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Schmiel

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[54] **HYDRAULIC REMOTE CONTROL JOYSTICK**

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[51] **Int. Cl.**[3] **F16K 31/02**; F16K 31/44

[52] **U.S. Cl.** **137/636.2**; 137/596.12; 250/221

[58] **Field of Search** ..... 137/596.12, 596.14, 137/596.16, 636.2; 91/170 MP; 250/221, 227

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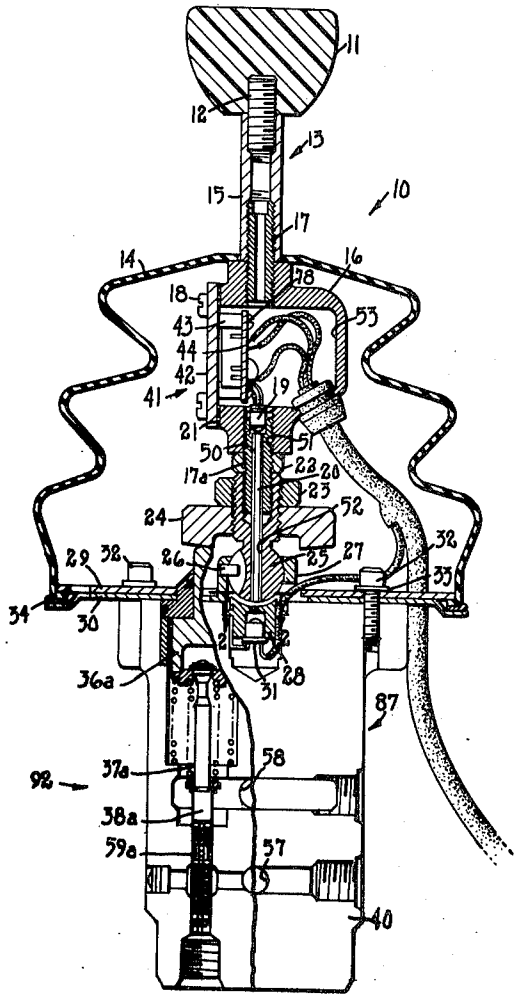
[57] **ABSTRACT**

A joystick controller **10** for remotely controlling hydraulic directional control valve **82** and also for controlling a solenoid actuated pressure build-up valve **90** is disclosed. A light-emitting diode **19** is carried in and by a handle **13** of the joystick controller **10.** A photosensitive transistor **31** receives the light emitted from the light-emitting diode **19.** When the handle **13** moves off of a neutral position, a receptacle **28** blocks the light from the photo-transistor **31.** In one embodiment, a fiber optic light conductor **20** extends from the light-emitting diode **19** toward the photo-transistor **31.** The photo-transistor **31** then actuates a relay switch which sends a control signal to a solenoid actuated pressure build-up valve **90,** thereby providing a ready means for effectuating both the control of the hydraulic directional control valve **82** and the pressure build-up valve solenoid **90** with one controller **10.**

13 Claims, 3 Drawing Figures



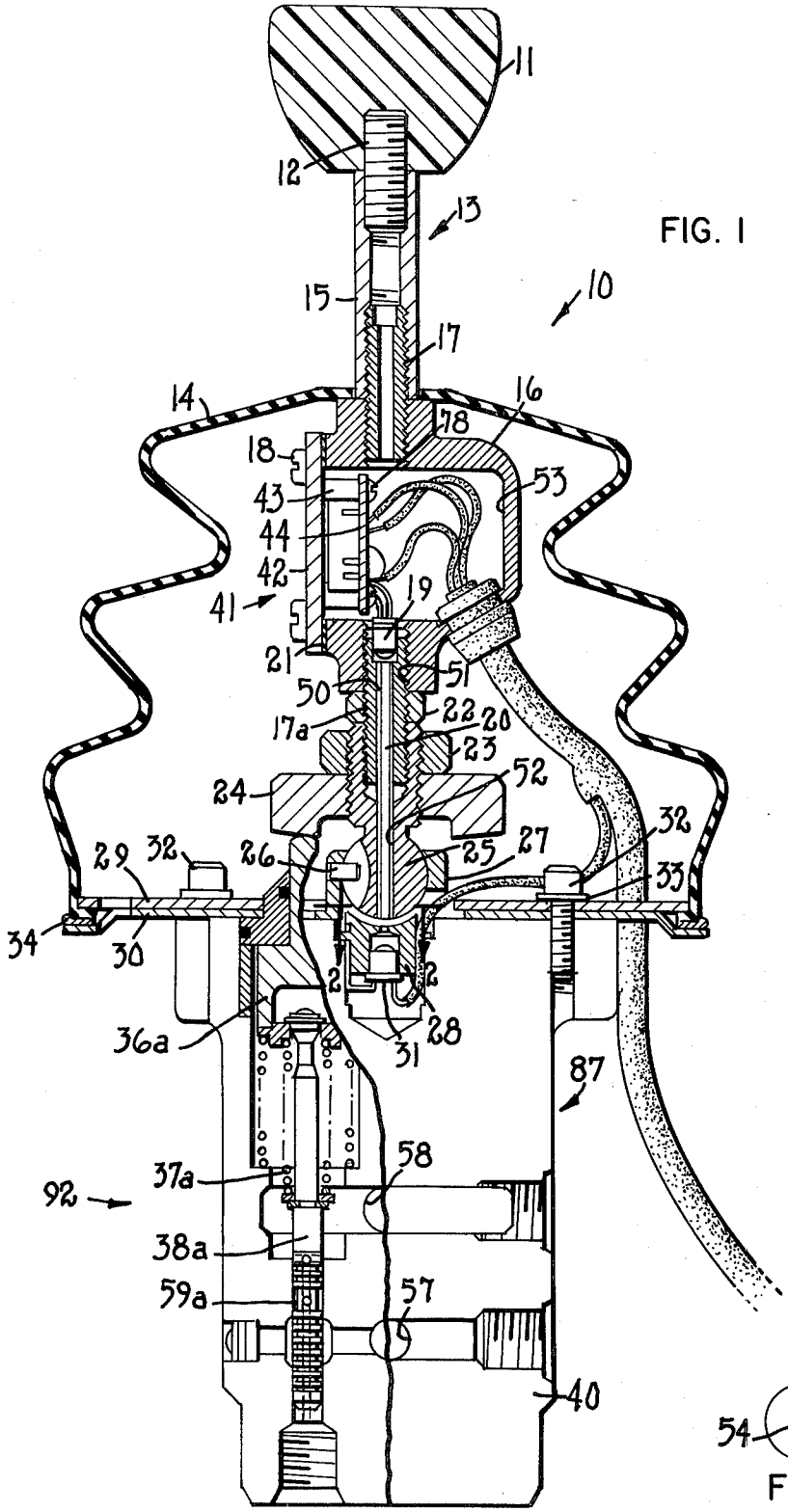

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FIG. 1

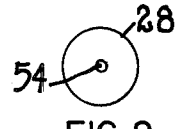
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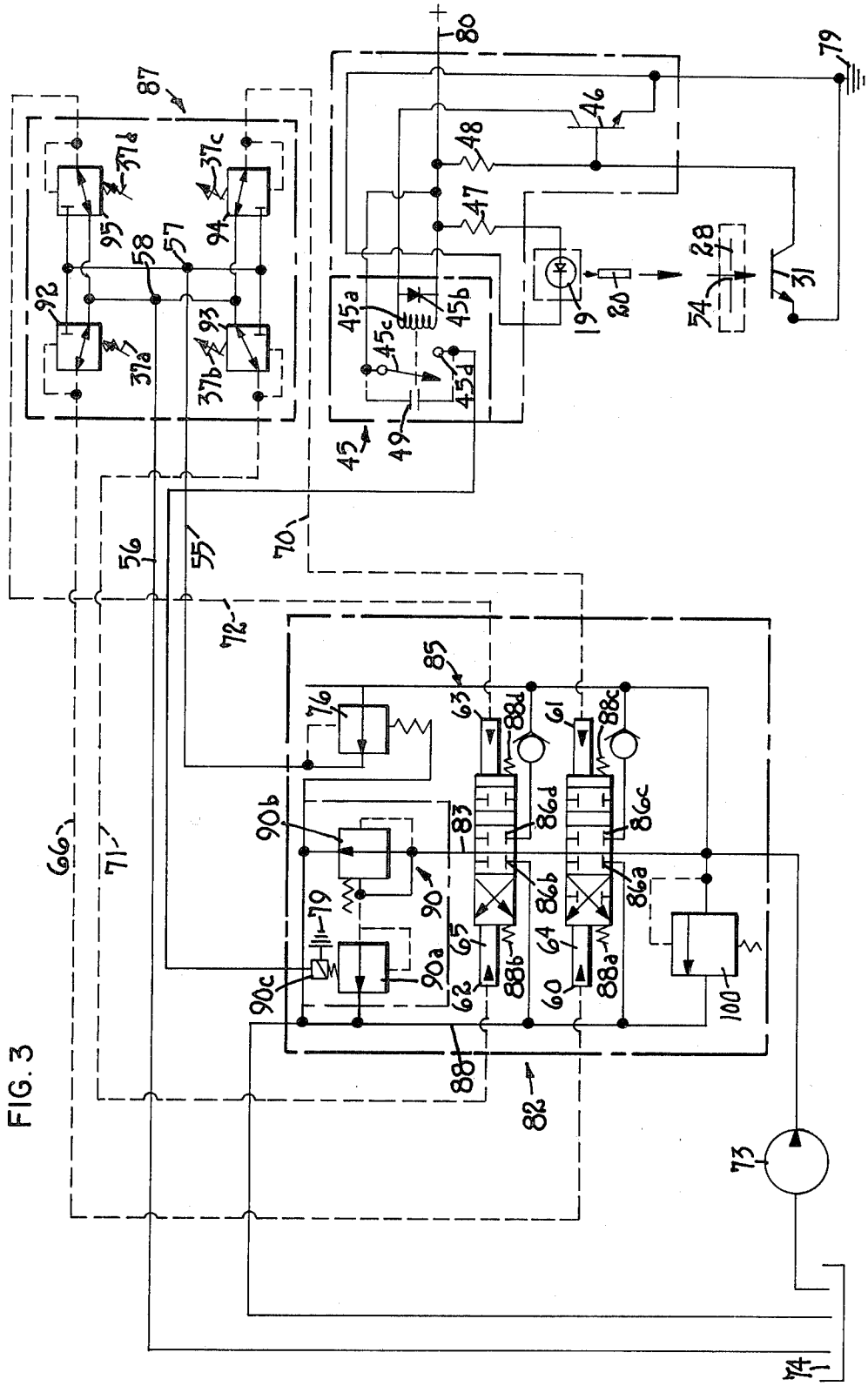
FIG. 2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83
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79
65
64
62
60
88b
88a
86b
86a
66
71
88
82
100
73
74

FIG. 3

HYDRAULIC REMOTE CONTROL JOYSTICK

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to controls for hydraulic directional control valves and more particularly to a hydraulic remote control joystick with an electronic switch to remotely control a solenoid operated pressure build-up valve and provide pressurized flow to actuate a hydraulically operated open-center directional control valve.

2. Description of the Prior Art

Hydraulic directional control valves employing a minimal pressure open center circuit and also being remotely controlled by modulating hydraulic controls require a separate actuator circuit to actuate the spools in the directional control valve. The separate circuit may be powered by either a separate power source, such as a separate pump, or by utilizing the main pump flow. The pressure in the main pump flow is typically in the range of up to 5,000 pounds per square inch when the directional control valve spool is actuated. The separate circuit only requires approximately 100 to 500 pounds per square inch pressure to operate. Therefore, when the main pump flow is utilized, it is advantageous to utilize only a portion of the main pump pressure and flow. This reduction in pressure and flow is accomplished by means of a pressure build-up valve for minimum actuating pressure, a pressure reduction valve to limit the maximum pressure, and a flow control valve to limit the flow of 1–5 gallons per minute when the pressure build-up valve is energized by means of a solenoid.

On a hydraulic remote controlled directional control valve with an open center circuit and using a joystick type of master control, this feature has not been readily adapted for use. It has been necessary to manually actuate the solenoid by means of a separate switch. In an open center circuit, when the spool is in the neutral position, the main pump flow will go through the control valve and back to the tank at a very low pressure. When the spool is shifted to either the right or left, the open center is closed off and the flow is directed to the work ports up to maximum pump pressure. While the design parameters of each open center circuit are different, typically a 3–4 degree movement in the joystick control moves the spool sufficiently to start closing off the open center. Therefore, the signal to the pressure build-up valve in the actuator circuit must be given before the 3 to 4 degree movement of the joystick control. If the signal was delayed beyond the 3–4 degree movement, a hydraulic pressure would be generated beyond the expected starting pressure to the actuator, causing the directional control valve spool to overrun its metering position, and in turn, create a jump pressure condition causing the hydraulic motor to start erratically instead of a smooth operation of the hydraulic motor. Therefore, it has been necessary for the operator to manually energize the solenoid to the pressure build-up valve by separate switch before moving the joystick control.

This invention allows the joystick controller to automatically send a signal via a beam of light located inside the joystick to actuate an electronic relay switch which energizes the solenoid of the pressure build-up valve without the operator actuation of a separate switch.

The control of circuitry by selective illumination and prevention of illumination of a light sensitive element by a light emission device are known. An example of this is a motor control apparatus adapted for use with a motorized vehicle such as a wheel chair. The vehicle includes two drive wheels, each being driven by its own separate motor, a mask, transmittor, and receiver assembly. This assembly can include four light emitting diodes and corresponding, oppositely disposed light receivers. Two of the emitter/receiver pairs are tied to each of the drive wheel motors. One of the pairs effectuates switching to drive the motor in one direction and the other of the pairs is linked to circuitry which causes the motor to be driven in the opposite direction. A mask is innerposed between the emitters and receivers so that light from certain emitters can be selectively unmasked and permitted to illuminate corresponding receivers in order to operate the drive motor as desired.

Another example is a control apparatus which is specifically designed for use in controlling propulsion and brake functions in rapid transit vehicles. The structure includes a fan-shaped mask having arcuate slots formed therein. The fan-shaped mask can be pivoted in a plane generally perpendicular to the direction of light emitted by a number of sources so that, as the mask is pivoted, light will be permitted to pass through various of the slots and illuminate various photo-responsive sensors. Illumination of these sensors actuates control circuits to operate the various propulsion and braking functions.

Still another example of a light operated control device is a structure that inclues a sphere housing and a photocell recessed therein. The sphere is part of a ball joint structure which can be rotated so that a light sensitive side of the photocell can be illuminated by various light emission devices positioned about the sphere. The photocell is connected to control circuitry which is used to effectuate various functions.

In another control device, the functions are not controlled by allowing illumination of a light sensitive photocell and selective interruption of the illumination. Rather, the illumination is constant, with the function being controlled by the color of the light which is received by the photo detector array. The color of light which is received is controlled by selective rotation of a knob at the end of a control stick. Rotation of the knob causes the color of the light to be varied by interposing a mirror coated with a different colored filter material in the path of the light beam.

To date, there are no known control structures for remotely controlling hydraulic directional control valves that also accomplish the function of remotely controlling a solenoid in a separate actuator circuit by means of an electronic relay switch controlled by a beam of radiant energy incorporated within the joystick controller.

The present invention addresses the problems associated with the prior art devices which require an operator to operate a separate switch from the joystick controller to operate the solenoid on a separate actuator circuit. The present invention provides a ready means for effectuating both the control of a hydraulic directional control valve and energizing a solenoid with one control handle.

SUMMARY OF THE INVENTION

The present invention is a joystick controller for remotely controlling hydraulic directional control valves and also for controlling a solenoid. In one em-

bodiment, the solenoid actuates a pressure build-up valve in an actuator circuit.

The joystick controller has a handle which has an axis with respect to which it is pivoted about a point. A means for transmitting a movement in the handle to a plurality of auxiliary spools is provided. The auxiliary spools actuate a plurality of remote directional control spools in a hydraulic directional control valve. In one embodiment, a cam plate is attached to the handle perpendicular to a longitudinal axis of the handle. Any pivotal movement of the handle causes the cam plate to coact with at least one of four plunger assemblies. A depression of the plunger assembly causes a spring to be compressed, thereby moving an auxillary spool in an auxiliary control valve. The movement in the auxillary spools permits hydraulic fluid in the actuator circuit to be directed toward the remote directional control valve spools until the resultant hydraulic force on the directional control valve spool spring is in equilibrium with the hydraulic force on the controller plunger spring, thereby controlling the movement of the remote directional control valve spools.

A radiant, energy means is carried in and by the handle and emits radiant energy generally parallel to a longitudinal the axis of the handle. In one embodiment, the radiant energy means is a light-emitting diode.

A means for receiving the radiant energy is provided. In one embodiment, the receiving means comprises a photosensitive transister.

The receiving means provides a control signal dependent upon a relative movement of the handle. A receptacle is positioned between the radiant energy means and the receiving means. The receptacle has a hole to allow the radiant energy to be received by the receiving means when the handle is in a neutral position. When the handle moves off of the neutral position, the receptacle blocks the radiant energy from the receiving means. When the radiant energy is blocked, the receiving means actuates a relay switch which sends a control signal to a remote solenoid.

To aid in transmitting the radiant energy to the receiving means, a fiber optic light conductor extends from the radiant energy means toward the receiving means and terminates at a position spaced from the receiving means.

The hole in the receptacle is sized such that the movement of the handle that is required to cause the receptacle to block the radiation from being received by the receiving means energizing a relay to an on position and thereby actuating the pressure build-up solenoid. The movement is less than the rotation required to start closing off the open center in the directional control valve and direct a main flow to the work ports in the directional control valve.

The present invention thereby provides a ready means for effectuating both the control of the hydraulic directional control valve, and the pressure build-up valve solenoid with one controller. Also, the solenoid is actuated before the open center in the control valve starts to close and the flow from the main pump is diverted to the work ports.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side-elevation in cross-section of the present invention with portions broken away.

FIG. **2** is a transverse section taken generally along the lines **2**—**2**, of FIG. **1**.

FIG. **3** is a schematic representation of a hydraulic remote control incorporating the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawing, wherein like numerals represent like parts throughout the several views, there is generally illustrated at **10** in FIG. **1**, a joystick controller to control remote hydraulic control valves and a remote solenoid. A handle assembly, generally designated as **13**, comprises a knob **11** connected to a stem **15** by means of a stud **12**. The stem **15** is connected to a junction box **16** by a stud **17**. A second stud **17***a* is threaded into the opening **51** of the junction box **16**. The stud **17***a* has a longitudinal bore **50**. A nut **22** is used to fasten the stud **17***a* to the junction box **16**. A pivot ball **25** having a longitudinal bore **52** is cooperatively connected to the stud **17***a*. Cam plate **24**, lying generally perpendicular to a longitudinal axis of the handle assembly **13**, is threaded to the pivot ball **25** and fastened in place by nut **23**. A pivot ball **25** is retained by pivot ball socket **27** and guided by pin **26** to maintain alignment of handle **13**. Mounting plate **29** retains pivot ball socket **27**. While the construction of handle assembly **13** has been described in detail, it is understood that there are numerous combinations that would result in a similar structure.

A radiant energy means **19** is carried by the handle assembly **13**. In one embodiment, the radiant energy means **19** is a light emitting diode and is located in the internal cavity **53** of junction box **16**. The radiant energy means **19** emits radiant energy generally parallel to the longitudinal axis of the handle assembly **13** and through bores **50** and **52**. A receiving means **31** is positioned in recepticle **28**. As shown in FIG. **2**, the recepticle **28** has a hole **54** in alignment with the bore **52**. In one embodiment, a fiber optic light conductor **20** extends from the radiant energy means **19** toward the receiving means **31** and terminates at a position spaced from the receiving means **31**. In the preferred embodiment, the receiving means **31** is a photosensitive transister.

Mounting plate **30** is cooperatively connected to the mounting plate **29** and housing **40** by screws **32** and washers **33**. Housing **40** encloses what is generally designated as **87**, an auxiliary control valve. The auxiliary control valve **87** has a first, second, third and fourth assemblies **92**, **93**, **94** and **95**, as shown in the schematic of FIG. **3**. FIG. **1** shows the first assembly **92** in detail, with the second, third and fourth assemblies similar to the first assembly **92**. The first assembly **92** comprises first auxiliary spool **38***a*, first bore **59***a*, first spring **37***a* and first plunger assembly **36***a*. The second assembly **93** comprises a second auxiliary spool, second bore, second spring **37***b* and second plunger assembly. The third assembly comprises a third auxiliary spool, third bore, third spring **37***c* and third plunger assembly. The fourth assembly comprises a fourth auxiliary spool, fourth bore, fourth spring **37***d* and fourth plunger assembly. First auxiliary spool **38***a* is positioned for slidable movement within first bore **59***a*. First spring **37***a* is connected to the auxiliary spool **38***a*. First plunger assembly **36***a* is positioned on top of first spring **37***a* and underneath cam plate **24**.

A housing **40** has a supply passage **55**, as shown in the schematic view of FIG. **3**, for connection to a supply of hydraulic fluid under pressure and a discharge passage **56** for connection to a reservoir **74**. A first bore **59***a* is

connected to the supply passage **55** and discharge passage **56**. Second, third and fourth auxiliary spools are positioned within second, third and fourth axial bores, similar to first auxiliary spool **38***a* and first axial bore **59***a*, and are also connected to supply passage **55** and discharge passage **56**. The first bore **59***a* is connected to a first end **60** of a first remote directional control spool **64** by passage **66**. The second bore is connected to the second end **61** of the first remote directional spool **64** by passage **70**. The third bore is connected to the first end **62** of the second remote directional control spool **65** by passage **71**. The fourth bore is connected to the second end **63** of the second directional control spool **65** by passage **72**.

Cover **42** of switch assembly generally designated at **41** is mounted to the junction box **16** by screws **18**. The printed circuit board **44**, on which the components of the switch assembly **41** are mounted, is attached to the cover **42** by stand offs **43** and screws **78**.

A boot **14** is held in position around the lower portion of the handle assembly **13** by a retainer **34**.

Switch assembly designated generally at **41**, in general sends a control signal to actuate a remote solenoid **90***c*.

Referring to FIG. **3**, a radiant energy source **19** which is in the preferred embodiment a light emitting diode has its anode connected through a resistor **47** to the positive end of bus **80** and its cathode directly connected to the reference terminal **79**. The light emitted from diode **19**, when energized, is transmitted through a fiber optic conductor generally designated at **20**. The light transmitted through the fiber optic conductor **20** impinges upon a photosensitive NPN transister **31**. The photosensitive transister **31** has a base disposed to receive the light source energy from the diode **19**, an emitter connected to the reference terminal **79** and a collector connected through a resistor **48** to the positive buss **80**.

The collector of transistor **31** is also connected to the base of a NPN switching transistor **46**. Transistor **46** further has an emitter connected to the reference terminal and a collector connected through the energizing coil **45***a* of a relay **45** to the positive buss **80**. The relay **45** further has a shunting diode **45***b* connected across the energizing coil **45***a* and a movable contact is connected to the positive buss **80** and is operable to apply the buss potential to a stationary contact **45***d*. Movable contact **45***c* is normally operable in an open condition when the energizing coil **45***a* is not energized. A capacitor **49** is connected in parallel with the movable contact **45***c* cross the positive buss **80** and the stationary contact **45***d*.

The stationary contact **45***d* of the relay **45** is connected through solenoid **90***c* of the pressure build-up valve **90**, to the reference **79**.

In the directional control valve, designated generally as **82**, a pump **73** supplies hydraulic fluid under pressure from reservoir **74**. Typically, the pump will provide a flow of 10 to 100 gallons per minute having a pressure of from 50 to 5000 pounds per square inch. As shown in the schematic in FIG. **3**, a pressure build-up valve **90**, having a pilot element **90***a*, reaction element **90***b* and solenoid **90***c*, is connected to the passageway **83** for the main pump flow. Pressure reduction valve **76** is connected to the pump pressure by passageway **85**. The pressure build-up valve **90**, pressure reduction valve **76**, and passages **85** and **55** are components of an actuator circuit. The actuator circuit provides hydraulic fluid under 100–500 pounds per square inch pressure to the auxiliary control valve **87**.

In operation, when the handle assembly **13** is in a neutral position, the radiant energy from the light emitting diode **19** is transmitted through a fiber optics light controller **20** positioned in bores **50** and **52** and passes through a hole **54** in receptacle **28**. The light emitting diode is normally biased in a conducting mode to emit radiant light energy through the fiber optic conductor **20**. The light is received by the photosensitive transister **31**. The control signal from the photosensitive transister provides for the electronic switch **41** to be in the off position until the beam from the light emitting diode **19** to the photosensitive transister **31** is blocked.

Before the movement of the handle **13** which is pivoted about a point, causes the spools **64** and **65** to start closing off the open center in the directional control valve **82**, the movement of the handle **13** causes the receptacle **28** to block the light from the light emitting diode **19** from being received by the photosensitive transister **31**. The photosensitive transistor **31** is normally biased in a conducting mode when light transmitted through the fiber optic conductor **20** impinges upon it. When transistor **31** is conducting, current flows from the positive buss **80** through resistor **48**, through transistor **31** to the reference **79**. When transistor **31** is conducting, the voltage drop across it is insufficient to forward bias the base-emitter junction of the switching transistor **46**, causing transistor **46** to be operative in a non-conducting mode of operation. When transistor **46** in non-conducting, relay **45** will be deenergized causing the pressure build-up valve **90** to be deactuated.

When light is blocked from transistor **31**, by the movement of handle **13** relative to the receptacle **28**, transistor **31** becomes operative in a non-conducting mode, momentarily causing the voltage level at base of transistor **46** to rise to a sufficient level to forward bias the base-emitter junction of transistor **46**, driving transistor **46** into a conductive mode of operation. When transistor **46** is switched to its conducting mode, a current flow path is established from the positive buss **80**, through the energizing coil **45***a* of the relay **45** through the transistor **46** and to the reference **79**. The surge of current flow through the energizing coil **45***a* of the relay **45** causes the movable contact **45***c* of the relay **45** to move into engagement with the stationary contact **45***d*, thereby establishing a current flow path from the positive buss **80** through the movable contact **45***c* and through the solenoid **90***c* of the pressure build-up valve **90** to the reference **79**. Energization of the solenoid **90***c* causes the pilot element **90***a* of the pressure build-up valve **90** to actuate the reaction element **90***c*. When the reaction element **90***c* is actuated, the passageway **83** is restricted by the reaction element **90***c*, causing the pressure to build-up in passageway **83**. This results in an increased pressure in passage **85** to the pressure reduction valve **76**. The flow out of the pressure reduction valve **76** to the supply passage **55** of the hydraulic control actuator circuit is typically in the range of the pressure build-up generated. Hydraulic fluid enters the auxiliary hydraulic control valve **87** through the supply port **57**.

The amount of movement of the handle **13** for the receptacle **28** to block the light, causing the photosensitive transistor **31** to de-energize the switch assembly **41** to the on position is controlled by the size of the hole **54**, as shown in FIG. **2**, in the receptacle **28**. The smaller the hole **54**, the less movement is required to de-energize

the switch 41. As will be evident later, the pivotal movement of the handle 13 that is required for the receptacle 28 to block the beam of light from the photosensitive transister 31 is less than the movement required to have the first auxiliary spool 38*a*, and the second, third and fourth auxiliary spools move the directional control spools 64 and 65 to start closing off the open center in the directional control valve 82 and direct the main pump flow to the work ports 86*a*, 86*b*, 86*c*, and 86*d*.

Further movement of the handle 13 causes the cam plate 24 to coact with one or more of the first, second, third or fourth plunger assemblies. To move the first remote directional control spool 64 to the right, as viewed in FIG. 3, the cam plate 24 depresses the first plunger assembly 36*a* which compresses the spring 37*a*, thereby moving the auxiliary spool 38*a*. When the first auxiliary spool 38*a* is moved, hydraulic fluid moves from the supply passage 55 through the bore 59*a* and out passageway 66. The hydraulic fluid in passage 66 causes the first end 60 of the first remote directional control spool 64 to move to the right, thereby compressing spring 88*a*. When the hydraulic force on the spring 88*a* is in equilibrium with the hydraulic force on the spring 37*a*, the first end 60 is stationary. The hydraulic fluid from 61 flows through passage 70 to the third bore and out through discharge port 58 to the discharge passageway 56 leading to the reservoir 74.

To move the first remote directional control spool 64 to the left, as viewed in FIG. 3, the cam plate 24 depresses the third plunger assembly which compresses third spring 37*c*, thereby moving the third auxiliary spool. When the third auxiliary spool is moved, hydraulic fluid moves from the supply passage 55 through the third bore and out passageway 70. The hydraulic fluid in passage 70 causes the second end 61 to move to the left, thereby compressing spring 88*c*. When the hydraulic force on the compression of spring 88*c* is in equilibrium with the hydraulic force on the spring 37*c*, the second end 61 is stationary. The hydraulic fluid from 60 flows through passage 66 to the first bore 59*a* and out through discharge port 58 to the discharge passageway 56 leading to the reservoir 74.

To move the second remote directional control spool 65 to the right, as viewed in FIG. 3, the cam plate 24 depresses the second plunger assembly which compresses second spring 37*b*, thereby moving the second auxiliary spool. When the second auxiliary spool is moved, hydraulic fluid moves from the supply passage 55 through the second bore and out passageway 71. The hydraulic fluid in passage 71 causes the first end 62 to move to the right, thereby compressing spring 88*b*. When the hydraulic force on the spring 88*b* is in equilibrium with the hydraulic force on the spring 37*b*, the first end 62 is stationary. The hydraulic fluid from 63 flows through passage 72 to the fourth bore and out through discharge port 58 to the discharge passageway 56 leading to the reservoir 74.

To move the second remote directional control spool 65 to the left, as viewed in FIG. 3, the cam plate 24 depresses the fourth plunger assembly which compresses the spring 37*d*, thereby moving the fourth auxiliary spool. When the fourth auxiliary spool is moved, hydraulic fluid moves from the supply passage 55 through the fourth bore and out passageway 72. The hydraulic fluid in passage 72 causes the second end 63 to move to the left, thereby compressing spring 88*d*. When the hydraulic force on the spring 88*d* is in equilibrium with the hydraulic force on the spring 37*d*, the second end 62 is stationary. The hydraulic fluid from 62 flows through passage 71 to the second bore and out through discharge port 58 to the discharge passageway 56 leading to the reservoir 74.

In one embodiment, the first and second remote directional control spools 64 and 65 start to close off the opening center in the directional control valve 82 after the handle 13 has pivoted three degrees. The hole 54 in the receptacle 28 is sized so that the light from the light emitting diode 19 is blocked from the photosensitive transister 31 after a two degree rotation.

While the present invention has been described as controlling a remote solenoid to actuate a pressure build-up valve, it is understood, that it may also be used in other applications than in a utility section of a directional control valve. One such example would be the application of actuating a solenoid that would operate a two-way or selector valve.

The present invention could easily be modified to control a variety of circuits requiring a control signal in addition to a solenoid. The control signal from the relay switch 45 could control a horn, buzzer or other warning circuits.

Modifications of the invention will be apparent to those skilled in the art in light of the foregoing description. This description is intended to provide specific examples of individual embodiments which clearly disclose the present invention. Accordingly, the invention is not limited to these embodiments or to the use of elements having specific configurations and shapes as presented herein. All alternative modifications and variations of the present invention which follows in the spirit and broad scope of the appended claims are included.

What is claimed is:

1. A joystick controller having a handle which has an axis with respect to which it is pivoted about a point and a means for transmitting a movement in the handle to a plurality of auxilary spools, the auxiliary spools actuating a plurality of remote direction control spools to remotely control hydraulic directional control valves and the movement controlling a device for actuating a pressure build-up in an actuator circuit comprising:

(a) radiant energy means carried by the handle and emitting radiant energy generally parallel to a longitudinal axis of the handle;

(b) means for receiving said radiant energy and providing a control signal dependent upon a relative movement of the handle, thereby controlling the device that is operable by said control signal; and

(c) a receptacle positioned between said radiant energy means and said receiving means, said receptacle having a hole to allow the radiant energy to be received by said receiving means when said handle is in a neutral position and said receptacle to block said radiant energy when the handle moves off the neutral position.

2. The controller of claim 1, wherein said radiant energy means is a light emitting diode.

3. The controller of claim 2, further comprising a fiber optic light conductor extending from said radiant energy means toward said receiving means and terminating at a position spaced from said receiving means.

4. The controller of claim 3, wherein said receiving means is a photosensitive transistor.

5. The controller of claim 1, wherein said hole is of such a diameter, whereby said receptacle blocks said

radiation energy from being received by said receiving means after a rotation of the handle that is less than the rotation required to start closing off the open center in the directional control valves and directs a main pump flow to work ports in the directional control valves.

6. The controller of claim 5, wherein after a 2 degree rotation of the handle, said receptacle will block said radiation energy from being received by said receiving means.

7. A joystick controller having a handle which has an axis with respect to which it is pivoted about a point and a means for transmitting a movement in the handle to a plurality of auxilary spools, the auxilary spools actuating a plurality of remote direction control spools to remotely control hydraulic directional control valves and the movement controlling a solenoid for actuating a pressure build-up valve in an actuator circuit comprising:

(a) a light emitting diode carried by the handle, said diode emitting light generally parallel to a longitudinal axis of the handle;

(b) a photosensitive transistor for receiving said light from said light emitting diode;

(c) said photosensitive transistor providing a control signal dependent upon a relative movement of the handle, thereby controlling the remote solenoid which activates a pressure build-up valve;

(d) a fiber optic light conductor extending from said light emitting diode toward said photosensitive transistor and terminating at a position spaced from said photosensitive transistor, thereby providing a passage for the light from said light emitting diode to said photosensitive transistor; and

(e) a receptacle positioned between said light emitting diode and said photosensitive transistor, said receptacle having a hole to allow said light from said light emitting diode to be received by said photosensitive transistor when said handle is in a neutral position and said receptacle to block said light when the handle is moved off the neutral position.

8. A joystick controller in a hydraulic control to remotely control hydraulic directional control valves and a solenoid for actuating a pressure build-up valve in an actuator circuit comprising:

(a) a housing having a supply passage for connection to a supply, a discharge passage for connection to a reservoir, a first, second, third and fourth axial bore connected to said supply and discharge passage;

(b) said first bore connected to a first end of a first remote directional control spool, said second bore connected to a second end of a first remote directional control spool, said third bore connected to a first end of a second remote directional control spool and said fourth bore connected to a second end of a second remote directional control spool;

(c) a mounting plate cooperatively connected to said housing;

(d) a handle having a pivot ball at one end;

(e) a ball pivot socket cooperatively connected to said mounting plate;

(f) said pivot ball cooperatively connected to said ball pivot socket;

(g) means for actuating an auxiliary spool in each of said bores, whereby the first and second directional control spools are displaced;

(h) radiant energy means carried by the handle and emitting radiant energy generally parallel to a longitudinal axis of said handle;

(i) means for receiving said radiant energy and said receiving means providing a control signal dependent upon a relative movement of said handle, thereby controlling remote solenoid that is operable by said control signal, wherein when said handle is in a position which starts to close off an open center in the directional control valve and directs a main pump flow to work ports in the directional control valve, said receiving means is not to be irradiated by said radiant energy from said radiant energy means.

9. Apparatus for actuating a pressure build-up valve in a hydraulic device which includes a plurality of spools controlled by a joystick controller which has an axis with respect to which it is pivoted about a point between a neutral position and various offset positions in which the spools are moved to effect operation of the device, comprising:

(a) radiant energy emitting means carried by the controller and transmitting energy unidirectionally;

(b) a radiant energy receiver disposed such that said radiant energy irradiates said receiver when the controller is one of in and closely proximate its neutral position;

(c) means responsive to movement of the controller for providing a control signal, said control signal operatively connected to a pressure build-up valve for energizing a pressure build-up valve when said receiver is not irradiated and for de-energizing a valve when said receiver is irradiated; and

(d) a receptacle positioned between said radiant energy means and said receiving means, said receptacle having a hole to allow the radiant energy to be received by said receiving means when said handle is in a neutral position and said receptacle to block said radiant energy when the handle moves off the neutral position.

10. In a hydraulic control system of the type having a joystick controller having a handle which has an axis with respect to which it is pivoted about a point and a means for transmitting a movement in the handle to a plurality of auxiliary spools, the auxiliary spools actuating a plurality of remote directional control spools to remotely control hydraulic directional control valves and an actuator device circuit, wherein the improvement comprises:

(a) radiant energy means carried by the handle and emitting radiant energy generally parallel to a longitudinal axis of the handle;

(b) means for receiving said radiant energy and providing a control signal dependent upon a relative movement of the handle, thereby controlling the device circuit that is operable by said control signal; and

(c) a receptacle positioned between said radiant energy means and said receiving means, said receptacle having a hole to allow the radiant energy to be received by said receiving means when said handle is in a neutral position and said receptacle to block said radiant energy when the handle moves off the neutral position.

11. The control system of claim 10, wherein said radiant energy means is a light emitting diode.

12. The control system of claim 11, further comprising a fiber optic light conductor extending from said radiant energy means toward said receiving means and terminating at a position spaced from said receiving means.

13. The control system of claim 12, wherein said receiving means is a photosensitive transistor.

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