockwise movement of member 110 causes pin 130 to move up inclined plane 98, and therefore extend into opening 136. After the edge of pin 130 engages the edge of opening 136, continued rotation of member 110 causes shaft 102 to rotate with it so that valve 22 will be actuated to connect inlet port 24 with fluid motor port 28 and to connect outlet port 26 with fluid motor port 30. When this occurs pressurized fluid is supplied to fluid motor 18 via conduits 32, 38 and 48, valve 52 now being open, to cause fluid motor 18 to extend. At the same time the other end of fluid motor 18 is connected to reservoir 12 via conduits 50, 40 and 34, valve 56 being open. By rotating handle 116 in a counterclockwise direction valves 52 and 56 will first be actuated to open, and then valve 22 will be actuated to connect fluid inlet port 24 with fluid motor port 30 and to connect fluid outlet port 26 with fluid motor port 28 with the result that pressurized fluid from pump 14 is supplied to fluid motor 18 through conduits 40 and 50, thus causing fluid motor 18 to retract.

Manipulation of handle 118 causes fluid motor 20 to extend or retract in a manner similar to fluid motor 18, so it is not felt necessary to describe this portion of the operation of control system 10.

The above-detailed description is intended to be illustrative only, since my invention is subject to many applications other than forklift trucks, and may be utilized with any combination and number of single and double-acting fluid motors. Consequently, the limits of my invention should be determined from the following appended claims.

I claim:

1. For use with a valve and a switch, a control comprising a rotatable shaft operatively connected to the valve so that rotation of the said shaft actuates the valve, a manually operable member mounted on the said shaft for rotation, means carried by the said member for actuating the switch upon initial rotation of the said member, and means for connecting the said member and shaft together for conjoint rotation following initial rotation of the said member.

2. A control as set forth in claim 1 wherein the said actuating means includes a pin carried by the said member, the said pin contacting the switch when the said member is in a given position.

3. A control as set forth in claim 2 wherein the said pin is slidable radially relative to the said shaft in the said member and the said connecting means includes an opening in the said shaft and an inclined surface which the said pin engages following initial rotation of the said member away from the said given position so that further rotation of the said member causes the said pin to slide radially inwardly into the said opening.

4. For use with first and second fluid motor, a source of pressurized fluid and a fluid reservoir, a fluid control system comprising a master control valve having inlet and outlet ports and first and second fluid motor ports, the said inlet and outlet ports being connected to the pressurized fluid source and fluid reservoir, respectively, the said valve being actuatable from a neutral position to connect the said inlet port to the said first fluid motor port and connect the said outlet port to the said second fluid motor port or to connect the said inlet port to the

said second fluid motor port and connect the said outlet port to the said first fluid motor port, valve means actuatable to connect either the first fluid motor to the said first fluid motor port or connect the second fluid motor to the said first and second fluid motor ports, and a control for actuating the said valve means and then actuating the said master control valve.

5. A fluid control system as set forth in claim 4 wherein the first fluid motor also is connected to the said second fluid motor port when connected to the said first fluid motor port.

6. For use with first and second fluid motors, a source of pressurized fluid, a fluid reservoir and a power source, the combination comprising a master control valve having inlet and outlet ports and first and second fluid motor ports, the said inlet and outlet ports being connected to the pressurized fluid source and fluid reservoir, respectively, the said valve being actuatable from a neutral position to connect the said inlet and outlet ports to the said first and second fluid motor ports, respectively, or to connect the said inlet and outlet ports to the said second and and first fluid motor ports, respectively, first valve means actuatable to connect the first fluid motor to the said first fluid motor port, a first solenoid connected to the said first valve means and operable upon energization to actuate the said first valve means, second valve means actuatable to connect the second fluid motor to the said first and second fluid motor ports, a second solenoid connected to the said second valve means and operable upon energization to actuate the said second valve means, a first normally closed switch for connecting the said first solenoid to the power source, a second normally closed switch for connecting the said second solenoid to the power source, a rotatable shaft operatively connected to the said master control valve so that rotation of the said shaft actuates the said master control valve, first and second manually operable members mounted on the said shaft for rotation away from neutral positions, first and second openings in the said shaft, a first pin carried by the said first member and disposed in alignment with the said first opening and in contact with the said first switch when the said master control valve and the said first member are in their neutral positions, the said first pin being slidable radially relative to the said shaft in the said first member, first spring means disposed in the said first opening for biasing the said first pin outwardly so

that the said first switch is held open when the said first member is in its neutral position, a second pin carried by the said second member and disposed in alignment with the said second opening and in contact with the said second switch when the said master control valve and the said second member are in their neutral positions, the said second pin being slidable radially relative to the said shaft in the said second member, second spring means disposed in the said second opening for biasing the said second pin outwardly so that the said second switch is held open when the said second member is in its neutral position, and a camming surface, the said first pin engaging the said camming surface following rotation of the said first pin away from contact with the said first switch, the said second pin engaging the said camming surface following rotation of the said second pin away from contact with the said second switch, the said camming surface being disposed so that further rotation of the said first pin after engagement with the said surface causes the said first pin to slide into the said first opening against the bias of the said first spring and further rotation of the said second pin after engagement with the said surface causes the said second pin to slide into the said second opening against the bias of the said second spring means.

7. The combination as set forth in claim 6 wherein the said first and second openings are wider than the said first and second pins, respectively, so that further rotation of either pin away from contact with its associated switch first causes the pin to slide into its associated opening and then engage the edge thereof.

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