Sept. 21, 1965 T. R. HALL 3,207,044

FEEDER TUBE CYLINDER

Filed May 20, 1963 2 Sheets-Sheet 1

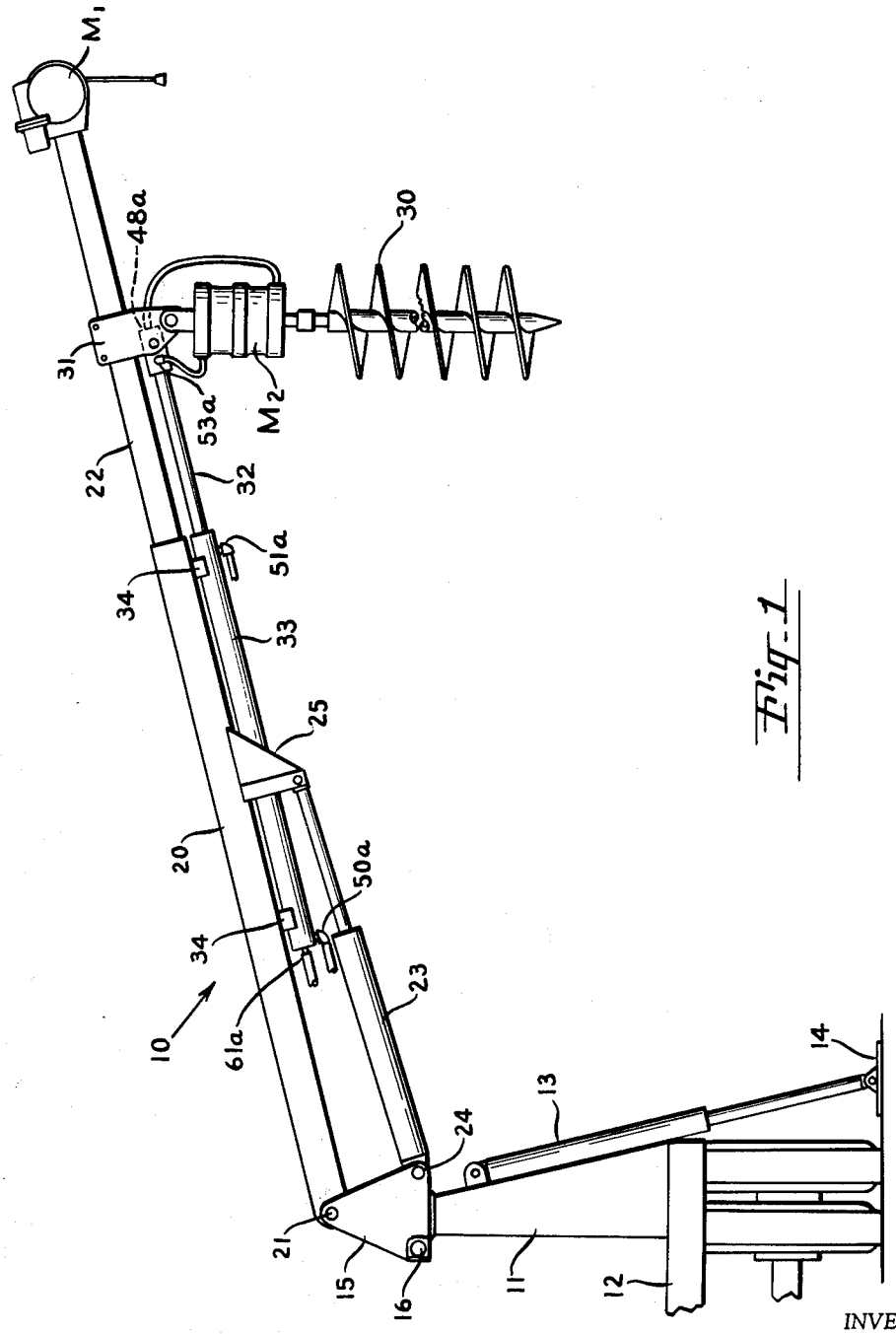

Fig. 1

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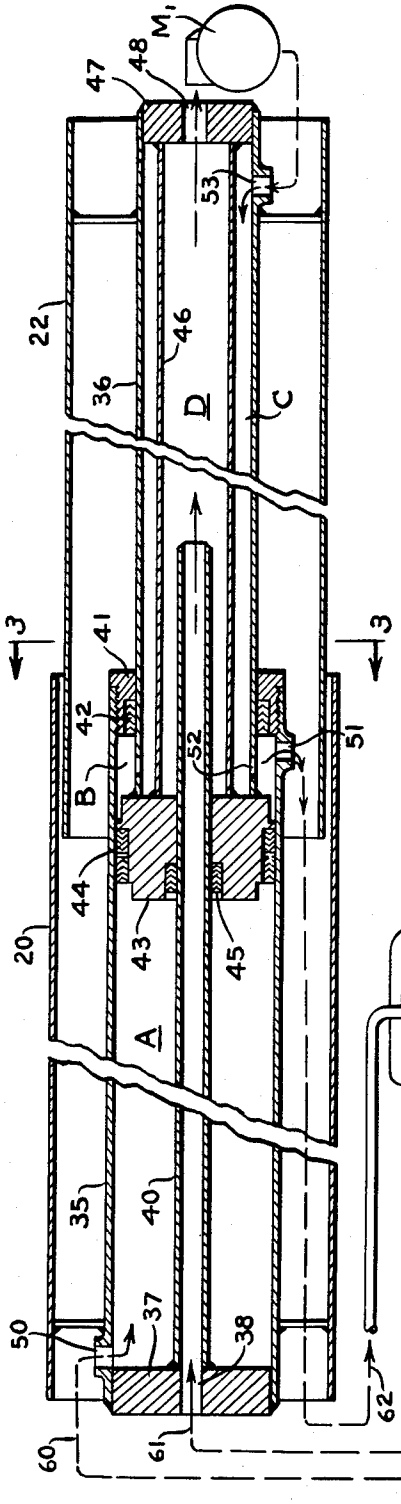


Fig-2A

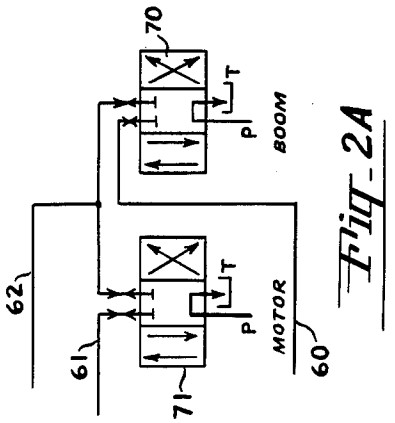


Fig-3

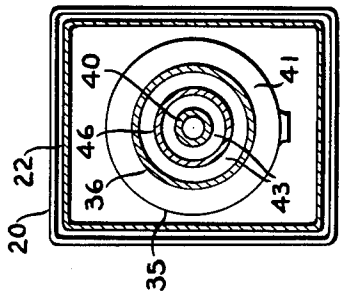
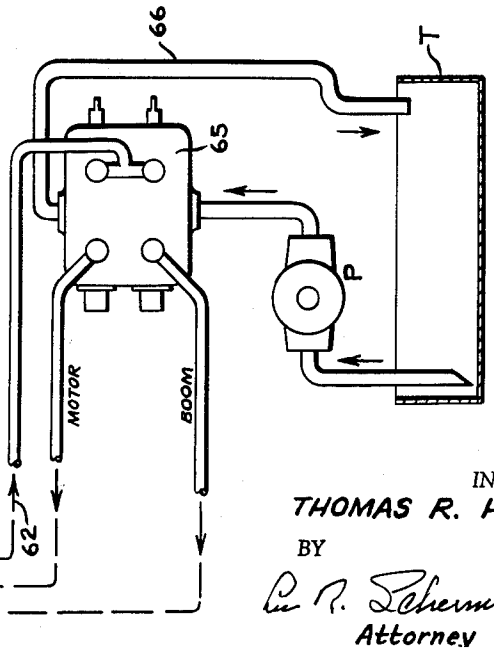


Fig-2



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3,207,044
Patented Sept. 21, 1965

3,207,044

FEEDER TUBE CYLINDER

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Filed May 20, 1963, Ser. No. 281,640
19 Claims. (Cl. 91—414)

This invention relates to a double acting fluid pressure cylinder having a novel feeder tube arrangement, for positioning and supplying and exhausting a second fluid pressure operated device from a hollow piston rod extending from the cylinder.

The invention is of general application but is of particular advantage in connection with devices operated by fluid pressure motors on the end of an extensible boom. For example, a hoist drum operated by a reversible fluid pressure motor may be mounted on the end of an extensible derrick boom. Heretofore, it has been necessary to supply such motor with flexible fluid conduits which require some means for taking up the slack in the conduits when the boom is retracted. It is highly desirable to dispense with the flexible conduits and, particularly, to obviate the necessity for slack take-up means for handling the excess length of conduits when the boom is retracted.

The general object of the present invention is, therefore, to provide means for positioning and supplying and exhausting a fluid pressure operated device on an extensible piston rod in a fluid pressure cylinder without the use of flexible conduits.

Further objects are to provide means for the purpose described, utilizing a hollow piston rod and a feeder tube in the cylinder, to provide a feeder tube arrangement through the body of a cylinder and piston unit itself, to provide a hydraulic circuit through a hydraulic cylinder and piston rod functionally independent of the hydraulic circuit for the cylinder, to provide an improved extensible boom derrick having a hydraulic motor mounted on the end of the boom, and to provide an extensible boom derrick having a pair of hydraulic motors on the boom.

The foregoing and other objects and advantages will become apparent and the invention will be better understood from the following description of the preferred embodiment illustated in the accompanying drawings. Various changes may be made, however, in the details of construction and arrangement of parts and all such modifications within the scope of the appended claims are included in the invention.

In the drawings:

FIGURE 1 is a side elevation view of a derrick embodying the principles of the invention;

FIGURE 2 is a sectional view of the derrick boom including its fluid pressure system;

FIGURE 2A is a diagram of the valve arrangement in the fluid pressure system using conventional symbols; and

FIGURE 3 is a cross sectional view taken on the line 3—3 of FIGURE 2.

In FIGURE 1 the derrick boom **10** is mounted on a base pedestal **11** on the rear corner of a truck **12**. The pedestal is provided with an outrigger hydraulic ram **13** equipped with a ground shoe **14** to stabilize the derrick and take the major portion of the derrick load off the truck spring. A similar outrigger stabilizer is preferably provided on the other side of the truck (not shown). The derrick boom is mounted for lateral swinging movements on the pedestal. For this purpose, the boom base member **15** may be equipped with a worm in mesh with a worm gear on pedestal **11**, the worm being rotatable by a worm shaft **16** which is adapted to receive a crank or other suitable means for turning it.

A lower boom section **20** is pivotally mounted at **21** on the boom base **15**. An upper boom section **22** telescopes within the lower section **20**. The boom may be

raised and lowered by a conventional hydraulic ram **23** which is pivotally connected at **24** with the boom base **15**. A piston rod extending from the upper end of the ram is pivotally connected with a bracket **25** on the boom section **20**. Mounted on the outer end of boom section **22** is a reversible hydraulic motor M_1 associated with a hoist drum or other power operated device.

It is often desirable to provide a second power operated device on the boom as, for example, an augur or post hole digger **30**. The augur **30** is rotated by a reversible hydraulic motor M_2 which hangs from a slide **31** on the upper boom section **22**. The augur may be extended and retracted along boom section **22** by a piston rod **32** in a double acting hydraulic cylinder **33**. Cylinder **33** is rigidly mounted at **34** on the lower boom section **20**.

Piston rod and cylinder **32, 33** have a novel form of construction embodying important features of the invention and the boom sections **22, 20** house a similar novel piston rod and cylinder construction, the latter being illustrated in longitudinal section in FIGURE 2.

In the present derrick the boom sections **20, 22** are rectangular in cross section, the lower section containing and being rigidly connected with a double acting cylinder **35**, and the upper section containing and being rigidly connected with a tubular piston rod **36**. The inner or left end of cylinder **35** is closed by a head **37** which has a central fluid connection **38** communicating with a tube **40** mounted on the head. The outer or right end of cylinder **35** is closed by a head **41** which has a circular seal **42** engaging the piston rod tube **36**.

Piston rod tube **36** is connected with its piston **43**. The piston has an outer sealing ring **44** engaging the inside of cylinder **35** and is centrally apertured and provided with an inner sealing ring **45** engaging the outer surface of tube **40**. Also connected with the piston is an inner piston rod tube **46** within which the tube **40** extends. The outer ends of the piston rod tubes are closed by a head **47** which is centrally apertured to provide a fluid connection **48** for the motor M_1.

The cylinder and piston rod construction just described forms a plurality of fluid chambers. The cylinder **35** has an inner end chamber A which is equipped with an external fluid connection **50** to admit fluid pressure for extending the piston rod. On the other side of the piston, the cylinder **35** contains an outer end chamber B with an external connection **51** for supplying fluid pressure to retract the piston rod. Between the two piston rod tubes **36** and **46** is an annular fluid chamber C, and within the inner tube **46** is another fluid chamber D. Outer tube **36** has one or more port openings **52** at its inner end interconnecting chambers B and C. The outer end of tube **36** is provided with a fluid connection **53** for the motor M_1.

The external fluid circuit comprises a conduit **60** from connection **50**, a conduit **61** from connection **38** and a conduit **62** from connection **51**. These three conduits are all connected with a control valve unit **65** which is supplied by pump P from a hydraulic reservoir or tank T. Discharge from cylinder **35** and motor M_1 returns to the tank through a conduit **66**.

In FIGURE 2A, the valve unit **65** is shown by conventional symbols as two separate three-position, four-connection manual valves for convenience in tracing the fluid circuits. It is to be understood, however, that the various valve functions to be described may be performed by a single combined valve or by different types of valves which are effective to perform the necessary functions. In FIGURE 2A a boom valve **70** controls extension and retraction of the boom, and a motor valve **71** starts, stops and reverses the hydraulic motor M_1.

Ordinarily, the first hydraulic operation is to extend the boom. This is accomplished by moving boom valve

70 to the right, making conduit 60 a pressure line and conduit 62 a return or discharge line. Thus, fluid pressure is supplied to chamber A causing the piston 43 to move outward to the right, discharging liquid from chamber B through conduit 62 to tank T. When the boom has been sufficiently extended, valve 70 is returned to its middle position shown whereby the piston is hydraulically locked against movement in either direction.

In order to operate motor M_1 forward, motor valve 71 is moved to the right making conduit 61 a pressure line and conduit 62 again a discharge line. Hydraulic pressure is then delivered through tube 40 and chamber D to the motor and discharged from the motor through chamber C, port 52 and chamber B to discharge line 62. The hydraulic lock on the outer end of piston 43 is thereby relieved but there is no tendency for the piston to move outward because chamber A remains sealed by the closed position of boom valve 70.

If desired, the boom may be extended while motor M_1 is running forward. The shifting of boom valve 70 to the right to extend the boom does not interfere with the forward operation of the motor. Suitable stop means are provided to limit the extension of the piston rod so that ports 52 will not be closed by seal 42.

Reverse operation of motor M_1 is produced by shifting motor valve 71 to the left. Then conduit 62 is the pressure line and conduit 61 is the discharge line. Pressure in line 62 is transmitted through chamber B, port 52 and chamber C to the motor in reverse direction and the motor discharge passes through chamber D and tube 40 back to the line 61. The introduction of pressure into chamber B does not disturb the boom because chamber A on the opposite side of piston 43 is closed and sealed at boom valve 70. Thus, the motor M_1 may be started, stopped and reversed without disturbing the position of upper boom section 22.

When it is desired to retract the boom, boom valve 70 is shifted to the left. This again makes conduit 62 a pressure line and conduit 60 a discharge line. Pressure is transmitted from conduit 62 into chamber B and fluid is discharged from chamber A into conduit 60. Motor M_1 is not affected by extension or retraction of the boom as long as motor valve 71 remains in its central off position, closing the end of conduit 61. If desired, however, the motor may be operated in reverse while the boom is being retracted. Conduit 62 then supplies both chamber B and the motor. Motor discharge returns through conduit 61 and chamber A discharge returns through conduit 60, both of which are then open to the tank T through the valves 70 and 71 both in left positions.

Piston rod 32 and cylinder 33 are constructed the same as the piston rod and cylinder in FIGURE 2, lacking merely the structural boom tubes 22, 20, and similar conduit and valve arrangements are provided. The end of piston rod 32 has a fluid connection 48*a* similar to connection 48 in FIGURE 2 supplying fluid pressure for forward rotation of motor M_2. A connection 53*a* similar to 53 supplies fluid pressure for reverse rotation. Cylinder 33 has fluid connections 50*a*, 51*a* and 61*a* corresponding to 50, 51 and 61, respectively.

After boom section 22 has been extended, the slider 31 may be extended to a desired position and motor M_2 may be started, stopped and reversed. When the derrick is mounted on the back end of a truck as shown, the retraction of the boom permits it to be swung over the cab of the truck for transportation without projecting beyond the front end of the truck, and when the boom is extended it will afford sufficient reach in all directions to accomplish its intended work. Flexible hydraulic conduits and slack take-up means associated with the boom extension are eliminated.

Ordinarily, it is not necessary to operate either motor M_1 or M_2 while it is being extended or retracted, thus making it convenient to combine the two valves 70 and 71 into a single valve unit when desired. Two separate valves are shown primarily to simplify the explanation of the fluid circuit so that the principles of the invention may be more readily understood.

The present fluid pressure system is suitable for either hydraulic fluid or compressed air. In either case the system is not limited to use with rotary motors but may be used to provide a pressure fluid circuit for any purpose whatsoever. As another example, it is often useful to supply fluid pressure for operating portable hydraulic or pneumatic tools in operations where it would be inconvenient to use long flexible hose conduits extending all the way back to the pump or compressor. Such tools and devices do not have to be supported by the boom in order to utilize the important advantages of the invention.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. A double acting fluid pressure cylinder and piston unit having a piston rod with fluid passageways therein, a reversible fluid pressure operated unit having inlet and outlet connections with said piston rod, and means in said cylinder and piston rod to operate both of said units individually from external supply connections with said cylinder.

2. A double acting cylinder, a piston in said cylinder having a hollow piston rod, a reversible fluid pressure operated device supplied through said piston rod, a fluid connection in the inner end of said cylinder communicating with the inner end cylinder chamber, a fluid connection for said device in the inner end of said cylinder and communicating with said piston rod, and a fluid connection in the outer end of said cylinder communicating with the outer end cylinder chamber and said piston rod.

3. A cylinder, a head in one end of said cylinder, a fluid connection in said end of said cylinder, a piston in said cylinder, a piston rod on said piston extending out of the other end of said cylinder, said piston rod comprising inner and outer concentric tubes, a head in said outer end of said cylinder surrounding said piston rod, a central fluid connection in said first head, a tube connected with said first head in communication with said central connection and extending through said piston into said inner tube of said piston rod, a fluid connection in said other end of said cylinder, a port in said outer piston rod tube adjacent said piston, a head closing the outer ends of both piston rod tubes, a fluid connection in said last head communicating with said inner tube, and a fluid connection in the outer end portion of said outer tube.

4. An extensible boom for supplying a reversible fluid pressure operated device, comprising lower and upper telescopic boom sections, said lower boom section including a double acting cylinder and said upper boom section including a piston rod in said cylinder, inlet and outlet fluid connections in the outer end of said piston rod for said device, a pair of passageways extending from said connections longitudinally through said piston rod, a fluid connection communicating with the inner end of said cylinder, a fluid connection in said cylinder communicating with one of said piston rod passageways, and a fluid connection in said cylinder communicating with the outer end of said cylinder and the other of said piston rod passageways.

5. An extensible boom for carrying a fluid circuit, comprising telescopic lower and upper boom sections, said lower boom section including a double acting cylinder and said upper boom section including a piston rod in said cylinder, inlet and outlet fluid connections for said fluid circuit in said piston rod, and means in said piston rod and cylinder for supplying said connections from said cylinder.

6. A derrick comprising an extensible boom having telescopic lower and upper boom sections, said lower section including a double acting cylinder and said upper section including a hollow piston rod in said cylinder, a

reversible fluid motor on the outer end of said upper boom section, inlet and outlet fluid connections in said piston rod for operating said motor, fluid connections in said cylinder for operating said piston rod and motor individually, and means interconnecting said piston rod fluid connections with said cylinder fluid connections, all within said cylinder and piston rod.

7. A derrick having an extensible boom, said boom comprising telescopic lower and upper boom sections, said lower boom section including a double acting cylinder and said upper boom section including a piston rod in said cylinder, a reversible fluid pressure operated device on the outer end of said upper boom section, inlet and outlet fluid connections for said device in said piston rod, a double acting cylinder on said lower boom section having a piston rod, a reversible fluid pressure operated device mechanically connected with said second piston rod and supported for sliding movement on said upper boom section, and inlet and outlet fluid connections for said second device in said second piston rod.

8. A derrick having an extensible boom, said boom comprising telescopic lower and upper boom sections, a double acting cylinder on said lower boom section having a piston rod, a reversible fluid pressure operated device mechanically connected with said piston rod and supported for sliding movement on said upper boom section, and inlet and outlet fluid connections for said device in said piston rod.

9. A double acting cylinder, a piston in said cylinder having a hollow piston rod, a reversible fluid pressure operated device supplied through said piston rod, and fluid pressure and discharge connections in said cylinder for said cylinder and said device, said device being reciprocable by said piston rod.

10. The structure of claim 9, including upper and lower boom sections, said upper boom section being extendable and retractable by said piston rod, and said device being carried by said upper boom section.

11. The structure of claim 1, said section unit being reciprocable by said piston rod.

12. The structure of claim 11, including upper and lower boom sections, said upper boom section being extendable and retractable by said piston rod, and said second unit being carried by said upper boom section.

13. The structure of claim 2, said device being reciprocable by said piston rod.

14. The structure of claim 13, including upper and lower boom sections, said upper boom section being extendable and retractable by said piston rod, and said device being carried by said upper boom section.

15. The structure of claim 3, including a fluid pressure operated device reciprocable by said piston rod and supplied by said fluid connections in the outer end of said piston rod.

16. The structure of claim 15, including upper and lower boom sections, said upper boom section being extendable and retractable by said piston rod, and said device being carried by said upper boom section.

17. A double acting cylinder, a piston in said cylinder having a piston rod with a pair of longitudinal passages therein, a reversible fluid pressure operated motor reciprocable by said piston rod and having fluid inlet and outlet connections with said piston rod passages, fluid connections in said cylinder and piston rod, a fluid pressure supply, a valve unit, and external fluid connections between said cylinder, valve unit and supply arranged to operate said piston and motor individually.

18. The structure of claim 17, including upper and lower boom sections, said upper boom section being extendable and retractable by said piston rod, and said motor being carried by said upper boom section.

19. A double acting cylinder having a piston and a piston rod with a pair of longitudinal passages therein, said passages having connections in the outer end of the piston rod for an external fluid circuit, said cylinder having a rod end and an opposite end, one of said passages communicating with said rod end of the cylinder, a tube mounted in said opposite end of the cylinder and extending slidably through said piston and communicating with the other passage, and external fluid connections to said tube, said rod end of the cylinder and said opposite end of the cylinder, said cylinder having a fluid operating circuit through its two end connections for reciprocating said piston without energizing said external fluid circuit, and said external fluid circuit having fluid connections through said tube and said rod end of the cylinder for energizing said external fluid circuit without actuating said piston.

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