R. M. DOWNIE.

MEANS FOR LEVELING AND STAYING EXCAVATING MACHINES.

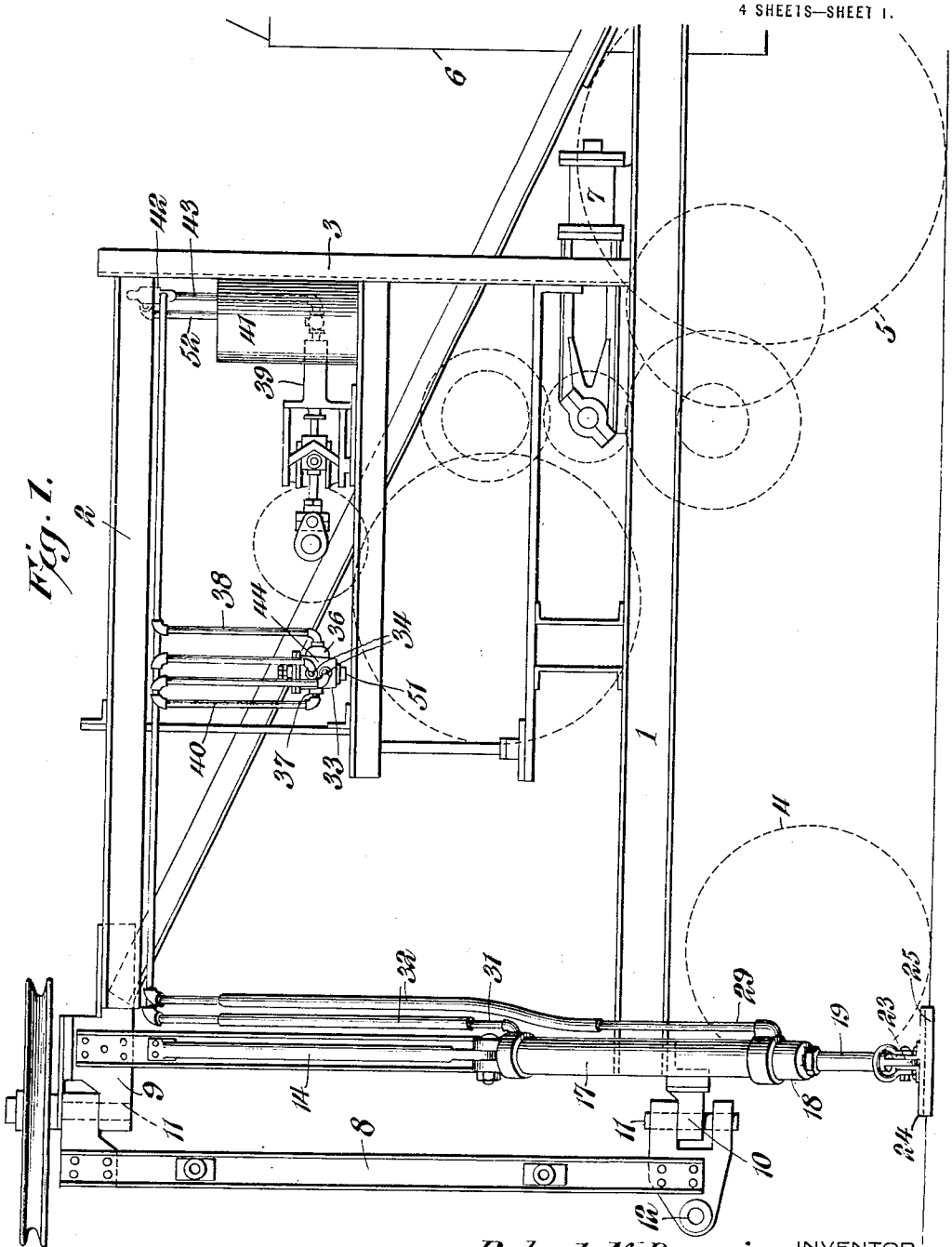
APPLICATION FILED FEB. 7, 1919.

1,350,992.

Patented Aug. 24, 1920.

4 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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Robert M. Downie, INVENTOR,

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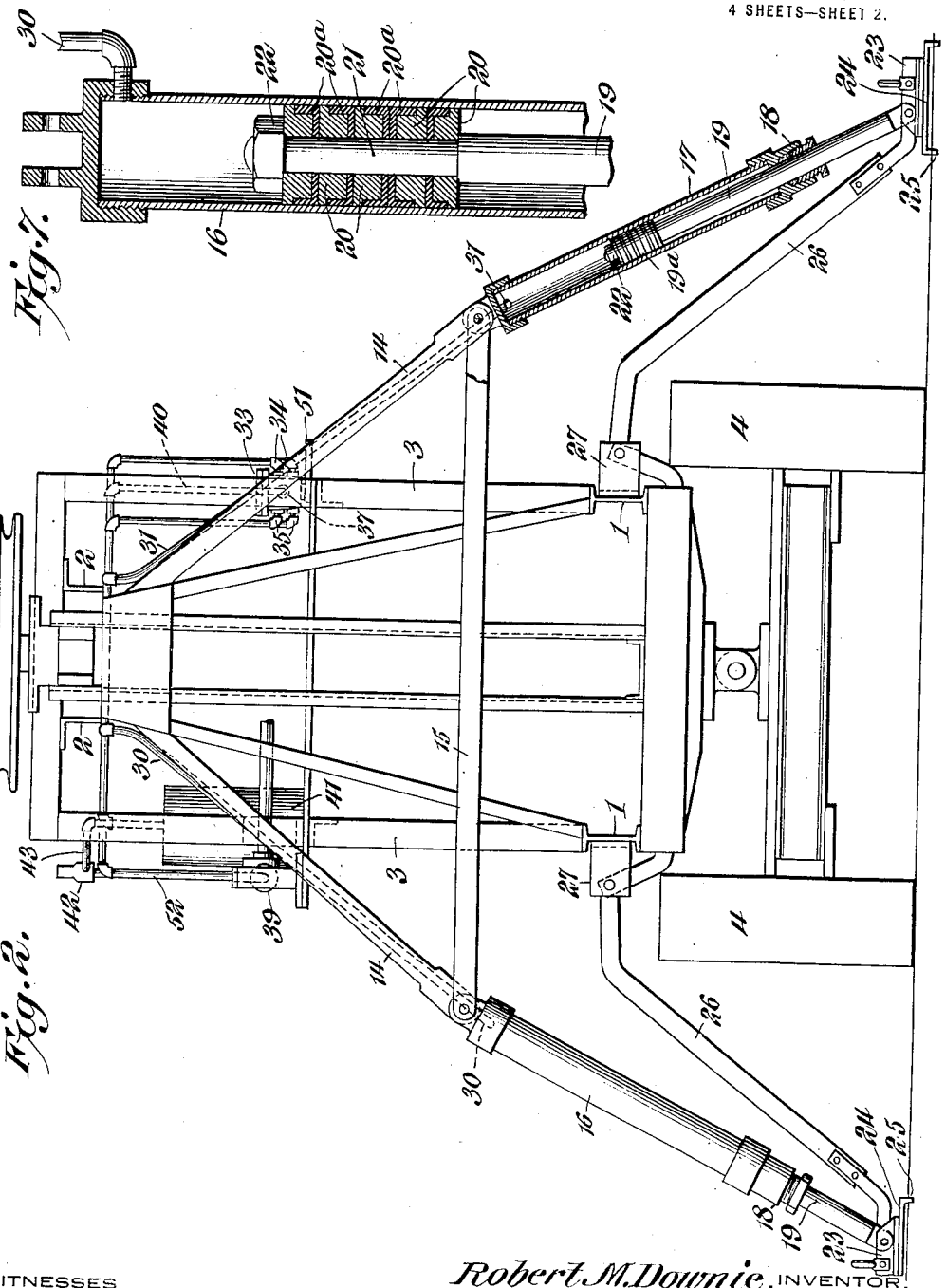

Fig. 2.

Fig. 1.

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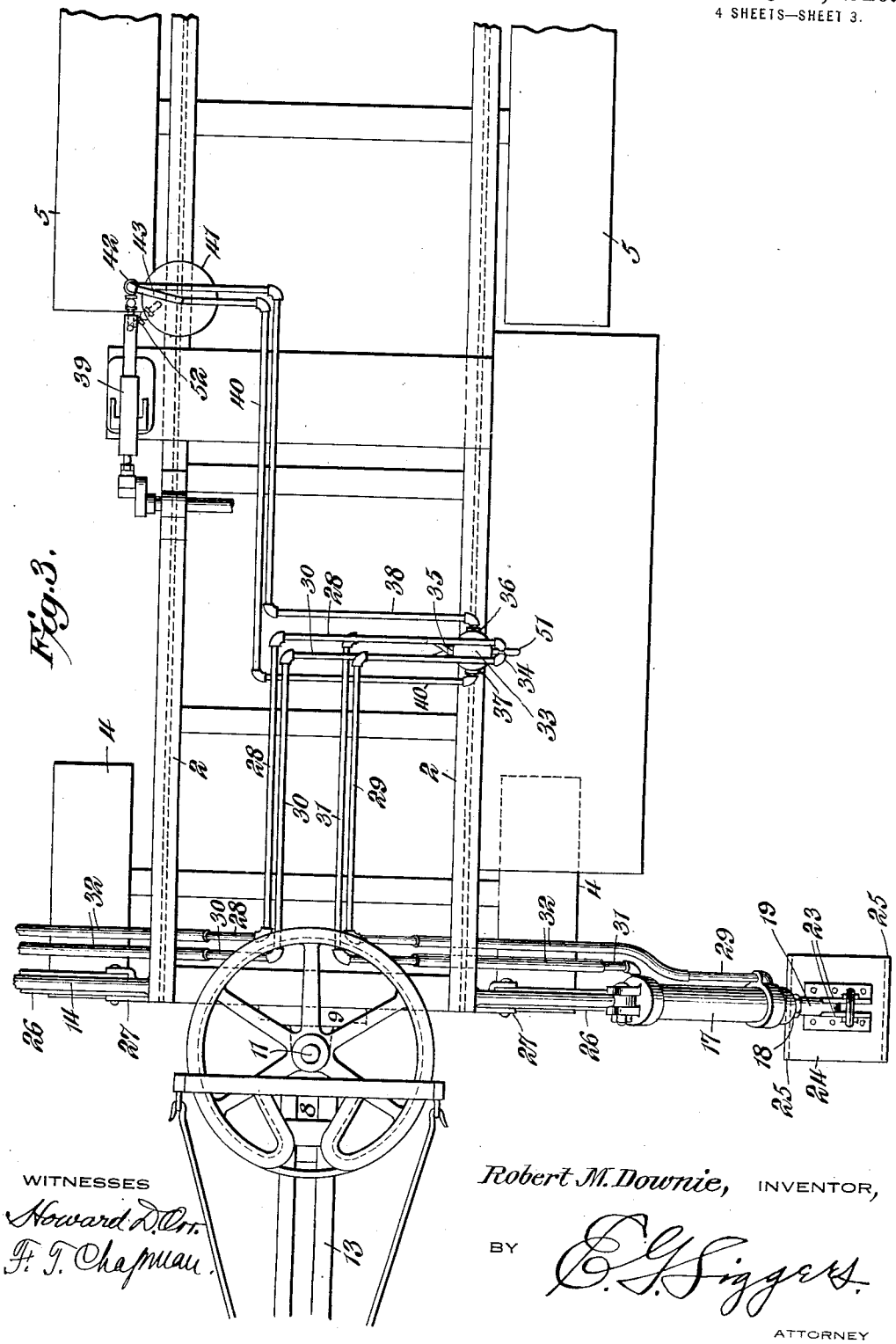
4 SHEETS—SHEET 3.

Fig. 3.



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4 SHEETS—SHEET 4.

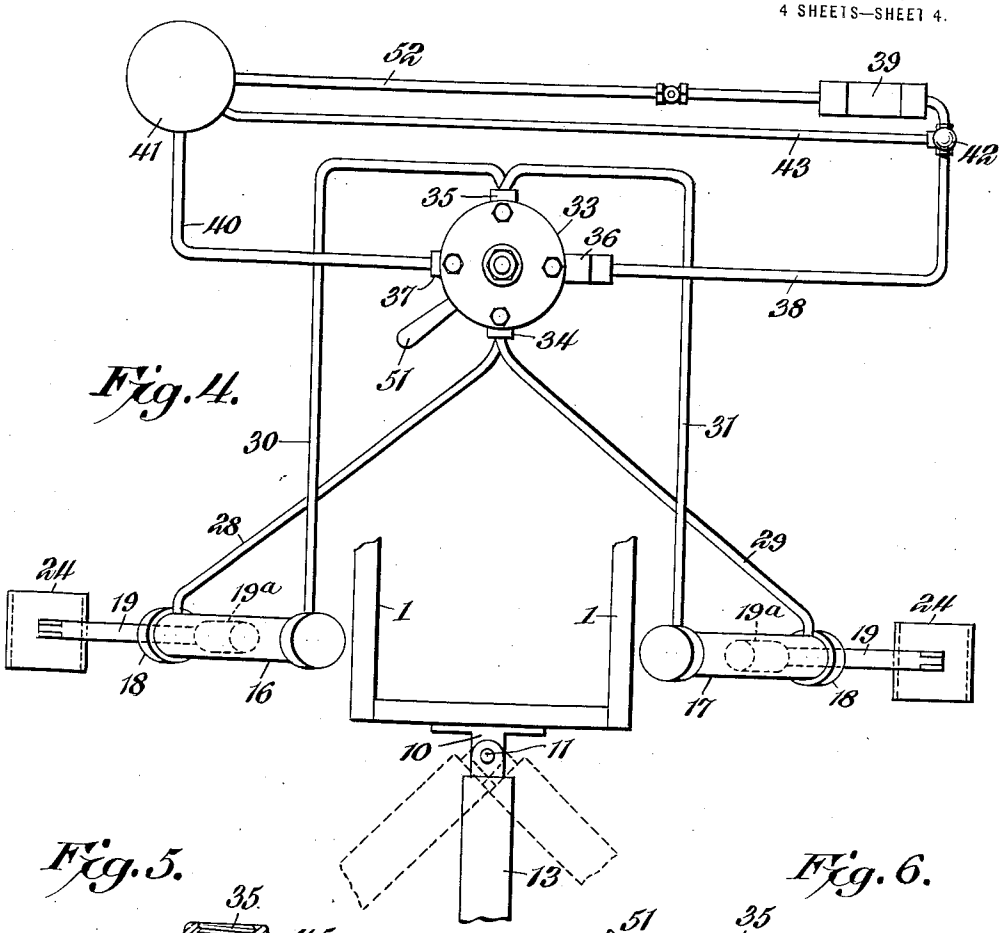


Fig. 4.

Fig. 5.

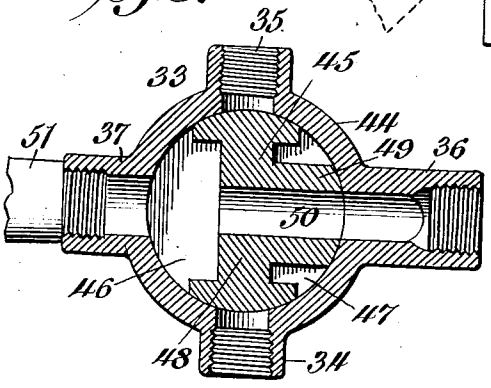
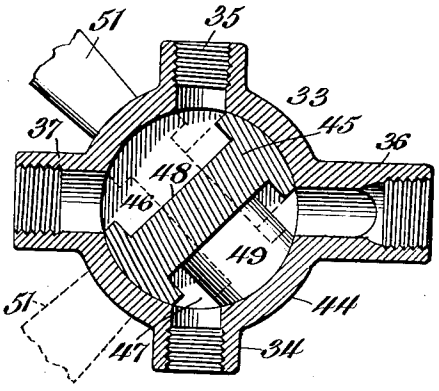


Fig. 6.



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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.

MEANS FOR LEVELING AND STAYING EXCAVATING-MACHINES.

1,350,992. Specification of Letters Patent. Patented Aug. 24, 1920.

Application filed February 7, 1919. Serial No. 275,570.

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 Means for Leveling and Staying Excavating-Machines, of which the following is a specification.

This invention has reference to means for leveling and staying excavating machines, and its object is to provide fluid actuated and controlled devices for the purpose.

The invention has to do particularly with a type of excavating machine used in connection with road building or grading and with trench making. An excavating machine used for such purpose and to which the invention is applicable, comprises a traction vehicle provided with a swinging boom carrying an excavating bucket. The boom, which may have an arc of movement of 180° more or less, is movable about an upright axis and the machine is provided with stays in the form of outriggers with foot pieces, which outriggers are extensible and contractible to not only steady the machine when the boom is swung from side to side but are used for leveling the machine. This last-named operation is needful since, when the boom is swung to one side with the bucket loaded or the bucket is operating to one side of the center line of the machine, the side strain must be counteracted. Moreover, it is necessary from time to time, especially where the ground is soft, to compensate for the sinking of the machine on one side or the other so that the axis of swing of the boom from side to side may be maintained in an upright position.

Heretofore the outriggers constituting the stays have been adjusted by ratchet mechanism, while the present invention contemplates the use of fluid operated and controlled jacks for the purpose. These jacks are, in fact, hydraulic jacks in which oil may be used as the controlling fluid, although, of course, water may be substituted for oil, but oil has the advantage of serving as a lubricant and being free from freezing, thus permitting the mechanism to be used in cold weather.

The hydraulic jacks are used with the stays or outriggers on opposite sides of the machine and are connected through a single valve device so that the liquid under pressure controlling the jacks is directed to both jacks simultaneously and the action of these jacks in bringing the machine from a tilted to a level position, in which the axis of the boom is upright, is controlled by the boom itself. This is done by swinging the boom toward the appropriate side of the machine, thus loading that side of the machine, whereupon, the operating liquid will automatically distribute as between the two hydraulic jacks, thus causing the tilted machine to approach a level position by the added weight of the boom on the high side of the machine. When the machine is leveled further interchange of liquid is stopped.

The feed of the liquid to the jacks and the interchange of liquid as between the jacks is controlled by a valve of peculiar construction, which is to be preferred to a multiplicity of valves, and this peculiar valve constitutes the subject matter of another application, Serial Number 275,571, for a six-way valve, filed by me on Febraury 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 a side elevation, partly in diagram and with some parts omitted, of an excavating machine with the invention applied.

Fig. 2 is a front elevation of an excavating machine, with parts omitted, and showing the invention applied.

Fig. 3 is a plan view of the excavating machine with the invention applied and also omitting parts not essential to an understanding of the invention.

Fig. 4 is a diagrammatic plan view of

parts making up the invention, with a fragmentary illustration of a portion of the front of the excavating machine.

Figs. 5 and 6 are sections of a valve used in connection with the invention.

Fig. 7 is a longitudinal section of a portion of one of the hydraulic jacks used in connection with the invention.

Referring to the drawings, there is shown longitudinal beams 1, 2, and upright beams 3 forming part of the main frame of the excavating machine, much of the structure of the latter being omitted from the drawings since the structure of the machine itself forms no part of the invention and a showing of such structure is not essential to an understanding of the invention.

The machine is supported upon wheels 4, 5, of which the latter may be traction wheels, and a boiler 6 and engine 7 provide the motive power for the machine as a whole and for parts carried by the machine, but no particular description of these parts is needed.

At the front of the machine there is provided a boom-carrying frame 8 mounted on supports 9, 10 respectively, carried by the main frame and mounted to turn upon an upright axis represented by pins or pivots 11 extending through the supports 9 and 10 and arranged in alinement.

The lower end of the boom support is provided with an eye 12 carrying a boom 13 which is capable of being swung from side to side about the upright axis of the boom support and such boom is assumed to be provided with the usual excavating bucket, which latter, however, is not shown in the drawings.

Fast to the forward end of the main frame is a supplemental frame comprising links 14 and a spreader 15. The spreader forms the lower member of the frame, which latter stops short of the level of the supporting wheels of the machine by a considerable distance. The spreader 15 is long enough so that the lower corners of the frame made up of the members 14 and 15 extend beyond the sides of the machine.

Pivoted to the lower corners of the frame 14, 15 are two cylinders 16, 17 respectively, these cylinders depending from the frame 14, 15. At the lower end of each cylinder 16, 17 is a stuffing box 18 through which extends a piston rod 19 carrying a piston 19^a within the cylinder. The piston is shown more particularly in Fig. 7 as made up of a series of disks 20 and cup washers 20^a, all clamped on a reduced portion 21 of the piston rod by a nut 22 at the extremity of the piston rod. The cup washers are arranged in two groups, one with the cup side toward the nut 22 and the other with the cup sides toward that end of the respective cylinder provided with the stuffing box 18. In this way fluid under pressure may be introduced into either end of the respective cylinder without liability of leakage past the piston.

Each piston rod 19 is pivotally connected to ears 23 fast on the upper face of a foot plate 24, which foot plate is provided with spurs 25 designed to engage in the ground or other surface upon which the excavating machine is resting. The ears or brackets 23 of each foot plate 24 are fast to the lower end of a respective bar 26 made fast at the other end to a bracket 27 secured to the main frame of the machine, say a respective one of the beams 1 at the forward end of the latter.

The arrangement is such that when a foot plate 24 is in engagement with the ground or other like surface the corresponding bar 26 rises therefrom in a slanting direction to the side of the machine at about the level of a longitudinal beam 1. At the same time the corresponding cylinder 16 or 17 also rises in a slanting direction toward the longitudinal upright central plane of the machine to the corresponding outer end of the spreader 15 making but a small angle with a respective link or bar 14, which latter is secured at the upper end to a high point on the main frame of the machine at the front portion of the latter. The bars 14, spreader 15, pistons 16 and 17, bars 26 and foot members 23 constitute side-stays or outriggers for laterally bracing the machine.

Communicating with the lower end of the cylinder 16 is a pipe 28 and communicating with the lower end of the cylinder 17 is a pipe 29. Communicating with the upper end of the cylinder 16 is a pipe 30 and communicating with the upper end of the cylinder 17 is a pipe 31. These pipes each include a section 32 of flexible pipe such as rubber hose.

The pipes 28, 29, 30 and 31 are connected to a valve 33 which, in the particular arrangement shown, is a six-way valve having two nipples 34 on one side to which the pipes 28 and 29 are connected and two other nipples 35 on the other side to which the pipes 30 and 31 are connected. In quadrature with the nipples 34 and 35 are other nipples 36 and 37 on diametrically opposite sides of the valve 33, the nipple 36 being connected by a pipe 38 with a pump 39 and the nipple 37 being connected by a pipe 40 with a tank 41 constituting a reservoir from which liquid, such as oil, is drawn as is needed. Included in the pipe 38 is a relief valve 42 connected by a pipe 43 to the tank 41 so that overflow from the relief valve is returned to the tank.

The valve 33, as shown in the drawings, comprises a casing 44 in which is contained a movable valve member or spigot 45 having cavities 46, 47 on opposite sides of a central web 48 from which latter there extends a

boss 49 within the cavity 47. Leading through the boss 49 is a port 50 opening into the cavity 46. A handle 51 is made fast to the movable valve member or spigot 45 in order that the operator of the excavating machine may handily actuate the valve, such valve being situated within convenient reach of the operator.

The pump 39 is kept in constant operation and, considering the valve as so positioned that the port 50 is in line with the nipples 36 and 37, oil passes from the pump by way of the pipe 38, through the nipple 36, port 50, cavity 46, nipple 37 and pipe 40 back to the tank 41, the pump being connected to the tank by a pipe 52 through the relief valve 42. Under the circumstances assumed, with the valve positioned as described, which position may for convenience be termed the neutral position, the oil is simply pumped through a closed course without any particular resistance and without doing any work.

If the movable member 45 of the valve be turned so that the nipple 36 be placed in communication with both nipples 34, as indicated in full lines in Fig. 6, the oil from the pump 39 passes through the pipe 38 to the nipple 36, thence distributes by way of the cavity 47 to both nipples 34 and by way of both pipes 28 and 29 to the lower ends of both cylinders 16 and 17. The movement of the valve, as just described, causes the cavity 46 to place the nipples 35 and 37 of the valve into communication, whereupon the upper ends of the cylinders 16 and 17 are connected by way of the pipes 30 and 31 and nipples 35 with the nipple 37 and by way of the pipe 40 to the tank 41.

Oil being forced from the pipe 39 finds its way to the lower ends of the cylinders 16 and 17, thus raising the pistons 19^a in these cylinders and through the piston rods 19 raising the plates or feet 23. This is the normal condition for travel of the excavating machine from place to place.

When the point of operation for the excavating machine is reached the valve member 45 is moved to a position opposite to that shown in solid lines in Fig. 6, namely, to the dotted line position shown in Fig. 6. This puts the lower ends of the cylinders 16 and 17 into communication with the tank 41 by way of the pipes 28 and 29, nipple 34, cavity 46, nipple 37 and pipe 40. At the same time the nipple 36 and the nipples 35 are put in communication with the pump by way of the cavity 47 so that oil under pump pressure is forced through the pipes 30 and 31 into the upper ends of the cylinders 16 and 17. The result is that the pistons 19^a are forced downwardly, the plates or feet 23 participating in such movement. If it be assumed that the excavating machine is level the jacks represented by the cylinders 16 and 17 and feet 23 engage the ground, thereby maintaining the level position of the excavating machine and this position may be continued by moving the spigot member 45 of the valve into the position shown in Fig. 5 where the passages through the nipples 34 and 35 are blanked and communication from the pump 39 to the tank 41 is opened.

The relief valve 42 is set to open only on the attainment of a predetermined pressure so that when the valve is in position to pump oil into the upper ends of the cylinders and thereby force the feet 23 into engagement with the ground or other support on which the machine is placed, there is always ample force available to bring the machine to a level if it be out of level. To do this the operator when desiring to level the machine with the oil pressure established at the upper ends of the jacks, swings the boom 13 by the mechanism usually provided for such purpose toward the side of the machine which it is necessary should be lowered. The weight of the boom is sufficient to tip the machine, which tipping is permitted by reason of the fact that the oil in the two jacks is in free communication so that as the weight on one jack is lessened by the weight of the boom swung to the other side of the machine. The oil will readily flow into such jack pushing out the piston rod and at the same time withdrawing from the other jack. While the oil is equalizing in the two jacks the machine becomes upright and as soon as this position is reached the operator moves the valve spigot to the neutral position represented in Fig. 5, whereupon, communication of both ends of the cylinders with the pump and oil supply is cut off and the jacks become locked, thus holding the stays for the machine rigidly in position.

The normal operation of the excavating machine may proceed with the boom swinging about an upright axis, which position of the axis is necessary for the proper operation of the excavating machine. Should the machine tip from any cause, such for instance as insecure support due to soft dirt, the operator can simply move the handle 51 in the proper direction to cause oil under pressure to enter the cylinders 16 and 17 at their upper ends and then move the boom about its upright axis in the proper direction. When the level position has been attained the machine is locked in such position by moving the handle 51 again to the neutral point.

When it is desired to move the machine as a whole to some other location, the foot plates are raised by directing oil under pressure through the pipes 28 and 29 into the cylinders 16 and 17 and when the new location is reached the jacks are again operated by liquid pressure to bring the feet

24 into contact with the ground or other support and if the machine be out of level it may be righted in the manner already described.

The pressure at which the relief valve will give is such as to brace the machine against all side loads to which it may be subjected in ordinary use. Such pressure is necessarily quite heavy and consequently the pistons 20 are constructed to withstand the pressure whether exerted on one end or the other. In the particular arrangement shown, there are three upturned cups 20^a and two downturned cups 20^a, since the upturned cups bear the greater pressure. It will be understood, however, that other arrangements may be provided than the particular construction of the piston as shown. The flexible connections of the jacks with the frame of the machine permits sufficient latitude of movement to accommodate the parts to all irregularities of surface met with in ordinary practice.

While oil is the preferable liquid for use in the hydraulic jacks because of its anti-rust and anti-freezing qualities, water may be used where freezing is not to be feared or a mixture of oil and water, or any liquid suitable for the conditions to be met may be used.

What is claimed is:—

1. In an excavating machine, means for righting the machine when tipped sidewise comprising stay devices on opposite sides of the machine each with hydraulic means simultaneously active to both stay devices to move them into engagement with the surface upon which the machine is resting, and means for causing a compensating distribution of pressure in the hydraulic means in opposition to the sidewise inclination of the machine.

2. In an excavating machine, means for righting the machine when tipped sidewise comprising projectable and retractible hydraulic stay devices on opposite sides of the machine, means for simultaneously directing fluid under pressure to the hydraulic devices, and means for distributing the fluid under pressure to said hydraulic devices in opposition to the inclination of the machine.

3. In an excavating machine, means for righting the machine when tipped sidewise comprising projectable and retractible hydraulic stay devices on opposite sides of the machine, means for simultaneously directing fluid under pressure to the hydraulic devices, and means for distributing the fluid under pressure to said hydraulic devices in opposition to the inclination of the machine, said distributing means including means for stopping the flow of liquid to the hydraulic devices to lock the latter in said positions.

4. In an excavating machine, means for righting the machine when tipped sidewise comprising stay devices on opposite sides of the machine each with hydraulic means simultaneously active to both stay devices to move them into engagement with the surface upon which the machine is resting, and overbalancing means on the machine movable to one side or the other thereof to cause the righting of the machine by a compensating distribution of liquid under pressure to the hydraulic means.

5. In an excavating machine, the combination with a boom capable of being swung from side to side of the machine, of staying devices in the form of outriggers on opposite sides of the machine and each including a hydraulic jack with means for engaging the surface upon which the machine is resting, and means for supplying liquid under pressure to both jacks simultaneously at the same ends thereof, whereby the swinging of the boom to one side or the other of the machine will cause the fed liquid to distribute to the jacks oppositely to the direction of swinging of the boom.

6. In an excavating machine, the combination with a boom capable of being swung to one side or the other of the machine, of stay members on opposite sides of the machine and including hydraulic jacks each having means for engaging the surface upon which the machine is resting, and a valve structure connected to the jacks and having means for directing liquid under pressure to like ends of both jacks simultaneously and open the other ends of the jacks to escape of liquid, whereby swinging of the boom to one side or the other of the machine will cause the liquid fed to the jacks to distribute to tip the machine in accordance with the movement of the boom.

7. In an excavating machine, the combination with a boom capable of being swung to one side or the other of the machine, of stay members on opposite sides of the machine and including hydraulic jacks each having means for engaging the surface upon which the machine is resting, and a valve structure connected to the jacks and having means for directing liquid under pressure to like ends of both jacks simultaneously and open the other ends af the jacks to escape of liquid, said valve structure having a position for cutting off the supply to and escape of liquid from the jacks, whereby liquid may be directed under pressure to the jacks to force them into engaging relation with the support upon which the machine is resting and the boom may be swung to one side or the other to cause an equalization of the flow of liquid to level the machine, if tipped sidewise, and the valve may then be moved to the cut-off position to lock the stay members in a position holding the machine level.

8. An excavating machine of the swinging boom type having hydraulic stay devices on

opposite sides, and means for distributing liquid under pressure to both hydraulic devices simultaneously, whereby a swinging of the boom of the excavating machine to one side or the other will cause a corresponding distribution of the liquid to the hydraulic devices.

9. An excavating machine of the swinging boom type having hydraulically operated stay devices on opposite sides, and means for directing liquid under pressure to like ends of the hydraulic devices simultaneously and permit the escape of liquid from the other ends of the said devices simultaneously, whereby a tilted machine may be righted by swinging the boom to one side or the other and thereby causing a compensating distribution of the liquid under pressure to the hydraulic devices.

10. An excavating machine of the swinging boom type comprising stay devices on opposite sides, each provided with a hydraulic jack with projectable and retractible means for engaging the surface on which the machine rests, and a liquid distributing system for operating the jacks comprising a distributing valve, piping leading from the valve to both ends of each jack for directing liquid to like ends of both jacks simultaneously, and means for supplying liquid under pressure to the valve for distribution to the jacks therefrom.

11. An excavating machine of the swinging boom type provided with staying devices on opposite sides, including hydraulic jacks for operating the staying devices, said jacks each comprising a cylinder with a piston therein, a piston rod extending from the cylinder and a surface engaging device carried by the piston rod, a controlling valve, piping leading from the valve to each end of both cylinders, a pump for supplying liquid under pressure to the valve, and a receptacle for the liquid connected to the pump and also connected to the valve for return of liquid from the valve to the receptacle, the valve being constructed to pass liquid from the pump directly therethrough to the receptacle in one position of the valve and to direct liquid under pressure simultaneously to like ends of both cylinders and to return the liquid from the other ends of both cylinders to the receptacle, whereby liquid under pressure may be directed by the valve to like ends of both cylinders simultaneously and distributed to the cylinders in compensating relation to right the machine when tipped sidewise by swinging the boom toward the high side of the machine.

12. In an excavating machine, stay devices on opposite sides thereof, each including a hydraulic jack in the form of a cylinder with a piston therein and a piston rod connected to the piston and projecting from the cylinder, a foot carried by the piston rod for engaging the surface upon which the machine rests, and a link connection from the foot to the machine.

13. In an excavating machine, an outrigger structure for staying the machine against sidewise forces comprising a frame fast to a respective side of the machine and projecting beyond the sides thereof, downwardly directed hydraulic jacks each pivoted at its upper end to the frame in outstanding relation to the machine and comprising a cylinder with a piston therein and a piston rod connected to the piston and projecting through the lower end of the cylinder, a surface-engaging foot carried by the lower end of the piston rod, and a link connection between the foot and the corresponding side of the machine, whereby the stay devices have a wide laterally spread footing and may be hydraulically operated by an attendant on the machine.

14. In an excavating machine, outstanding stay devices on opposite sides thereof including hydraulic jacks each comprising a cylinder with means for the admission and escape of liquid from opposite ends thereof, a piston in the cylinder, a piston rod connected to the piston and projecting from the cylinder, and a surface-engaging foot on the piston rod, the piston comprising a series of disks and cup washers with the cups at one end of the piston directed one way and those at the other directed the other way, with the open ends of the major portion of the cups directed toward that end of the piston subjected to greater pressure in operation.

15. An excavating machine provided with stay devices on opposite sides, each including a hydraulic jack, and means for controlling and operating the hydraulic jacks comprising a six-way valve with a pair of pipes leading therefrom to like ends of the jacks, another pair of pipes leading from the valve to the other ends of the jacks, a reservoir for liquid, a pump connected to the reservoir and to the valve for delivering liquid under pressure to the valve, and a pipe leading from the valve to the reservoir, said valve having a single manipulating means and a movable valve member under the control of the manipulating means constructed to direct liquid under pressure from the pump to the like ends of both jacks simultaneously and at the same time connect the other ends of the jacks to the reservoir, or to blank the pipes leading to and from the jacks and at the same time connect the pump directly with the reservoir.

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.