June 1, 1965 R. C. SCHNECKLOTH 3,186,432

HYDRAULIC ACTUATING AND CONTROL SYSTEMS

Filed Sept. 26, 1963 2 Sheets-Sheet 1

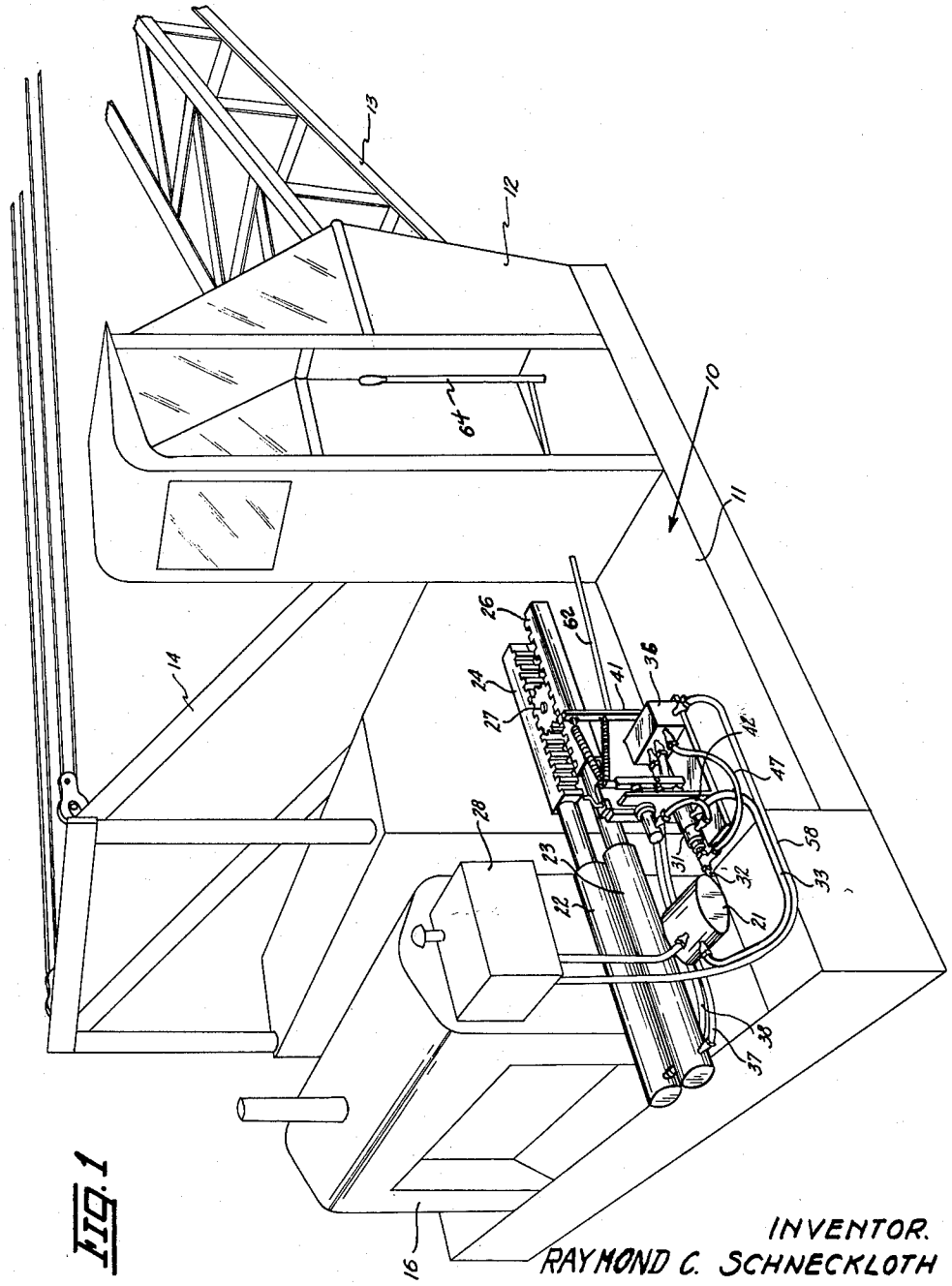


Fig. 1

INVENTOR.
RAYMOND C. SCHNECKLOTH

BY Corey & Corey
ATTORNEYS

June 1, 1965 R. C. SCHNECKLOTH 3,186,432

HYDRAULIC ACTUATING AND CONTROL SYSTEMS

Filed Sept. 26, 1963 2 Sheets-Sheet 2

FIG. 2

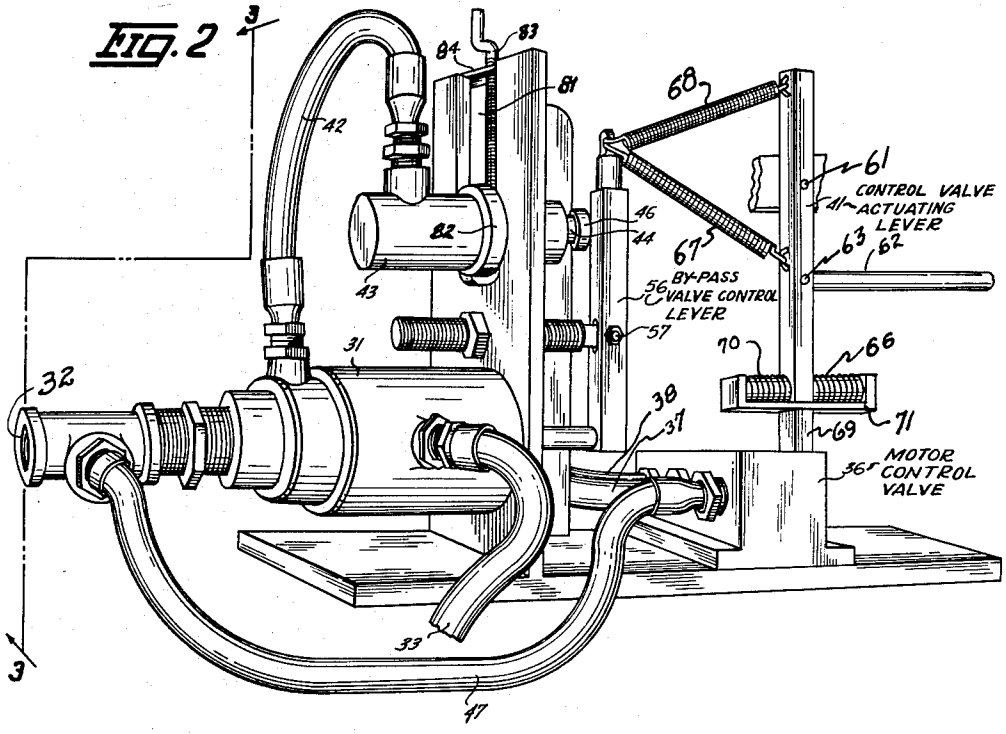
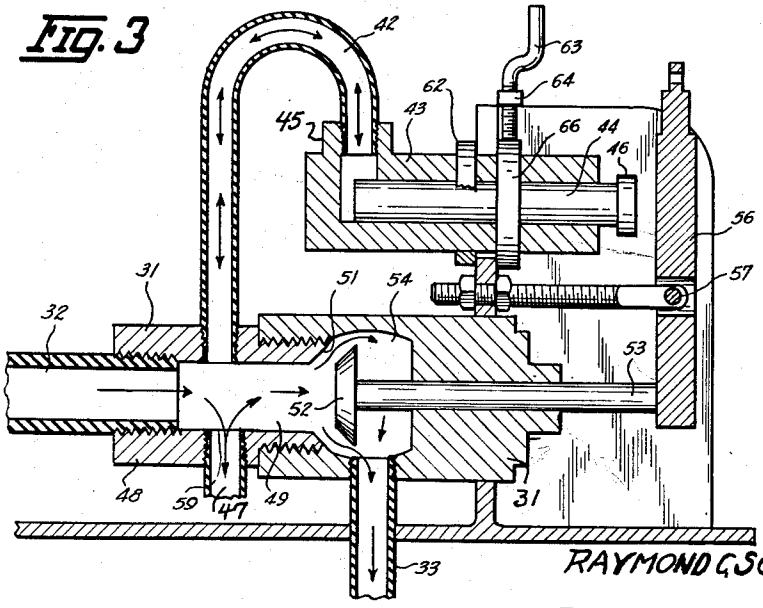


FIG. 3



INVENTOR.
RAYMOND C. SCHNECKLOTH

BY Corey & Corey
ATTORNEYS

United States Patent Office 3,186,432 Patented June 1, 1965

3,186,432

HYDRAULIC ACTUATING AND CONTROL SYSTEMS

Raymond C. Schneckloth, Rte. 2 on Stockwell Lane, Clinton, Iowa

Filed Sept. 26, 1963, Ser. No. 311,771
2 Claims. (Cl. 137—596.13)

This invention relates to hydraulic actuating and control systems and has particular relation to means for selectively assisting in the manual operation of control levers and the like for controlling the flow of hydraulic fluid to and from the cylinders or jacks utilized to actuate an excavating shovel, crane and the like, and particularly for furnishing fine control of such devices so that the operator can apply only the necessary force to secure the results he desires, and regulate the power and speed of the swing apparatus of such a device.

In the operation of cranes and the like, it is very desirable that the speed and power of the turntable be finely and accurately controlled. The operator may want to move the turntable relatively slowly or rapidly or with increasing and then decreasing speed. He may want to apply full power to the rotation, or only a select portion of the full power. He can do this best by actually feeling the power required to effect the desired control and, in so doing, he should not have to exert any considerable muscular force, yet the muscular force required for direct operation may be quite heavy.

For best control, both the speed and power required preferably is secured by muscular, sensory effort of the operator, but if such effort is heavy, the fineness of tactile effort may be dulled.

It is one of the objects of my invention to provide a new and improved control system for excavating shovels and the like in which the "feel" of the load may be actually felt by the motor senses of the operator.

It is a more specific object of my invention to provide a hydraulic valve control system in which the operator may, by feel, ascertain the amount of power and speed necessary to move and control the load and to feed back pressures to the operator's hand, so that he may actuate the crane to secure such action as necessary.

It is a still further object of my invention to provide means for varying the degree of pressure applied by the hydraulic system of the control apparatus.

A further object of my invention is to divide the back pressure between a mechanical control means and a muscular responsive control so as to reduce the muscular effort required to values well within the best tactile control effects.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawings and following specifications, wherein is disclosed a single exemplary embodiment of the invention, with the understanding however, that such changes may be made therein as fall within the scope of the appended claims, without departing from the spirit of the invention.

In said drawings:

FIGURE 1 is a view in perspective of the jacks and control system for a crane or the like constructed in accordance with one embodiment of my invention. The boom is not shown in its entirety.

FIGURE 2 is an enlarged view in perspective of the control and hydraulic assist system shown in FIGURE 1.

FIGURE 3 is a diagrammatic view in sectional relation of the control valve shown in FIGURE 2, to illustrate the interior structure.

Referring now to the drawings, and more particularly to FIGURE 1; the deck of the crane **10** is illustrated more or less diagrammatically at **11**, with the cab of the crane

indicated at **12** and the boom at **13**. The boom supporting frame is indicated at **14** and the power plant at **16**, all in accordance with usual practice. The engine of the power plant is utilized to raise and lower the boom and for other functions of this type of apparatus, also in accordance with the usual practice.

My control and actuating system, according to my invention, includes a pump **21** connected to the engine for pumping fluid under pressure to the motor means such as jacks **22** and **23**, which are employed to drive the respective gear racks **24** and **26** to rotate the platform by engagement and movement of the jacks on the stub pinion shaft **27** of the excavator base. Fluid for the hydraulic system is stored in the tank **28** located above the pump.

Referring more particularly to FIGURES 2 and 3, fluid under pressure from the pump is introduced into the valve body **31** by means of the hydraulic pressure supply line **32**. The hydraulic line **33** is a bypass line, better illustrated in FIGURES 2 and 3, and leads back to the low pressure side of the pump as indicated in FIGURE 1. The line **47** leads to the connection box **36** which is so chamberd that fluid under pressure will be led by line **37** to one end of one of the cylinders **23** while the other line **38** leads fluid under pressure to the cylinder **22**. The lever **41** is employed to move valves within the valve and connection block **36** to selectively actuate one cylinder or the other, depending on which direction of rotation is required. This valve body and valve system is constructed in accordance with the usual practice, but the lever system at **41** is novel and will be described.

The lever **41** is pivoted to a fixed pivot at **61**. The rod **62** is a push-pull rod and is connected at its rear end to lever **41** at **63** and to control lever **64** in cab **12**, with the control lever pivoted at its lower end. When the operator in the cab pushes forward on lever **64**, push-pull rod **62** pulls the lower portion of the lever **41** forward against spring **66** located on top of the valve operating lever **69** of two-way control valve **36** to set the valve to rotate the turntable in one direction. The pull of the rod **62** pulls cord **67** connected to an intermediate portion of valve control lever **56** to push valve **52** in throttling or closing position with relation to the seat **51** to supply fluid under pressure to the two-way valve **36** and rotate the turntable in one direction.

Note that the valves at **36** must operate in two directions from the closed position, while lever **56** and valve **52** operate in only one direction from the open position. Lever **69** is attached to yoke **71**. The lower end of lever **41** may move forward and back against springs **66** and **70**.

When the operator pulls back on control lever **64**, he forces lever **41** back against spring **70** to actuate the control lever **69** of two-way valve **36** in the opposite direction to set the two-way valve to direct fluid, under pressure, to the other jack to rotate the turntable in the other direction. Movement forward of the top of lever **41** causes cord **68** to also pull forward on the top of lever **56** to close valve **52** and direct fluid under pressure to the two-way valve **36** and to the other jack.

The auxiliary hydraulic line **42** leads from the chamber in the valve body **31** to a small auxiliary hydraulic cylinder or jack **43**, having plunger or ram **44** therein with an actuator button **46** at the outer end thereof. Thus when fluid under pressure is supplied to the valve body **31** by the line **32**, the fluid pressure is applied also to the chamber **45** behind the ram **44**.

A high pressure line **47** leads from the pressure line **32** to the valve body **36**, as shown in FIGURES 1 and 2, or may lead directly from the control valve body **31** to valve body **36** as shown in FIGURE 3. This line supplies fluid under pressure to the two-way valve at **36** and thus to the jacks **22** and **23**.

Now referring more particularly to the cut-away drawing, FIGURE 3; fluid under pressure from the pressure line 32 from the pump is led into the interior of the cylindrical cap-like portion 48 of the valve body 31, the chamber within the cap being indicated by the numeral 49.

The inner end of the cylindrical cap 48 is chamfered, as illustrated at 51, to receive the head 52 of the valve stem 53 and a chamber 54 is provided below the valve head. The bypass line 33 is connected to the chamber 54 below the valve. Thus when the valve is withdrawn from its seat, the fluid under pressure from supply line 32 can pass through the by pass line 33 and back into the body of the pump 21.

When, however, the valve is forced forward against the seat as by means of a lever 56, pivoted at 57, the fluid under pressure cannot pass through the bypass conduit 33 and thus is forced through the conduit 47 leading to the valve chamber 36, and thence to one or the other high pressure ends of the cylinders 22 and 23 to selectively drive one or the other of the rams to rotate the turntable on its base. A return line 58 leads from the exhaust side of the jacks 31 and 32 in accordance with the usual practice, and the fluid being exhausted passes back through the intake of the pump.

At the same time that fluid is forced through the port 59 in the cylindrical cap 48, it is also driven out through the line 42 to the auxiliary cylinder 43. The pressure thus applied within the cylinder 43 causes the ram 44 of the cylinder to be driven outwardly from the cylinder and the head 46 engages the lever 56 above its fulcrum point 57 to augment the pressure applied by the operator, and thus affords additional pressure for closing valve 52 against its seat 51.

The degree of pressure of the head 46 against the lever 56 may be increased or decreased by raising or lowering the cylinder 43 in its slot 81, and locking means 82 may be employed to lock the cylinder at any desired position in the slot.

Moving the cylinder up and down is accomplished by means of the screw shown at 83, which has threaded engagement in the nut 84 and the head of which is engaged to the ring 66 which supports the cylinder. In this way more or less pressure may be applied by the assist cylinder so that any desired division of back pressure may be secured to regulate the degree of pressure the operator exerts to move the valve against the pressure of the fluid from the pump.

In this manner, the operator may secure the assistance of the assist cylinder to any desired degree so that limited manual pressure is needed, and thus the operator can regulate the degree of closing of the valve with very fine movements, as desired, and secure any desired degree of throttling of the fluid escaping through the bypass line 33 and move the table very slowly with very little power, or he may apply full power to rotate the table at its maximum rate.

By use of devices constructed according to my invention, the operator is enabled to "feel" the load of starting and stopping the turntable and accommodating the power of this hydraulic system to the needs set up by the load. For instance, in starting to rotate the turntable it is apparent that if the table were tilted, or the load heavy or light, or at short or long radius with short or long boom, or if the machine is employed in casting the bucket or other load, an infinite variation of a combination of speed and power is required. The operator, by the use of my invention, can apply manual pressure only sufficient to do what he senses must be done and actual touch and muscle sense is given full scope to supply only the power and speed necessary to secure the desired result.

The assist cylinder supplements the variable manual effort of the operator in varying degree according to the

pressure the operator applies, with greater assist when great operation pressure is necessary, and less when less pressure is required, but always in a proportionate part of the total and without at any time taking over the control.

The amount of assistance can be varied to suit the individual by adjustment of the assist cylinder up or down.

The greater the load, the greater the muscular sensory effort required, but excessive musclar effort is avoided. Any desired proportion of "feel" may be secured and a nice, smooth "feel" is an outstanding characteristic of machines incorporating my control. A slight individual may operate the machine all day without heavy muscular exertion and yet secure the same high efficiency secured by the big strong operator.

The only resistance to movement of the valve is created by the hydraulic pressure required to move the load; therefore the manual effort required by the operator is proportionate to the load. No springs are required. The force required to move and control the load is proportionate to the effort required by the operator to move his control lever and is proportionate through the entire range of loads. Further, this proportion of effort required by the operator may be varied in degree as desired.

Although I have described a specific embodiment of my invention, it is apparent that modifications thereof may be made by those skilled in the art. Such modifications may be made without departing from the spirit and scope of my invention as set forth in the appended claims.

I claim as my invention:

1. In a hydraulic system for actuating a fluid actuated device from a source of fluid pressure, a control valve means having a high pressure supply line port adapted to be connected to said source of fluid pressure, said control valve means having multiple use ports adapted to be connected to said fluid actuated device, pivoted control lever means for actuating said control valve means, said control lever means being movable from a central cut-off position in opposite directions to open positions at which said valve will discharge through selected ones of said use ports, a by-pass line in fluid communication with said supply line port and leading to a low pressure zone, a by-pass valve in said by-pass line, said by-pass valve being oriented so its movement toward a closed position is opposed by pressure in said high pressure supply line port, a pivoted by-pass lever operating said by-pass valve, flexible means connecting points on said control lever means at opposite sides of the fulcrum thereof with a given point on said by-pass lever to move said by-pass valve toward its closed position when said control lever is moved to any of its open positions, and means for augmenting movement of said by-pass valve toward its closed position including an auxiliary hydraulic cylinder in communication with said high pressure supply line port, said cylinder having a ram bearing against said by-pass lever.

2. A hydraulic system as set forth in claim 1 including a mounting for the auxiliary cylinder which permits movement of the cylinder toward and away from the fulcrum of the lever to decrease and increase the effective moment delivered to said lever.

References Cited by the Examiner

UNITED STATES PATENTS

2,115,414	4/38	Davis	91—426 X
2,243,364	5/41	Trautman	60—52
2,322,611	6/43	Winkler	91—426 X
2,729,241	1/56	Clark	137—596.13
2,782,802	2/57	Sassen	137—596.12
2,979,908	4/61	Shook	60—97

JULIUS E. WEST, *Primary Examiner.*