R. M. DOWNIE.

SIX-WAY VALVE.

APPLICATION FILED FEB. 7, 1919.

1,344,490.

Patented June 22, 1920.

3 SHEETS—SHEET 1.

Fig. 1.

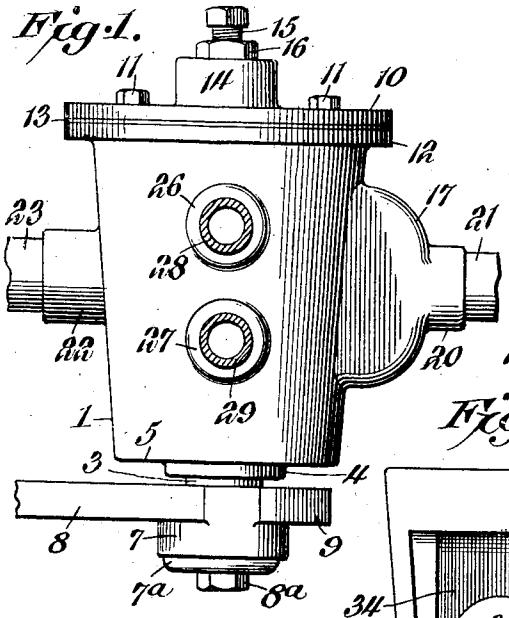


Fig. 2.

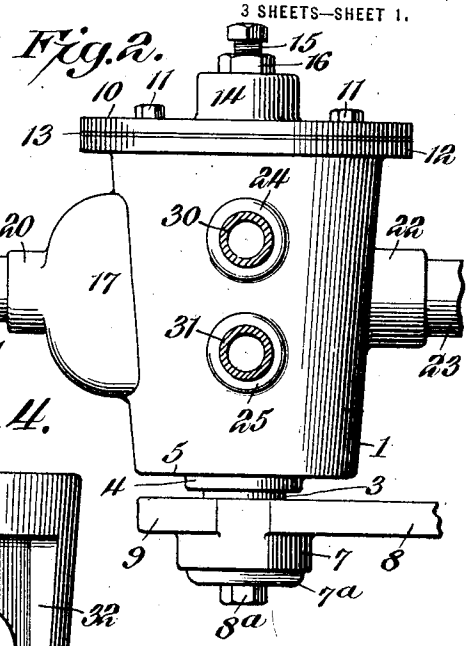


Fig. 4.

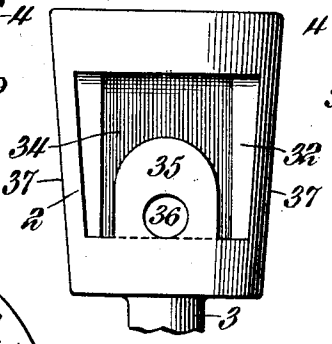


Fig. 3.

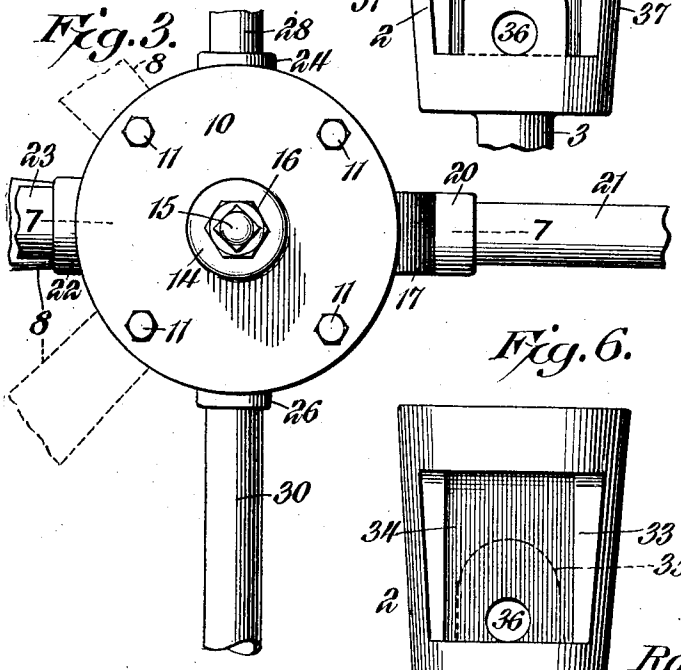


Fig. 5.

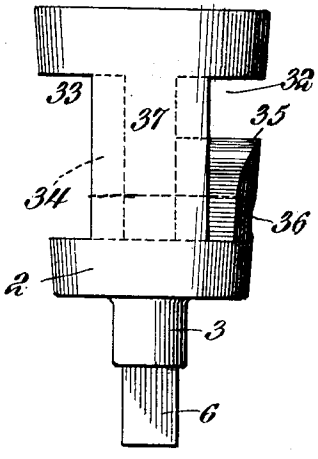


Fig. 6.

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3 SHEETS—SHEET 2.

Fig. 7.

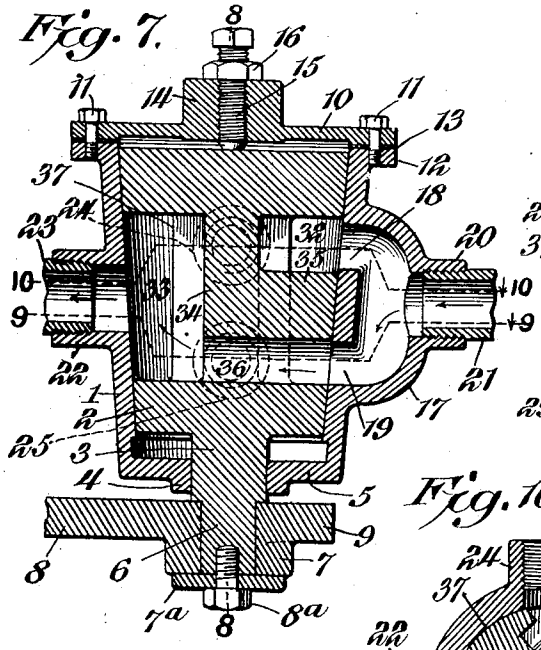


Fig. 8.

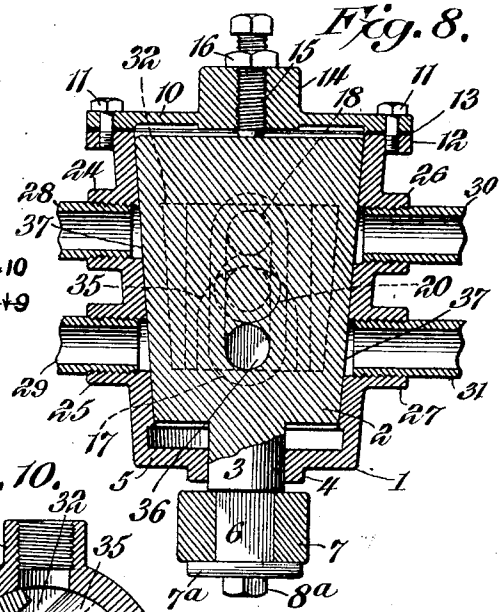


Fig. 10.

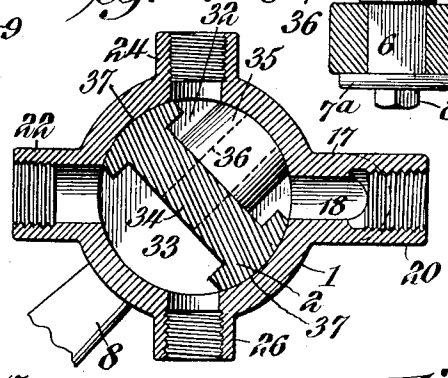


Fig. 9.

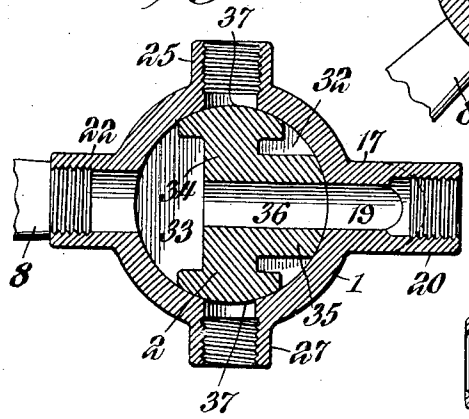
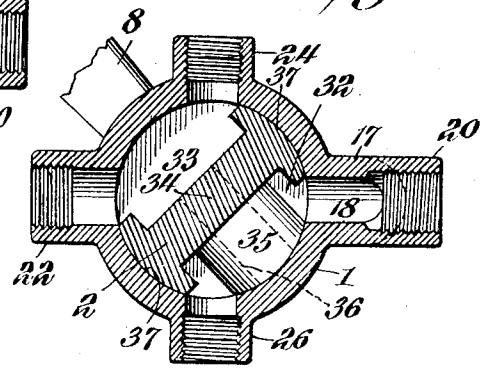


Fig. 11.



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3 SHEETS—SHEET 3.

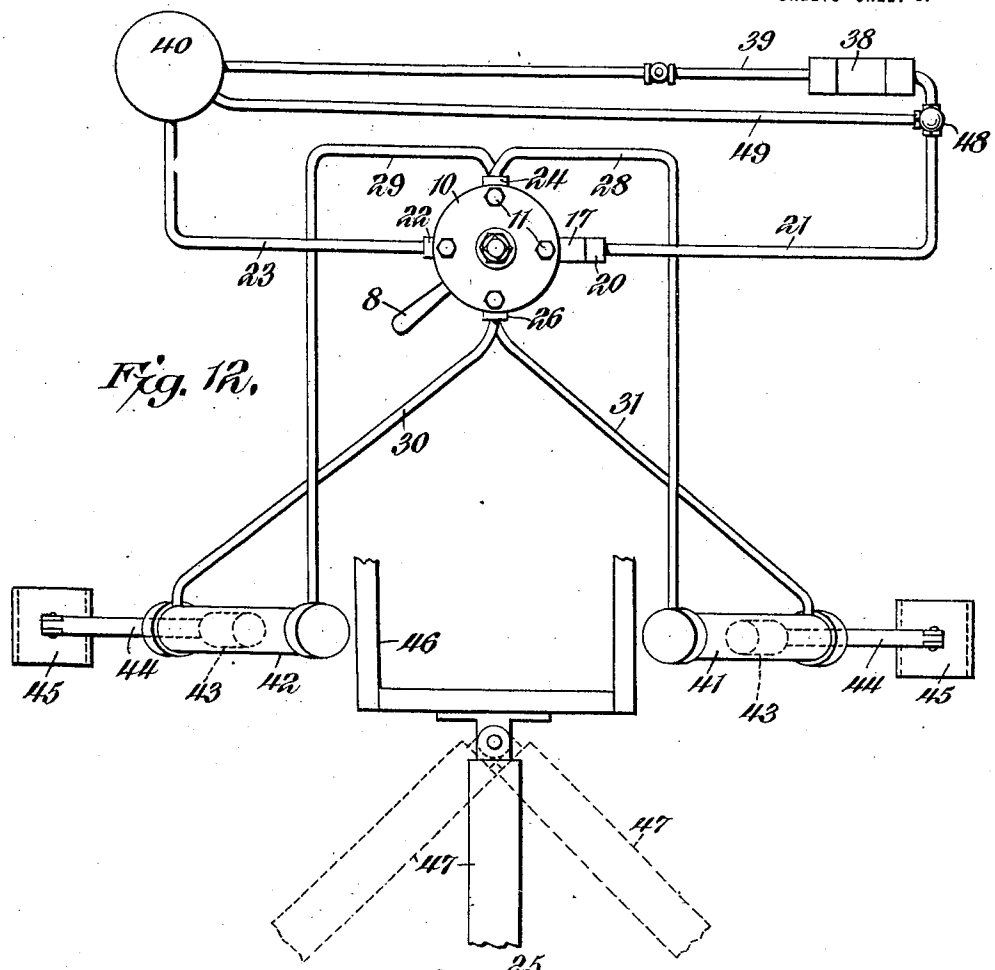
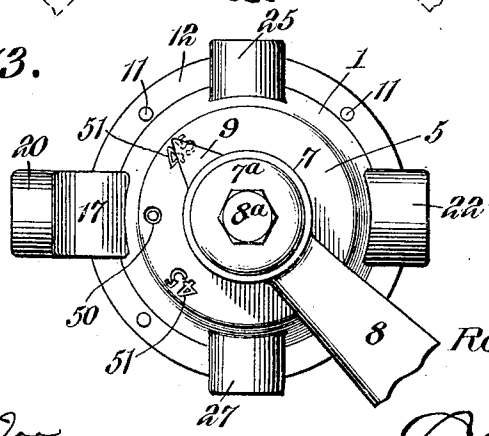


Fig. 12.

Fig. 13.



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UNITED STATES PATENT OFFICE.

ROBERT M. DOWNIE, OF BEAVER FALLS, PENNSYLVANIA, ASSIGNOR TO KEYSTONE DRILLER COMPANY, OF BEAVER FALLS, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

SIX-WAY VALVE.

1,344,490. Specification of Letters Patent. **Patented June 22, 1920.**

Application filed February 7, 1919. Serial No. 275,571.

To all whom it may concern:

Be it known that I, ROBERT M. DOWNIE, a citizen of the United States, residing at Beaver Falls, in the county of Beaver and State of Pennsylvania, have invented a new and useful Six-Way Valve, of which the following is a specification.

This invention has reference to six-way valves for distributing and controlling the flow of fluids, and its object is to provide a valve structure particularly adapted for use in connection with the control of hydraulic staying devices of excavating machines.

The valve is of especial value in connection with excavating machines provided with swinging booms where the boom, in operation, is movable about an upright axis, which axis, in the operation of the excavating machine, must approximate closely to the vertical, the valve acting as a controlling means for feeding liquid under pressure to hydraulic staying devices on opposite sides of the machine, and intended not only to level the machine but also to prevent tipping of the machine when the boom, in its normal operation, is swung to one side or the other of the longitudinal central upright plane of the machine.

The invention comprises a valve casing with a valve member of spigot type therein. The casing is provided with numerous ports, which are six in number in a particular form of the invention, and the valve spigot is provided with cavities and a through port or passage by means of which the ports in the valve casing may be coupled up in different ways, or certain of them blanked, in accordance with the position of the spigot member of the valve. This permits a distribution of liquid under pressure through the valve to cause certain operations of other mechanisms solely under the control of the valve as manipulated by an operator and particularly useful in the leveling and staying of the type of excavating machine to which the invention particularly relates.

The application of the valve to an excavating machine is shown, described and claimed in my application, Serial Number 275,570, for means for leveling and staying excavating machines, filed February 7, 1919.

The invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing of the drawings, but may be changed and modified so long as such changes and modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:—

Figure 1 is an elevation of the valve as seen from one side thereof with certain pipes connected to the valve shown in cross section.

Fig. 2 is a similar view of the opposite side of the valve.

Fig. 3 is a top plan view of the valve.

Fig. 4 is an elevation of one side of the movable member or spigot of the valve.

Fig. 5 is an elevation of the left hand side of the valve shown in Fig. 4.

Fig. 6 is an elevation of the opposite side of the spigot shown in Fig. 4, this being the left hand side of Fig. 5.

Fig. 7 is a section on the line 7—7 of Fig. 3.

Fig. 8 is a section on the line 8—8 of Fig. 7.

Fig. 9 is a section on the line 9—9 of Fig. 7.

Fig. 10 is a section on the line 10—10 of Fig. 7, but with the valve spigot turned to one operative limit of its movement.

Fig. 11 is a view similar to Fig. 10, but with the valve turned to the opposite limit of its operative movement.

Fig. 12 is a diagrammatic plan of a portion of an excavating machine with the invention applied.

Fig. 13 is a bottom plan view of the valve.

Referring to the drawings, there is shown a valve casing 1 which may be of the usual taper form, although such particular form is not at all obligatory. Within the valve casing there is fitted a plug or spigot 2 having at one end a stem 3 passing through a suitably bored boss 4 in the bottom or smaller end of the casing 1, which end is indicated at 5 and is closed except where passing the valve stem 3. Outside of the casing the valve stem 3 has a continuation 6 which may be of square or non-circular shape to receive an enlargement or hub 7 at one end of a handle 8. On the side of the hub 7 remote from the handle 8 there is formed a projection or pointer 9. The handle is held

to the stem 3 by a washer 7ª and a screw 8ª threaded into the extension 6.

The other or larger end of the casing 1 is open and is provided with a cap or cover 10 secured to the valve casing by screws 11 passing through the cap and into a marginal flange 12 on the casing, leakage being prevented by an interposed washer 13. It will be understood, of course, that any other suitable means of completing the casing may be employed.

The central portion of the cover or cap 10 is provided with a boss 14 tapped for the passage of a set screw 15 entering the casing and bearing against the upper end of the valve plug or spigot 2, thereby holding the spigot firmly seated in the valve casing against leakage even under heavy pressure and at the same time permitting the turning of the valve with comparative ease. A lock nut 16 on the screw 15 prevents accidental loosening of the screw.

On one side of the valve casing 1 there is formed a hollow enlargement or projection 17 extended lengthwise of the casing and opening into the interior of the casing through ports 18 and 19 respectively, in spaced relation one to the other lengthwise of the casing. The outer end of the enlargement 17 terminates in a nipple 20 designed to receive a pipe 21 shown in Figs. 1, 2, 3, 7, 8 and 12. Diametrically opposite from the enlargement 17 and in line with the nipple 20 is another nipple 22 designed to receive a pipe 23 shown in the same figures as the pipe 2. In quadrature with the enlargement 17 and nipple 22 are other nipples 24, 25, 26 and 27 designed to receive pipes 30, 31, 28 and 29 respectively. These nipples and pipes in part or in whole are found in Figs. 1, 2, 3, 7, 8 and 12 and also certain of the nipples are found in Figs. 9, 11 and 13.

The nipples all open into the interior of the valve casing by single ports, except that the nipple 20 opens into the enlargement 17 and then into the casing 1 by way of the separated ports 18 and 19.

The spigot or plug 2 constituting the movable member of the valve has cavities or recesses 32 and 33 on diametrically opposite sides, the inner limits of the cavities being determined by a wall 34 forming an integral part of the spigot. In the cavity 32 there is a projection 35 continued from the wall 34 to the peripheral portion of the spigot and is of somewhat less width circumferentially than the cavity 32. Extending diametrically through the enlargement 35 and wall 34 is a port or passage 36 opening through the wall 34 into the cavity 33. The outer or peripheral wall of the enlargement 35 makes a snug fit with the inner face of the casing or shell 1, the fit being such as to prevent leakage from the passage 36 into the cavity 32. The passage 36 is so positioned as to register with the port 19 in one position of the plug or spigot 2. Under such conditions the nipple 20 and port 19 are in communication through the passage or port 36 with the cavity 33 and nipple 22 then leading therefrom. When the nipples 20 and 22 are in direct communication through the passage 36 diametrically opposite blank portions 37 of the plug or spigot block the nipples 24, 25, 26 and 27.

Each cavity 32 and 33 is of sufficient peripheral extent and of sufficient extent lengthwise of the plug or spigot to bridge the space between the openings into the casing of adjacent nipples. With the plug in the position shown in Fig. 9 the nipples 20 and 22 are in communication, as before explained, and the nipples 24 to 27 inclusive are blanked or blocked. When the spigot is turned through an arc of 45° from the position shown in Fig. 9 to the position shown in Fig. 10, the passage 36 is blocked or blanked by a blank portion of the inner wall of the casing and the nipple 20 is then in communication with the nipples 26 and 27 through the cavity 32 and ports 18 and 19, while the nipples 24 and 25 are in communication through the cavity 33 with the nipple 22. When the valve spigot or plug is turned 45° from the first position, but in the other direction, to the position shown in Fig. 11, then the nipple 20 is put into communication with the nipples 24 and 25 and the nipples 26 and 27 are put into communication with the nipple 22.

The pipe 21 connected to the nipple 20 is also connected to a pump 38 which may be considered as power driven and as connected by a pipe 39 with a tank or reservoir 40 containing a suitable quantity of liquid, which by preference is oil but may be water or a mixture of oil and water. The pipe 23 also communicates with the tank 40.

Both pipes 28 and 29 connect to the upper ends of respective cylinders 41 and 42 constituting the cylinders of hydraulic jacks each set at an angle to the upright and provided with a piston 43 and piston rod 44, the latter extending through the lower end of the cylinder and carrying a foot 45 intended to press against the ground or other surface upon which the excavating machine is supported. Such machine is indicated at 46 in Fig. 12 by a fragmentary portion of the frame of the machine, and the excavating machine is provided with a swinging boom 47 capable of movement to either side of the machine about an upright axis as is customary in certain types of excavating machines. The boom is assumed to carry an excavating scoop or shovel but since such devices are very common in excavating machines no showing of the scoop is attempted in the drawings. The pipes 30 and 31 are carried to the lower ends of the hydraulic cyl-

inders 41 and 42. The six-way valve indicated generally by the casing 1 is assumed to be mounted on the excavating machine in a position convenient to an operator and the pump 38 is assumed to be in operation. The hydraulic cylinders 41 and 42 together with the piston rods 44 and feet 45 constitute parts of outrigger stay members carried by the machine 46 on opposite sides thereof to hold the machine against sidewise tilting when the boom 47 with its load is swung to one side or the other of the machine. The stay members are also utilized and are capable of operation under the action of the six-way valve 1 to right the machine when the latter, from any cause, becomes tilted about its longitudinal axis. It frequently happens that the ground upon which the machine is brought to its work is uneven or is soft and so one or the other of the feet or shoes 45 will sink into the softened ground, thus causing a tilting of the machine, and under these circumstances there is a similar tilting of the axis of swinging of the boom. Such a tilting axis of swinging is detrimental to the action of the boom which should always swing in its work upon an axis actually or very closely approaching the vertical.

In order to level the machine, when tilted, the spigot 2 of the valve 1, which spigot may be assumed to be normally in the position shown in Figs. 7 and 9 with the pump 38 going and oil flowing through the pipe 21 directly through the valve plug by way of the passage 36 to the pipe 23 and back to the tank, is turned by a proper manipulation of the handle 8 to the position illustrated in Fig. 10. Oil under pressure is then directed from the pump 38 by way of the pipe 21 to the ports 18 and 19 and into the cavity 32. From this cavity oil passes by way of the nipples 24 and 25 to both pipes 28 and 29 simultaneously and the oil under pressure enters both cylinders 41 and 42 at the upper ends simultaneously engaging the pistons 43. The pressure thus established in the hydraulic cylinders forces the piston rods 44 outwardly, bringing the feet or shoes 45 against the ground or other surface upon which the excavating machine is at the time supported.

If it be assumed that the boom is pointing straight forward and that the supporting surface be uneven, the hydraulic jacks constituting the side stays for the machine will come to rest in engagement with the surface upon which the machine is located and will be there held by the liquid pressure in the jacks. The projecting movement of the portions of the jacks carrying the feet 45 is permitted by the outflow of oil from under the pistons through the pipes 30 and 31 to the cavity 33 in the valve plug 2, the oil returning to the tank or reservoir 40 by way of the pipe 23.

Since, when the parts are at a standstill, the pump pressure increases, a relief valve 48 is provided in the pipe 21 and connected by a pipe 49 to the tank 40 so that the oil may not be wasted. The valve 48 is set to open at a predetermined pressure which may represent the maximum pressure employed in the hydraulic system.

Now, in order to level the machine the boom 47 is swung toward the high side of the machine, thus adding its weight and whatever may be carried by the boom to the high side of the machine, whereupon, the then heavier side of the machine will tend to tip in that direction. The pipes 28 and 29 and the high ends of the cylinders 41 and 42 being, at the time, interconnected, the piston in the hydraulic cylinder on the higher side of the machine will move toward the high end of the cylinder forcing the oil through the pipes 28 and 29 and common junction in the cavity 32, into the high end of the cylinder 42, forcing the piston 43 therein downwardly and consequently raising the lower side of the machine. This movement continues with a speed corresponding to the overbalancing effect of the boom, which overbalancing may be great or small in accordance with the extent of swing of the boom toward the high side of the boom. When the desired level position is reached the operator has but to move the valve plug to the intermediate or neutral position shown in Fig. 9, whereby oil under pressure is cut off from the hydraulic cylinders or members and the outlet ports in the valve are blanked with respect to the hydraulic members, whereupon, the hydraulic members are locked against movement in either direction and the machine is consequently locked in the righted position.

In order to guide the operator the bottom 5 of the casing 1 is provided with markings 50, 51, indicating the limits of movement in opposite directions of the manipulating handle 8 and an intermediate neutral position, in which latter the passage 36 through the valve plug or spigot matches the port 19 and thereby there is established a closed path of flow of the liquid from the pump through the valve to the tank and back to the pump without doing any work.

The six-way valve of the invention permits the continuous running of the pump and the ready leveling of the machine without the necessity of stopping the ordinary operation of the machine, since sometimes the machine will get out of level because of the sinking of the stay device on one side or the other of the machine due to soft ground. Such tilting may be compensated for even while the machine is at work, especially if during the normal operation of the machine the boom is swung toward the high side thereof. If the machine tips on

the side toward which the boom is swung in the normal operation of the machine, then it is necessary to swing the boom in the opposite direction while pressure direct from the pump is established in the hydraulic devices, wherefore, on swinging the boom toward the high side of the machine the leveling of the machine in the manner already stated is effected and on locking the machine in this position by turning the valve to the neutral point, the machine is again leveled and locked in the leveled position.

What is claimed is:—

1. A six-way valve comprising a casing with oppositely located pairs of ports and other oppositely located single ports, and a valve plug for the casing having oppositely located cavities for bridging certain of the single and pairs of ports in the casing and a passage opening into one of the cavities for connecting the single ports.

2. A multi-way valve comprising a casing with pairs of ports, for connection to different instrumentalities, and other ports, and a valve plug in the casing provided with separated cavities, free from communication with each other, for bridging certain of the pairs of ports and other ports, and one of said cavities having a port for placing it in communication with one of said other ports.

3. A multi-way valve comprising a casing with oppositely located pairs of ports and other oppositely located single ports, and a valve plug for the casing having oppositely located cavities of an extent lengthwise and circumferentially of the valve plug so as to each connect a pair of ports and a single port and having blank spaces between the cavities to cover or close the pairs of ports.

4. A multi-way valve comprising a casing with oppositely located pairs of ports and other oppositely located single ports, and a valve plug for the casing having oppositely located cavities of an extent lengthwise and circumferentially of the valve plug to each connect a pair of ports and a single port and having blank spaces between the cavities to cover or close the pairs of ports, one of the cavities having an enlargement therein with a port therethrough communicating with the other cavity and situated to communicate with a port of one of the pairs of ports.

5. A multi-way valve comprising a casing with ports, of which certain of the ports are arranged in pairs, and a valve plug with oppositely located cavities each of a peripheral extent to connect certain of the ports, said valve plug having an interior wall or partition common to both cavities, and a port or passage extending from one cavity through the wall or partition to the periphery of the plug.

6. A multi-way valve comprising a casing with pairs of ports and single ports, and a valve plug adapted to the casing and provided with oppositely located cavities and an intermediate division wall or partition common to the cavities, said partition having an enlargement in one of the cavities extending to the periphery of the plug and narrower than the width of the cavity, said wall and enlargement having a port or passage therethrough.

7. A multi-way valve comprising a casing with ports and a valve plug adapted to the casing and provided with peripheral cavities distinct one from the other and separated by a wall or partition, and situated in the valve plug to connect, on appropriate movement of the plug, certain ones of the ports in the casing, and one of the cavities containing an enlargement of the division wall or partition extending to the periphery of the plug and provided with a passage through it and through the wall or partition connecting the peripheral portion of the plug at the enlargement with the cavity on the opposite side of the division wall.

8. A multi-way valve comprising a casing with oppositely located pairs of ports, other oppositely located single ports with one of the single ports divided and entering the interior of the casing at separated points, and a valve plug adapted to the casing and provided with cavities on opposite sides of an intermediate division wall or partition common to the cavities, and said cavities each being of a length and circumferential extent to connect a pair of ports with one of the single ports, and one of the cavities having an enlargement therein constituting a continuation of the division wall, said enlargement being of less width than the cavity containing it, there being a passage through both the enlargement and the division wall adapted to connect the cavity other than the one containing the enlargement with one branch of the division of one of the single ports.

In testimony, that I claim the foregoing as my own, I have hereto affixed my signature.

ROBERT M. DOWNIE.

Witnesses:

JAMES D. BOWSER,

CHARLES THEO. SMITH.