Feb. 21, 1956 C. H. HARPER ET AL 2,735,255

HYDRAULIC TREE SHAKER

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FIG. 1.

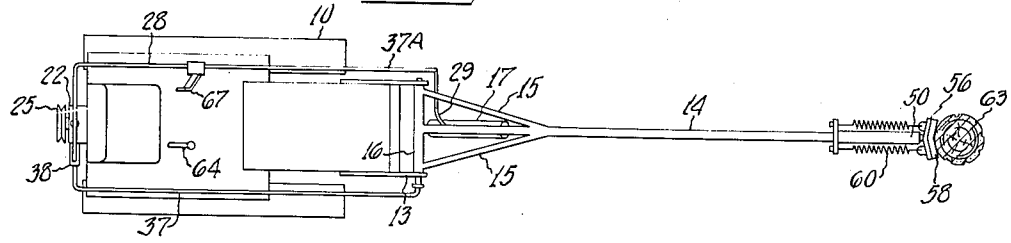

FIG. 2.

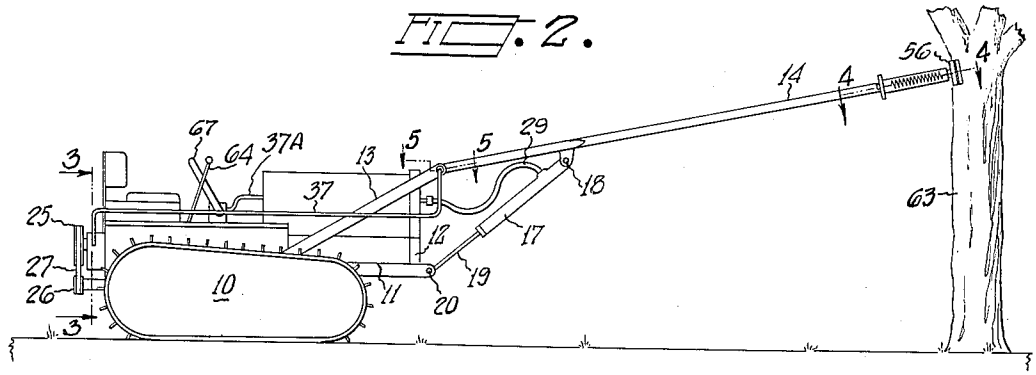

FIG. 3.

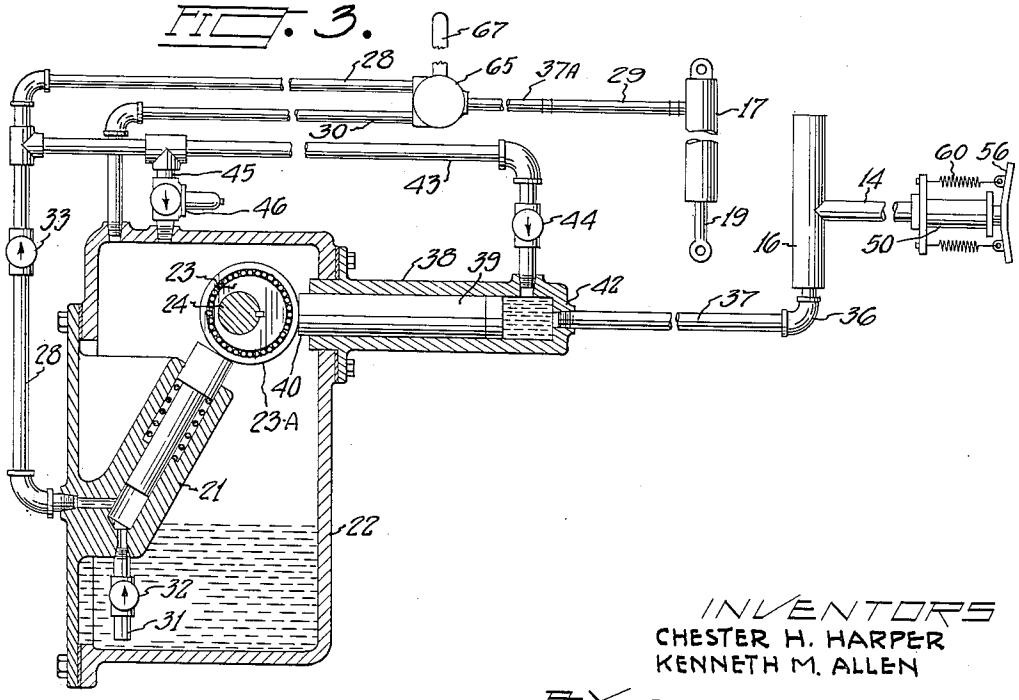

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FIG. 4.

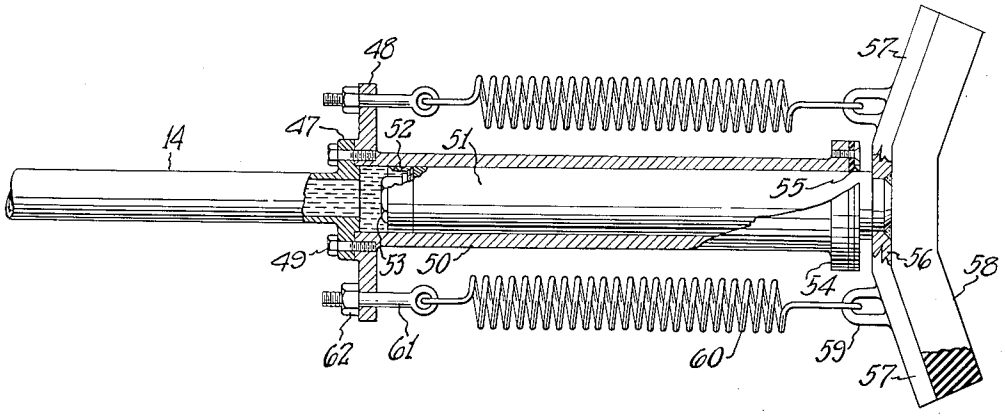

FIG. 5.

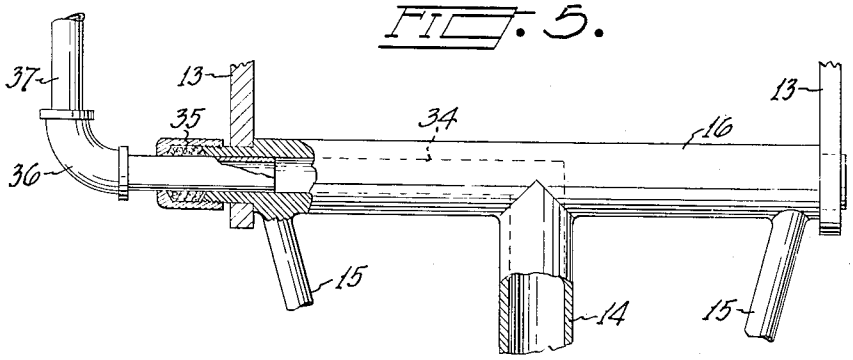

FIG. 6.

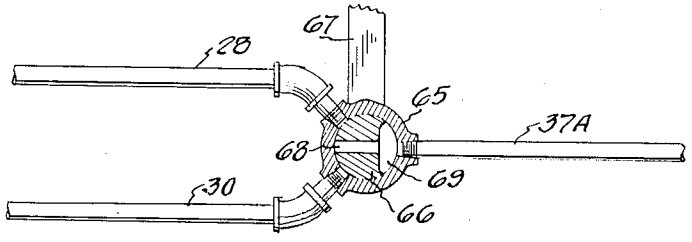

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FIG. 7.

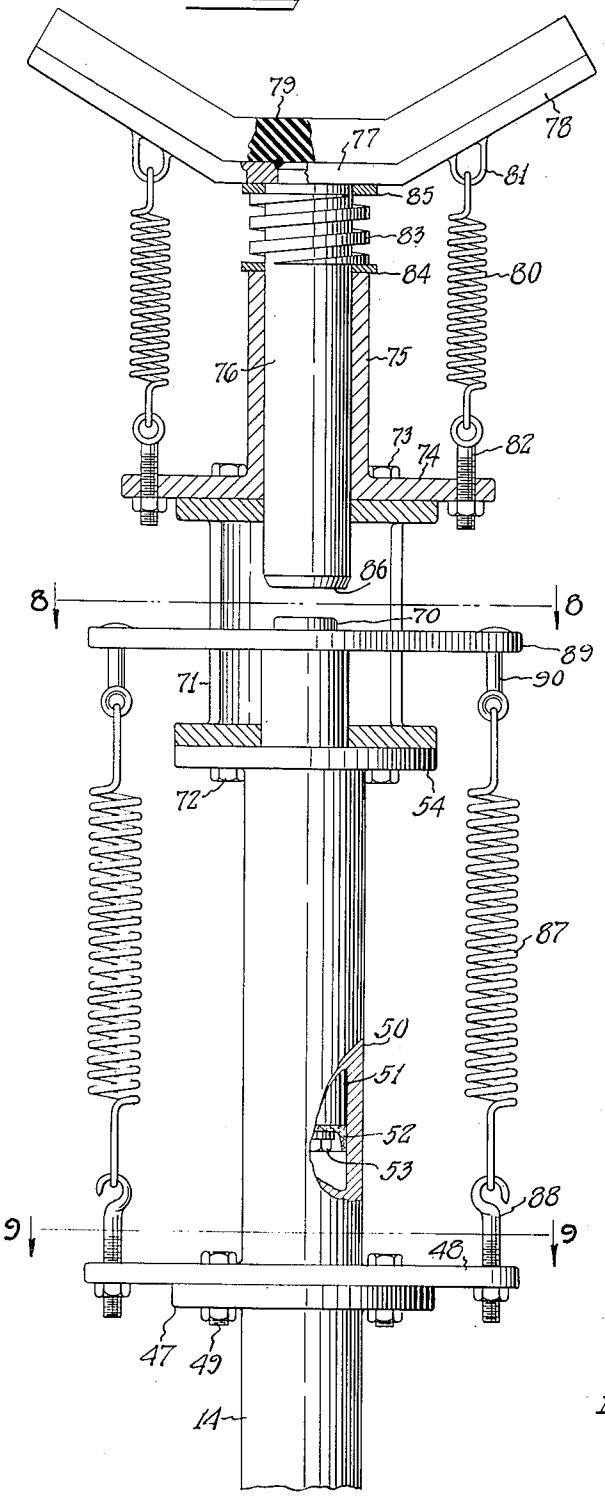


FIG. 8.

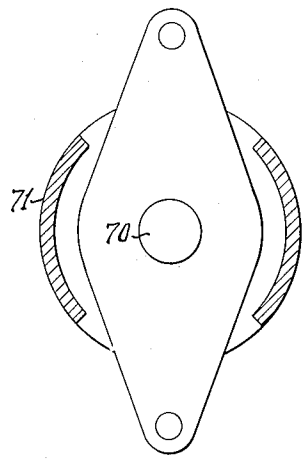
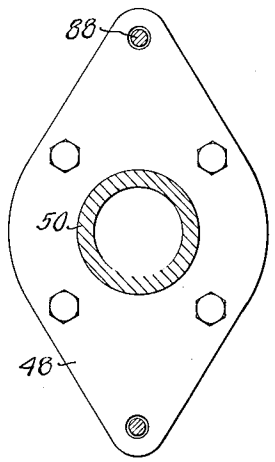


FIG. 9.



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HYDRAULIC TREE SHAKER

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Application April 25, 1952, Serial No. 284,376

9 Claims. (Cl. 56—328)

This invention relates generally to a means for hydraulically converting rotary movement into reciprocating movement and particularly to an apparatus for converting rotary movement to a reciprocating movement through the use of a hydraulic medium and the provision of a means for automatically maintaining a fixed oil supply in the actuator of the apparatus.

The main object of this invention is to provide an apparatus for converting rotary movement into reciprocating movement by hydraulic means in which the oil supply is automatically maintained.

The second object is to produce a device of the character described which is adaptable to a wide range of uses, as for operating wood barking spuds, drills for wood and concrete, tampers for concrete structures and molded objects made of concrete, vibrators or concentrators, shakers for fruit and nut trees, and other uses in which a vibratory action is desired.

A third object is to produce a device which will be low in weight and which will require a relatively low amount of power for a given amount of work done and in which the reaction of the device upon the operator is almost entirely eliminated.

The fourth object is to provide an apparatus of the class described in which the resulting movement obtained therefrom may vary from a sharp striking blow to a relatively soft shaking action, either of which may vary in degree depending upon the requirements of the problem at hand.

We accomplish these and other objects in the manner set forth in the following specifications as illustrated in the accompanying drawings, in which

Fig. 1 is a plan of the entire equipment.

Fig. 2 is a side elevation of Fig. 1.

Fig. 3 is an enlarged section taken along the line 3—3 in Fig. 2.

Fig. 4 is an enlarged section taken along the line 4—4 in Fig. 2.

Fig. 5 is an enlarged section taken along the line 5—5 in Fig. 2.

Fig. 6 is an enlarged portion of Fig. 3 with parts broken away to show the internal connections in a valve to the control hoist.

Fig. 7 is a view similar to Fig. 4 showing an alternate form of boom end in which provision is made for obtaining a striking action or a vibratory surging action.

Fig. 8 is a section taken along the line 8—8 in Fig. 7.

Fig. 9 is a section taken along the line 9—9 in Fig. 7.

Like numbers of reference refer to the same or similar parts throughout the several views.

In order to illustrate the present invention we have shown, by way of example only, a shaker for nut and fruit trees, although it must be understood that the essential elements: namely, the means for producing rotary motion. a reciprocating element and a hydraulic drive therebetween, including a means for maintaining an operating condition in the hydraulic drive, constitute the essence of invention and are usable, as stated, for different purposes.

Referring in detail to the drawing, there is shown a tractor 10 on whose chassis 11 are mounted the standards 12 which are held by the inclined braces 13.

Hinged on the foremost ends of the braces 13 is a tubular boom 14 which is provided with lateral braces 15. The boom 14 can swing in a vertical plane on the pivot shaft 16. A hydraulic jack or hoist 17 is attached to the boom 14 by a hinge 18, while its piston 19 is connected to the chassis 11 by a pin 20.

Oil is admitted from a pump 21 confined within the housing 22 and actuated by a cam 23 on the shaft 24 on which is mounted a pulley 25 which is driven from the power take-off pulley 26 through a belt 27.

Fluid is conducted from the pump 21 to the hoist 17 by a pipe 28 and hose 29 and is returned to the housing 22 through the pipe 30. Fluid is admitted from the sump in the housing 22 through a short pipe 31 in which is a check valve 32. There is also a check valve 33 in the pipe 28.

In the shaft 16 is formed a duct 34 which communicates with the interior of the boom 14 and is provided at its outer end with a stuffing box 35 which is connected by an L fitting 36 with the pipe 37 which in turn is connected to the end of the shaker pump cylinder 38 whose plunger 39 has a rounded end 40 which engages the runner 23–A on the cam 23. The plunger 39 is urged toward the cam 23 by pressure within the cylinder 38.

Fluid is admitted to the cylinder 38 between the plunger 39 and the closed end 42 through the pipe 43 which communicates with the pipe 28. In the pipe 43 is placed a check valve 44. The pipe 45 connects the pipe 43 with the housing 22.

In the pipe 45 is a spring-urged relief valve 46. On the outer end of the boom 14 is formed a flange 47 to which is attached the flange 48 by means of the bolts 49. The flange 48 is integral with the cylinder 50 in which is disposed a piston 51 provided with a flexible cup washer 52, which is held in place by a nut 53.

On the flanged end 54 of the cylinder 50 is mounted a wiper 55 which will prevent foreign matter from working its way into the cylinder 50. On the end of the piston 51 is secured a shaker head 56 whose sides 57 are turned outwardly and lined with rubber shoes 58 or other soft material. The sides 57 have eyes 59 on the rear side thereof, to which are attached the springs 60, the opposite ends of which are connected to the eyebolts 61 and adjustably held by the nuts 62. The springs 60 work in opposition to the pulsations of the plunger 39 and resiliently oppose rotative movement of the shaker head.

It can be seen from the foregoing that the shaker can be moved into position by manipulating the tractor 10 and operating the hoist to bring the rubber shoes 58 against the desired spot on the tree 63, and then applying the brakes to the tractor 10, then by operating the lever 64 on the tractor 10, a surging impulse is given to the fluid in the cylinder 50 causing a reciprocation of the shoes 58 and the shaking of the tree 63.

Power is applied to the pulley 26 by means of gearing and clutch (not shown) within the body of the tractor 10 and under control of the lever 64.

The purpose of the feeder pipe 43 is to make it possible to automatically maintain the desired quantity and minimum pressure of fluid within the shaker to increase the rigidity of the boom.

In the oil line 28, leading to the jack 17, is a control valve 65 whose valve plug 66 has attached thereto a hand lever 67 by means of which the plug 66 may be positioned. The ports 68 and 69 in the plug 66 are so arranged as to bring into communication the pipes 28 and

37–A to raise the hoist **17**, or the pipes **30** and **37–A** to lower the hoist **17**. The hoist **17** will be held in a fixed position when the plug is turned to an intermediate position as shown in Fig. 6, while permitting oil from the pump **21** to circulate back to the housing **22** through pipe **45** and check valve **46**.

Any pressure in the line **28** is also in line **43** and will pass a drop or two of oil through the check valve **44** into the cylinder **38**, after which or at the same time the valve **46** will open at predetermined pressure and return oil to the housing **22**. The circulation during inoperative periods is through the relief valve **46**. Thus, there is provided a self-compensating oil system whereby variable impulses may be given and the quantity of fluid in the shaker maintained and, at the same time, the hoist pump is used to elevate the boom **14** and assist in maintaining the oil supply in the shaker.

In the form of the device shown in Figs. 7, 8 and 9 there is shown the tubular boom **14** to whose end flange **47** is attached the flange **48** of the cylinder **50** within which is disposed a piston **51** which, in this case becomes the actuating piston, one end of which is a flexible cup washer **52** while the end **70** of the piston **51** projects beyond the flange **54** formed on the cylinder **50** opposite the flange **48**. Attached to the flange **54** is a tubular cylinder **71** by means of the bolts **72**. Mounted on the end of the cylinder **71** and secured thereto by the bolts **73** is a flange **74** of the guide **75** within which is a shaker plunger **76**. On the plunger **76** is mounted a shaker head **77** having the diverging sides **78** and the rubber shoes **79** which extend around the members **77** and **78**. Springs **80** are attached to the eyes **81** on the members **78** and to the eyebolts **82** which extend through the flange **74**.

Between the shaker head **77** and the guide **75** is interposed the spring **83** and the washers **84** and **85**. The purpose of the washers **84** and **85** is to permit a variation in the operation of the device by changing the distance between the piston end **70** and the plunger face **86**; that is to say, if the members **70** and **86** are brought into contact by the removal of washers **84** in sufficient quantity to permit the parts **70** and **86** to engage, then any movement imparted by the piston **51** will not be in the nature of a striking blow but rather of a gentler or pulsating action, whereas if space is left between the members **70** and **86**, then the movements of the piston **51** will be of the nature of striking blows, the intensity of which can be regulated by the pressure of the oil and the manner of application.

In this form of the device the springs **87** are connected to the flange **48** by means of the hook bolt **88** and to the flange **89** by means of the eyebolts **90**, which flange **89** is mounted on the end **70** of the actuating piston **51**. The function of the springs **87** is to return the piston **51** against the pressure within the cylinder **50**. The springs **80** tend to prevent the head **77** from turning on its axis and also to hold the plunger **76** against outward movement. Spring **83** provides a resilient stop or bumper to cushion the return movement of shaker head **77**. In some cases it will be found desirable to omit the spring **83** for certain classes of work for which this device is employed.

We claim:

1. An apparatus for imparting reciprocating movement in selective amounts with regard to distance and force, comprising a plunger, a guide supporting said plunger for reciprocating movement, a head on one end of said plunger, a spring on said plunger urging said head away from said guide, a pair of adjustable springs between said head and guide opposing said first mentioned spring, a hydraulic cylinder having a piston coaxial with said plunger and capable of being brought into contact with one end of said plunger, a spacer supporting said guide one one end of said cylinder, a spring anchor on said piston, a flange on the opposite end of said cylinder, tension springs between said spring anchor and flange urging the end of said piston away from the adjacent end of said plunger, and means for supplying a controlled oil pressure within said cylinder.

2. The device described in claim 1, in which said supplying means comprises a pump cylinder for delivering a pulsating flow of oil to said hydraulic cylinder, and further including means for maintaining said pump cylinder full of oil at all positions of said hydraulic cylinder.

3. In an hydraulic vibrating device, a liquid reservoir housing, a shaft in said housing having an eccentric, a shaker pump cylinder in said housing, a piston in said cylinder operable by said eccentric, a pressure pump cylinder in said housing having an intake in said reservoir, a piston in said pressure pump cylinder operable by said eccentric, a check valve in said intake, a dicharge conduit for said pressure pump, a pipe connecting said discharge conduit with said reservoir, a relief valve in said pipe for maintaining a predetermined pressure in said discharge conduit, a pipe connecting said discharge conduit with said shaker pump cylinder, and a check valve in said last pipe for maintaining said predetermined pressure as a minimum pressure in said shaker cylinder.

4. In a device as defined in claim 3, a tubular boom connected at one end with said shaker pump cylinder and subject at all times to an internal liquid pressure at least equal to said predetermined pressure, a cylinder and piston having a shaker head mounted on the other end of said boom and actuated by liquid in said boom, an hydraulic jack for lifting said boom, a control valve for raising and lowering said jack, a conduit from said control valve to said jack, a pressure pipe from said discharge conduit to said control valve, and a return pipe from said control valve to said reservoir.

5. An hydraulic vibrating device comprising a rigid tube, a cylinder on one end of said tube communicating therewith, a piston in said cylinder equipped with a vibrating working head, spring means holding said piston in said cylinder, a shaker pump cylinder connected with the other end of said tube, a piston in said cylinder, a pressure pump cylinder having a discharge conduit connected with said shaker cylinder and said tube, a piston in said pressure cylinder, a driven shaft having an eccentric for operating both of said pistons, a discharge pipe having a relief valve connected with said discharge conduit for maintaining a predetermined minimum pressure in said discharge conduit, shaker cylinder and tube and discharging the flow from said pressure pump, and a check valve in the connection between said discharge conduit and said shaker pump cylinder.

6. A tree shaker and the like comprising a long tubular boom, means for mounting said boom on a vehicle, shaker head having a cylinder and piston mounted on the outer end of said boom, said cylinder being connected with the interior of said boom, a shaker pump cylinder connected with the interior of said boom at its other end, a pressure pump, common driving means for said two pumps, a conduit from said pressure pump connected with said shaker pump cylinder and said boom for maintaining a predetermined minimum pressure in said boom during operation of said shaker pump, an hydraulic jack for lifting said boom, a conduit from said pressure pump to said jack, and a control valve in said last conduit.

7. A tree shaker and the like as defined in claim 6 in which said shaker head is mounted for longitudinal and rotative movements relative to the axis of the boom, and spring means on said boom urging said shaker head longitudinally in the direction of said other end of the boom and urging said shaker head toward a predetermined rotative position.

8. A tree shaker and the like as defined in claim 6 in which said shaker head is integrally connected with said piston, and tension springs on opposite sides of said cylinder each having one end operatively connected

to said cylinder and the other end connected with said shaker head at a distance from the axis of the piston in opposition to said pump pressure in said boom and resiliently opposing rotation of said piston and shaker head in said cylinder.

9. An hydraulic tree shaker and the like comprising a tubular boom, hydraulic means for raising said boom, a shaker pump connected with the interior of said boom, means for maintaining a predetermined minimum hydraulic pressure in said boom to increase the rigidity of said boom, a cylinder on the outer end of said boom communicating with the interior of said boom and supported by said boom, a piston mounted for longitudinal and rotative movements in said cylinder, a shaker head on said piston, and springs operatively connected between said boom and shaker head in opposition to said hydraulic pressure in said boom acting on said piston and resiliently opposing rotative movement of said shaker head.

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