

[54] **MOBILE DRILLING RIG HAVING
ADJUSTABLE BOOM**

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[58] Field of Search 173/22-29, 43,
173/44, 46

[56] **References Cited**

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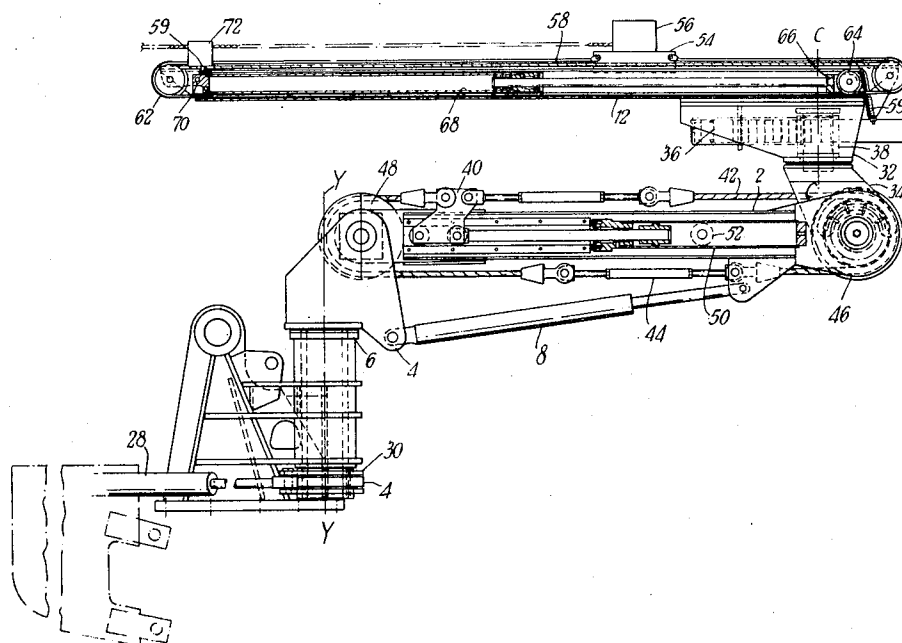
Primary Examiner—Ernest R. Purser

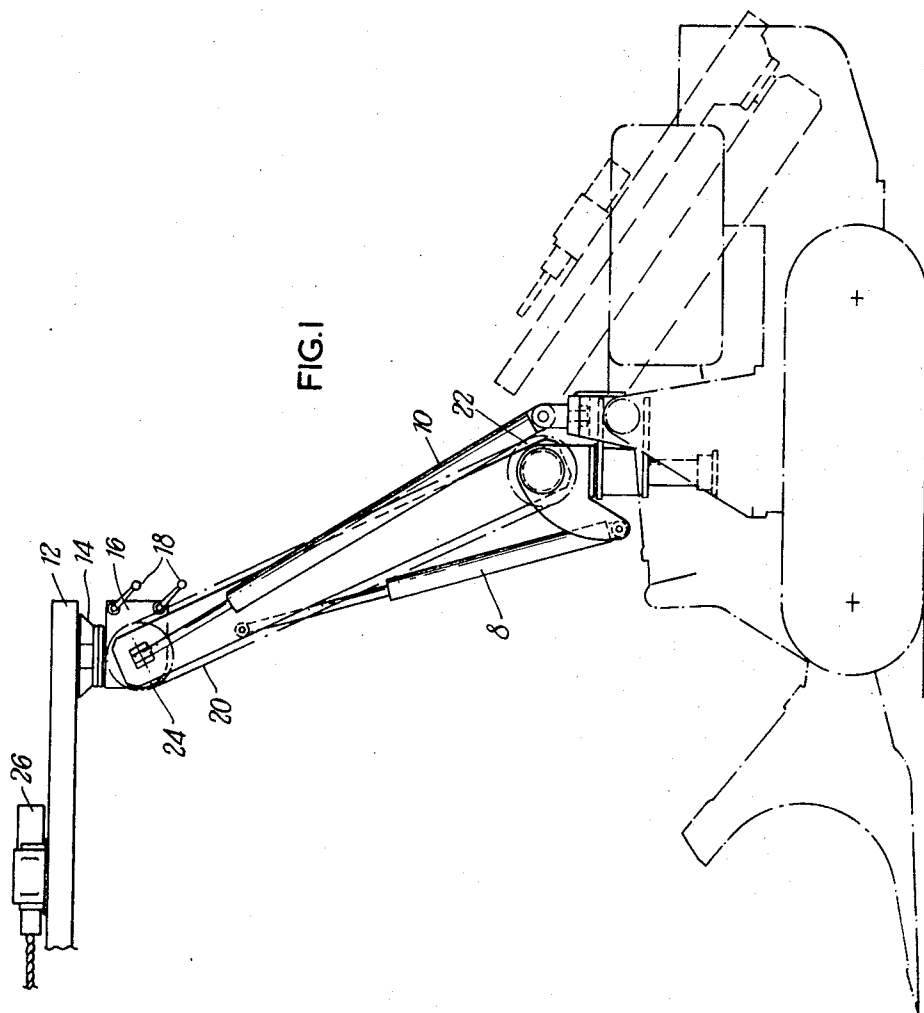
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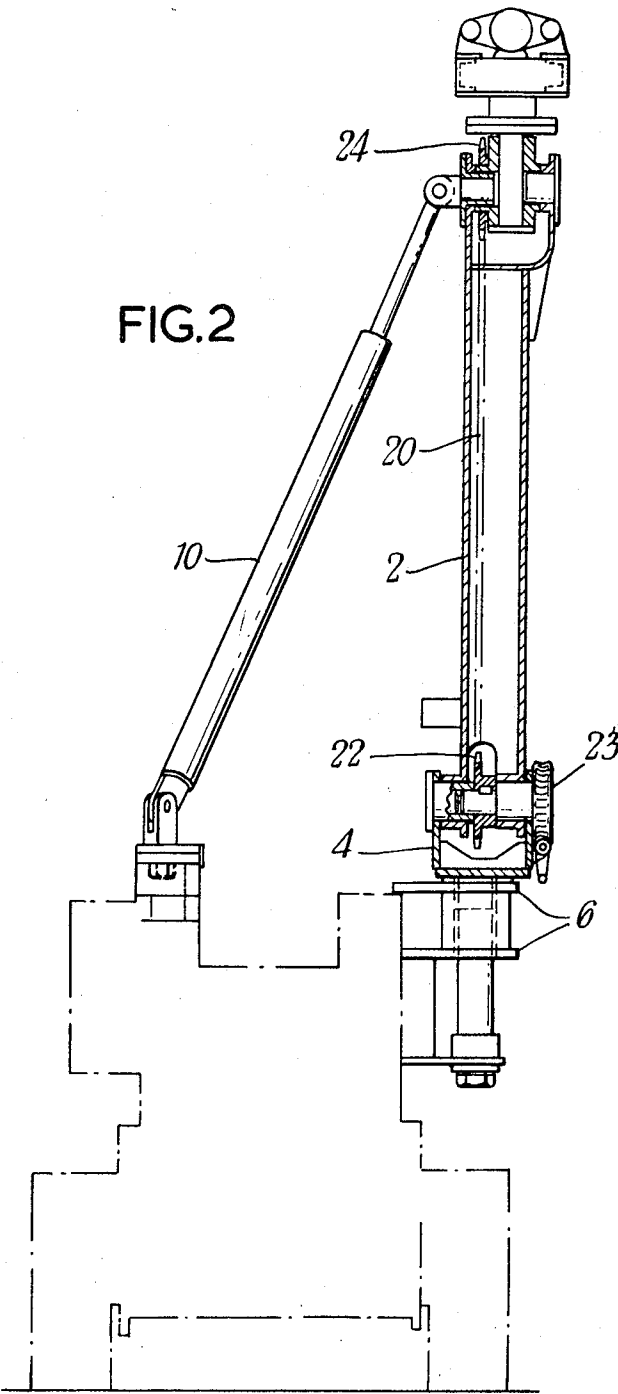
[57] **ABSTRACT**

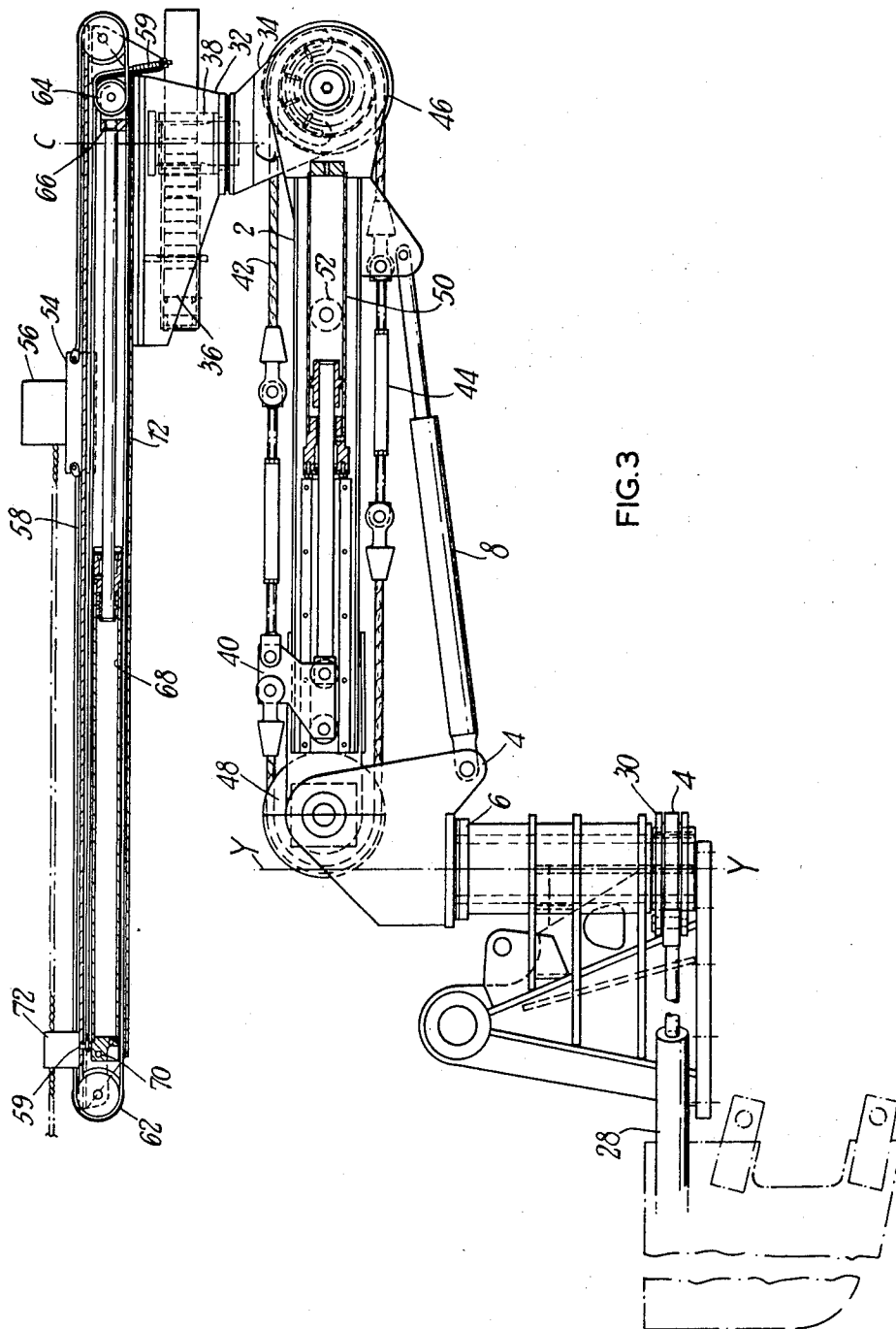
The drilling rig comprises a boom, one end of which is arranged to be pivotally attached to the vehicle while the other end supports a drilling-head carrier arm tiltably mounted thereon. The carrier arm is also rotatably mounted about an axis normal to the axis of tilting. The boom is arranged to be pivoted in a vertical plane by at least one hydraulic piston-and-cylinder unit attached to a vehicle and connected to the hydraulic system. The carrier arm is tiltable over an arc of 180° by an endless drive transmission extending from one end of the boom to the other. In one embodiment the transmission includes a drive wheel located at or close to one end of the boom. The drilling rig may be attached to a buck-digger vehicle having a hydraulic actuating system for providing the necessary hydraulic source.

19 Claims, 6 Drawing Figures









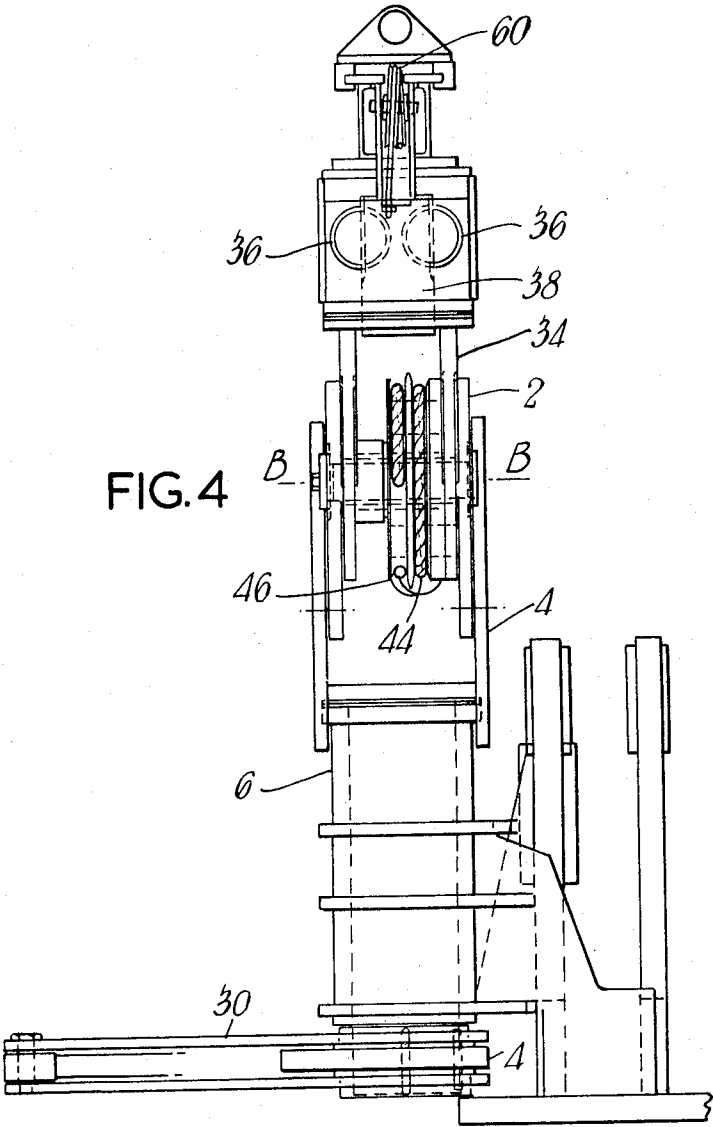


FIG.5

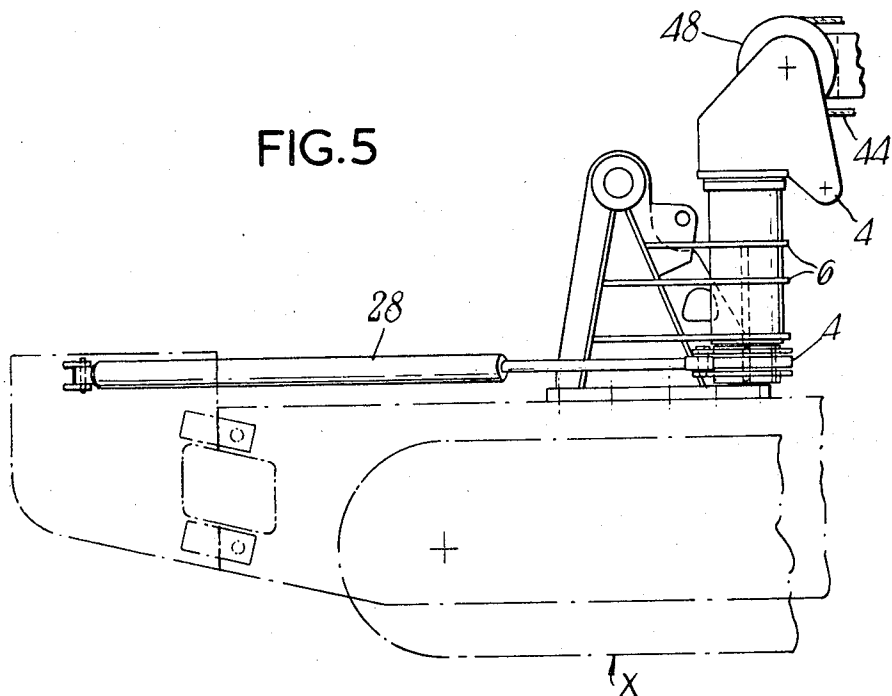
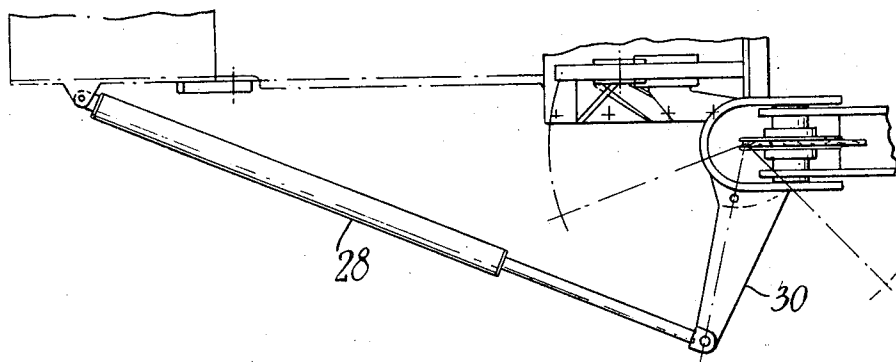


FIG.6



MOBILE DRILLING RIG HAVING ADJUSTABLE BOOM

BACKGROUND OF THE INVENTION

This invention relates to drilling rigs attachable to bucket-digger vehicles, including those adapted for side-tipping, equipped with a hydraulic actuating system.

OBJECTS OF INVENTION

It is a primary object of this invention to provide a drilling rig which is adapted for attachment to existing digging or loading equipment. Another object of this invention is to provide a drilling rig adaptable for connection and use to hydraulic activating systems carried by existing equipment.

Still another object of this invention is to provide a drilling rig adapted for side tipping and equipped with a hydraulic actuating system.

SUMMARY OF THE INVENTION

The invention aims at providing a drilling rig so designed that it can be attached to the front or rear of a vehicle of the type referred to in such a way that the latter with the attachment mounted thereon may still be used for its basic or main purpose, that is to say digging and loading. Accordingly, for one aspect, the invention consists in a drilling rig attachable to a bucket-digger vehicle equipped with a hydraulic actuating system, wherein the drilling rig comprises a boom one end of which is arranged to be pivotally attached to the vehicle while the other end supports a drilling-head carrier arm tiltably mounted thereon and rotatable about an axis normal to the axis of tilting, wherein the boom is arranged to be pivoted in a vertical plane by at least one hydraulic piston-and-cylinder unit attachable to the vehicle and connectable to the hydraulic system, and wherein the carrier arm is arranged to be tilted over an arc of substantially 180° by an endless drive transmission extending substantially from the one end to the other end of the boom.

From another aspect the invention consists in a drilling rig attachable to a bucket-digger vehicle equipped with a hydraulic actuating system wherein, the drilling rig comprises a boom one end of which is arranged to be pivotally attached to the vehicle while the other end supports a drilling-head carrier arm tiltably mounted thereon and rotatable about an axis normal to the axis of tilting wherein the boom is arranged to be pivoted in a vertical plane by at least one hydraulic piston-and-cylinder unit attachable to the vehicle and connectable to the hydraulic system, wherein the carrier arm is arranged to be tilted over an arc of substantially 180° by an endless-drive transmission extending substantially from one end to the other end of the boom, and wherein the transmission includes a drive wheel located at or close to the one end of the boom.

Preferably, the boom of a drilling rig attachment according to the invention is pivoted by means of two hydraulic piston-and-cylinder units, one of which may be permanently attached to the vehicle while the other one requires to be detached therefrom when the drilling operation for which the attachment is used has been completed and the attachment is stowed away.

In order to make the invention more thoroughly understood and to explain some additional features thereof, two embodiments thereof will now be described in more detail with reference to the accompanying diagrammatic drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a side view of a bucket-digger including an attachment according to the invention.

FIG. 2 is an end view of part of the digger and the attachment.

FIG. 3 is a side view, on an enlarged scale of a modified embodiment of the attachment.

FIG. 4 is an end view of the attachment illustrated in FIG. 3.

FIG. 5 is a side view of a boom-mounting bracket of the attachment and means for rotating the boom in a horizontal plane.

FIG. 6 is a plan view of the rotating means illustrated in FIG. 5.

DESCRIPTION OF PREFERRED EMBODIMENT

A drilling attachment according to the invention is mounted on the frame of a bucket-digger vehicle generally denoted by the reference character X and being equipped with a hydraulic actuating system. It comprises a boom 2 the lower end of which is universally mounted to allow motion in horizontal and vertical planes. For this purpose, it is held in a bracket 4 mounted in a bearing 6 attached to the vehicle frame. The boom 2 in the embodiment illustrated is pivotable in both planes by two hydraulic piston-and-cylinder units 8 and 10 and held by them in any selected position within its pivotal range. The piston-and-cylinder units 8 and 10 are attached to the vehicle frame and connected to the hydraulic system but one of the units, the unit 10 in the embodiment illustrated, is so connected to the vehicle that it can be detached therefrom to permit the vehicle to operate as a digger and tipper. The operation of the units 8 and 10 is controlled by suitable hydraulic valves — not shown — which may be hand-operated. Since, as indicated, the piston-and-cylinder units are connected or connectable to the hydraulic system of the vehicle no separate pump and reservoir are required for delivering the hydraulic pressure fluid to and emptying it from the cylinders, the pump and reservoir of the vehicle system being used for this purpose.

The other, upper, end of the boom 2 supports a drilling-head carrier arm 12 by means of a support 14 and a block 16. The carrier arm 12 including the support 14 fixed thereto are rotatably mounted in the block 16 in such a fashion that unless locked they can be rotated over 360° in and relative to the block 16, in a plane parallel to the upper end face of the block. The support 14 is lockable in the block 16 in any desired position by tightening clamps 18. The block 16 is arranged to be swivelled in a vertical plane over an arc of substantially 180° and to be held in any desired position within this arc by an endless drive transmission comprising a chain 20 trained over two sprockets 22 and 24 of which the latter is rigidly attached to the block 16. The sprocket 22 is located at the lower end of the boom 2 which is pivotally attached to the vehicle frame. This sprocket is the drive sprocket of the transmission and is

arranged to be turned in the embodiment illustrated in FIGS. 1 and 2 by a worm and worm-wheel drive 23 which maybe hand or power operated. The chain and sprocket transmission may be replaced by an endless V-belt and two pulleys at least the driving one of which may comprise two discs hydraulically movable against each other.

The carrier arm 12 supports a drill-head 26 arranged to slide in the axial direction of the arm and to be secured thereto. For normal operation the assembly comprising the elements 16, 14, 12 and 26 will be disposed parallel to the floor of, for example, a tunnel in which the loader is working, and the drillhead will drill into a vertical wall — not illustrated — at right angles thereto. This is the position of the assembly illustrated in FIG. 1. If it is desired to drill the wall at a lower elevation, but still at 90°, the boom will be lowered and the assembly 16, 14 and 12 be swivelled relatively to the boom. If it is desired to drill the vertical wall at an angle other than 90°, it may suffice to pivot the boom 2 only. Alternatively, in addition to pivoting the boom the assembly 16, 14 and 12 may be swivelled relatively to the boom by swivelling the block 16 by means of the sprocket and chain transmission, as previously indicated. Thus, the assembly can be set at any required inclination within the swivelling range of the block 16 and drilling may take place at substantially any elevation of the vertical wall and also the floor may be drilled.

Valves — not shown — are provided for admitting hydraulic fluid to and exhausting it from the units 8 and 10 and a hydraulic motor of the drill-head 26 — if the latter is hydraulically operated. These valves may be mounted on a valve bank — not shown — in easy reach of the vehicle operator and are connected by hydraulic ducts — not shown — to the units and the motor.

The drill-head 26 in the embodiment illustrated is hydraulically operable so that it can also be connected to the hydraulic system of the vehicle. Alternatively, the drill-head 26 may be powered by other suitable or available means, for example compressed air or electric power.

If the vehicle is required to be used for its normal purpose, the drilling-rig attachment may be stowed away by pivoting the boom 2 by means of the piston-and-cylinder unit 8 — the unit 10, as already indicated, having first been detached from the vehicle — from its illustrated position. The stowing position of the attachment on the side of the vehicle is indicated in FIG. 1 by broken lines. The attachment is brought into the latter position by pivoting the boom 2 in a vertical plane and rotating the whole of the attachment in a horizontal plane. It is held in the stowing position by clamps or straps — not illustrated.

Referring now to the embodiment illustrated in FIGS. 3 to 6, it will be seen that the attachment, although basically the same as that illustrated in FIGS. 1 and 2, is arranged to be operated entirely by hydraulic actuating means. The actuation of the various hydraulic piston-and-cylinder units forming part of the attachment is controlled from a bank of manually operable hydraulic valves — not illustrated — in easy reach of the vehicle's attendant.

The hydraulic piston-and-cylinder unit 8 is arranged to raise and lower the boom 2 in a vertical plane. The

lower end of the boom 2 is again pivotally mounted in the bracket 4 which, as in the embodiment illustrated in FIGS. 1 and 2, is rotatable to a limited extent in a horizontal plane about the axis Y — Y, shown in FIG. 3. A further hydraulic piston-and-cylinder unit 28 is provided for effecting the limited rotary motion of the bracket 4 and thus of the boom 2. The cylinder of the unit 28 is attached to the vehicle while its piston rod is pivotally attached to a crank arm 30 connected to the bracket 4 (see also FIG. 5). The crank arm 30 is connected to a tubular extension of the bracket 4 — said extension extending through the bearing 6 — by means of a movable pin — not illustrated. The pin is removed if it is required to rotate the boom 2 beyond the operating range of the unit 28, for example for the purpose of stowing away the attachment.

A support 32 of the drilling-head carrier arm 12 is mounted in a block 34 attached to the other, upper, end of the boom 2. It is mounted in the block 34 so as to rotate about the axis C — C which is normal to the longitudinal axis of the arm 12 and which, in the position of the boom and the carrier arm illustrated in FIG. 3 is vertical permitting rotation of the support 32 and the arm 12 in a horizontal plane. However, it will be evident from the further description that the axis C — C can be moved out of its vertical position and hence the arm 12 rotated in a plane other than horizontal — even if, for ease of description, the axis C — C may be referred to as being vertical and the rotary motion of the arm 12 as being in a horizontal plane. The block 34 attached, as already stated, to the other end of the boom is mounted so as to be pivotable relatively to the boom 2 in a vertical plane about the axis B — B over an arc of substantially 180° as in the embodiment illustrated in FIGS. 1 and 2. Thus, if the block 34 is pivoted out of the position illustrated, the axis C — C will be tilted into a position other than vertical, and any rotary motion of the support 32 and the arm 12 will therefore be in a plane other than horizontal.

Rotation of the support 32 about the axis C — C is effected by a pair of hydraulic piston-and-cylinder units 36. The piston of each unit is joined to a piston rod toothed to form a rack meshing with the teeth of a pinion 38 mounted fixedly in the block 34 and rotatably in the support 32. When the piston-and-cylinder units 36 are actuated, their respective piston rods will be moved out of or retracted into the cylinders causing the support 32 to rotate about the axis C — C, that is to say relatively to the pinion 38, either in a clockwise or an anti-clockwise direction, depending upon which of the two piston-and-cylinder units is pressurized.

The pivotal motion of the block 34 in a vertical plane is effected by means of an endless-drive transmission comprising a cross-head 40, ropes or chains 42 and 44, a driven wheel, or pulley, 46 fixed to the block 34, a guide wheel, or pulley, 48, and a cross-head driving piston-and-cylinder unit 50. The rope 42 is attached at its one end to the cross-head 40 and at its other end to the pulley 46. One end of the rope 44 is also attached to the pulley 46 while its other end after passing over the pulley 48 is attached to the cross-head 40. Thus, it will be seen that the ropes 42 and 44 impart rotary motion to the pulley 46 when the cross-head is moved along and parallel with the longitudinal axis of the boom 2.

The boom is of profiled cross-section, for example rectangular, so as to define a hollow space between two parallel side walls. Any other cross-sectional shape providing two spaced parallel walls, or edges, may be used instead. The cross-head 40 is arranged to slide along the boom 2 guided by its side walls when moved by the piston rod of the unit 50 which is disposed in the hollow space of the boom 2. The cylinder of the unit 50 is pivotally attached by means of two pivot pins 52 to the same side walls of the boom 2 that guide the cross-head 40. The piston rod of the unit 50 is connected to the cross-head 40 so that when the unit 50 is actuated by pumping hydraulic fluid into the unit or exhausting it therefrom, the cross-head 40 will slide along the boom 2 in the same direction as the piston and piston rod of the unit 50 is caused to move. Since the cross-head 40 is connected through the ropes, or chains, 42 and 44 to the pulley 46, its sliding motion will be transmitted to the latter and to the block 34 so that motion of the cross-head 40 will cause the block 34 to pivot in the vertical plane.

The carrier-arm 12 supports a slide, or slidable base, 54 on which a drill-head 56 is rigidly mounted. Alternatively, the head 56 and the base 54 may form an integral unit as the head illustrated in FIG. 1. The slide 54 is arranged to be moved along the carrier-arm 12 by means of a rope 58 attached thereto and trained over two rotatable pulleys 60 and 62 one arranged at, or close to, each end of the carrier-arm 12. The rope 58, the ends of which are secured to two anchorages 59 — one located at or close to each end of the arm 12 — also passes over a pulley 64 of a further cross-head 66 slidably attached to the carrier arm 12. The cross-head 66 is arranged to be moved along the carrier-arm 12 by means of a hydraulically operated carrier-arm piston-and-cylinder unit 68, the cylinder of which is joined by a pin 70 to the carrier-arm 12. The rope 58 is trained over the pulley 60, 62 and 64 in such a fashion that it multiplies the sliding motion of the slidable base 54 compared with the displacement of the piston in the unit 68 by a predetermined factor which in the embodiment illustrated is two so that if the total possible displacement of the piston is 3 feet 6 inches the slide together with the drilling head 56 will be moved over a maximum distance of 7 feet.

The drill-head 56 includes a drill spindle arranged to be rotated by a hydraulic motor — not illustrated. The drill insertable into the drill-head is supported by a drill steady 72, mounted at the front end of the carrier arm 12 close to the pulley 62.

Thus, it will be seen that in contrast to the drilling rig illustrated in FIGS. 1 and 2, all rotary, pivotal or tilting motions of the rig illustrated in FIGS. 3 to 6 are affected hydraulically. However, it is to be understood that, except for the endless-drive transmission in the embodiment illustrated in FIGS. 1 and 2, all the other rotary, pivotal or tilting motions may also be produced by the hydraulic piston-and-cylinder units described in connection with the second embodiment.

As will be gathered from the preceding description of the two embodiments, a drilling rig according to the invention is capable of being permanently attached to a digger vehicle, particularly a vehicle arranged for side tipping. Its advantage is that it can stay attached even when it is required to use the vehicle for its primary

purpose of digging and (side) tipping. In this instance, the rig merely requires to be moved into its inoperative, or stowing, position on the vehicle itself. All that is needed to do this is to disconnect one end of one of the hydraulic piston-and-cylinder units actuating the boom or to take out the removable pin referred to in connection with the crank-arm 30 in FIG. 3. This possibility of leaving the rig attached to the vehicle, thus permitting the latter to be used as a dual-purpose vehicle has never before been achieved. It has been necessary either to dismantle the rig completely or to change from one type of vehicle, or appliance to another type. This has involved protracted interruption of work, not to mention the difficulty of moving one vehicle past the other in a confined space, such as in mining or tunnelling. A rig according to the invention when mounted on a vehicle of the type referred to obviates this difficulty and reduces the interruption of work to a minimum. Thus, it will reduce capital expenditure and working time and hence operators' wages.

What we claim is:

1. A drilling rig attachable to a bucket-digger vehicle equipped with a hydraulic actuating system, wherein the drilling rig comprises a boom one end of which is arranged to be pivotally attached to the vehicle while the other end supports a drilling-head carrier-arm tiltably mounted thereon and rotatable about an axis normal to the axis of tilting, wherein the boom is arranged to be pivoted in a vertical plane by at least one hydraulic piston-and-cylinder unit attachable to the vehicle and connectable to the hydraulic system, and an endless-drive transmission extending substantially from the one end to the other end of the boom for tilting the carrier arm over an arc of substantially 180°.

2. The drilling rig of claim 1 wherein said endless drive transmission includes a drive wheel located at or close to the one end of the boom.

3. A drilling rig according to claim 2, wherein said drive wheel is arranged to be rotated by a worm and worm-wheel drive.

4. A drilling rig according to claim 3, wherein said worm is power-driven.

5. A drilling rig according to claim 4, wherein the power is hydraulic power.

6. A drilling rig according to claim 2 wherein said drive wheel is a sprocket connected by a chain to a driven sprocket fixed to a block tiltably mounted at the other end of the boom and supporting the carrier-arm.

7. A drilling rig according to claim 1 wherein the pivotal motion of the boom is effected by means of two hydraulic piston-and-cylinder units, one of which is detachably connected to the vehicle.

8. A drilling rig according to claim 7, including a means for pivoting the boom in a horizontal plane.

9. A drilling rig according to claim 8, wherein the means for pivoting the boom in a horizontal plane includes a hydraulic piston-and-cylinder unit.

10. A drilling rig according to claim 1 wherein said drilling-head carrier-arm includes a support fixed to one end thereof, wherein the support is mounted in a block for rotary motion about an axis normal to the longitudinal axis of said drilling-head carrier-arm, and wherein the block is tiltably mounted on the other end of said boom.

11. A drilling rig according to claim 10, wherein the rotary motion of the block and said drilling-head carrier-arm is effected under hydraulic power.

12. A drilling rig according to claim 11, wherein the hydraulic power is provided by a pair of piston-and-cylinder units.

13. A drilling rig according to claim 1 wherein the endless-drive transmission comprises a cross-head arranged to slide along the boom, a driven wheel fastened to the block, a guide wheel mounted at or close to the one end of the boom, a chain attached to the cross-head and the driven wheel and trained over the guide wheel, and a piston-and-cylinder unit attached to the boom and arranged to impart sliding motion to the cross-head, the arrangement being such that in operation actuation of the driving piston-and-cylinder unit and the resulting sliding motion of the cross-head will tilt the block.

14. A drilling rig according to claim 13 wherein a drill-head is slidably mounted on said drilling-head carrier-arm.

15. A drilling rig according to claim 14, wherein hydraulically actuated operated means are provided to impart sliding motion to the drill-head.

16. A drilling rig according to claim 15, wherein the

actuating means comprise a further cross-head slidably mounted on the carrier-arm and arranged to be moved by a piston-and-cylinder unit mounted on the arm, two pulleys one rotatably mounted at or close to each end of the arm, and a rope fastened to the drill-head, trained over the pulleys and passing around a pulley on the further cross-head, and wherein the piston rod of the piston-and-cylinder unit is connected to the further cross-head, the arrangement being such that in operating actuation of the piston-and-cylinder unit and the resulting motion of the further cross-head will produce sliding motion of said drill-head.

17. A drilling rig according to claim 16, wherein the maximum sliding distance of said drill-head is a multiple of the total displacement of the piston of the carrier-arm piston-and-cylinder unit, and wherein the multiplication is effected by training the rope over the pulley on the further cross-head.

18. A drilling-rig according to claim 17 wherein said drill-head comprises a drill spindle arranged to be rotated by a hydraulic motor.

19. A drilling rig according to claim 1 wherein the bucket digger vehicle includes a bucket and means for tipping said bucket sideways.

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