Feb. 1, 1966 D. V. BAGLOW 3,232,359

EARTH DRILLING EQUIPMENT

Filed March 4, 1963 2 Sheets-Sheet 1

Fig. 1.

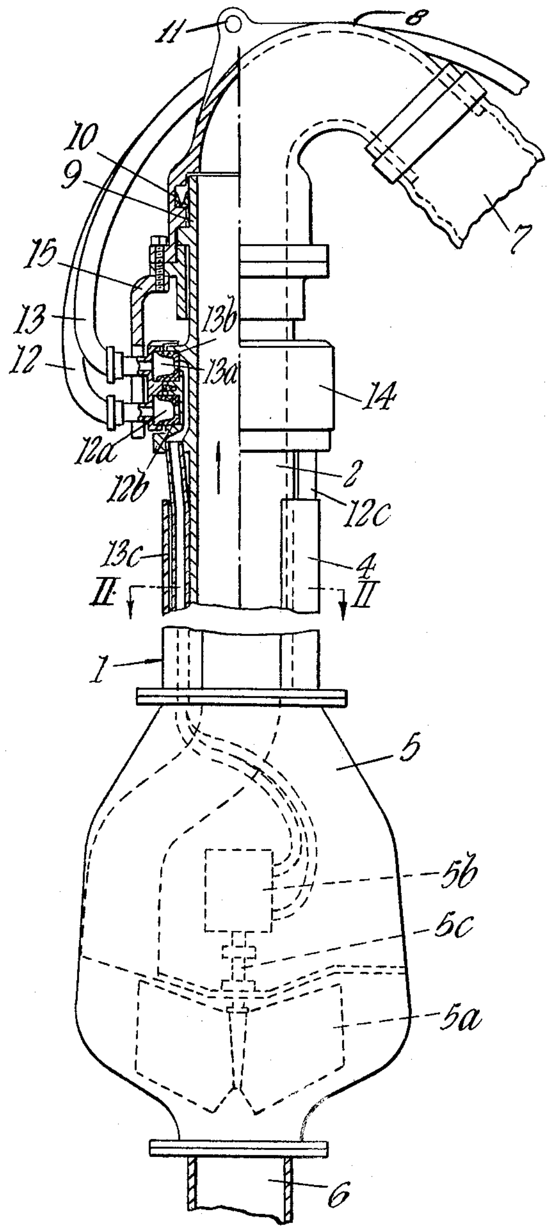
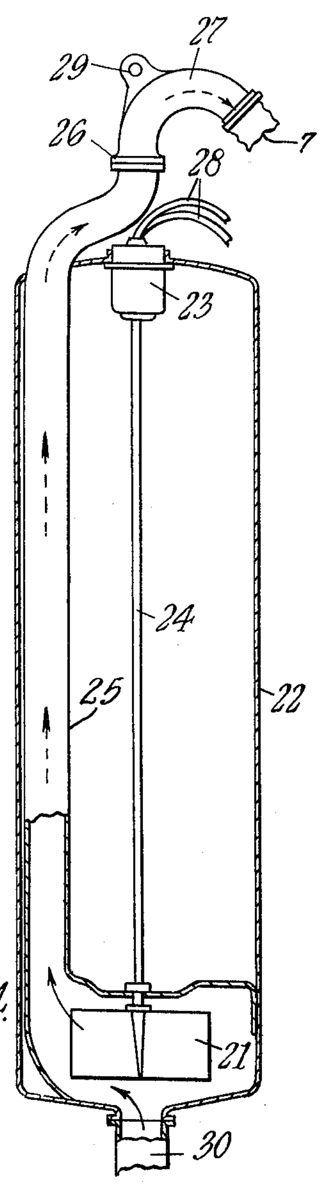



Fig. 4.



Feb. 1, 1966 D. V. BAGLOW 3,232,359

EARTH DRILLING EQUIPMENT

Filed March 4, 1963 2 Sheets-Sheet 2

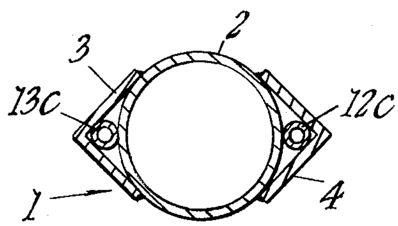



Fig. 2.

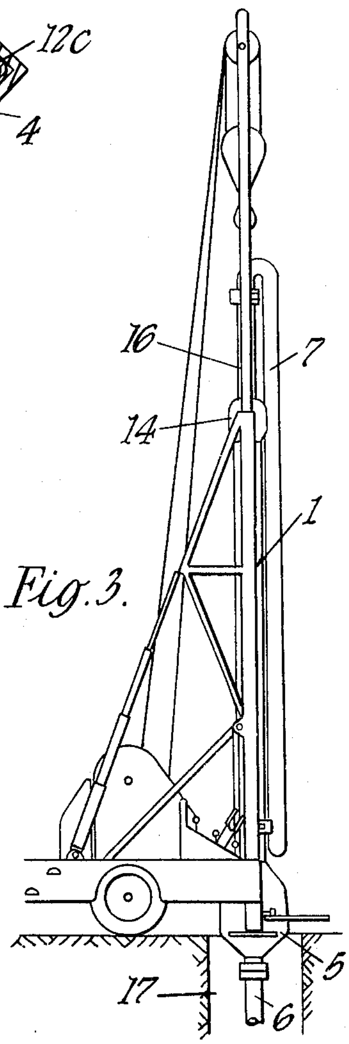



Fig. 3.

3,232,359
Patented Feb. 1, 1966



# 3,232,359
# EARTH DRILLING EQUIPMENT

Denis Vaughan Baglow, Weybridge, Surrey, England, assignor to Watermaster Limited, Weybridge, England

Filed Mar. 4, 1963, Ser. No. 262,644
Claims priority, application Great Britain, Mar. 24, 1961, 10,772/61
4 Claims. (Cl. 173—57)

This application is a continuation-in-part of my application Serial No. 181,747, filed March 22, 1962, now abandoned.

The invention relates to drilling rigs for use with the system of earth drilling known as reverse circulation in which a bit or drilling tool is connected to the end of a drill pipe and rotated about the axis of the pipe whilst being lowered vertically into the ground. The hole thus produced is filled with water (or other aqueous medium) and a pump is used to pump the various cuttings produced by the rotating bit up the drill pipe and discharge them away from the hole. Normally this pump is fixed above ground level and the necessary suction connection to the drill pipe made with a combination of flexible pipes and rotating and sliding joints.

As the efficiency of this system of drilling depends on the capabilities of the pumping arrangements, arrangements such as flexible connections or rotating joints are objectionable insofar as they may cause many stoppages and failures when leakages occur and the suction head of the pump is broken. In addition, in order to start the system, an auxiliary priming pump or other suitable device with various extra venting connections is usually required to start the circulation.

In the conventional drilling rig, a connection to the rotary boring gear, which includes the drill pipe, for rotating the bit is made by way of a kelly, which is an extended member which in operation is fixed to the upper end portion of the drill pipe, and in one arrangement slidably engages in a rotary member on the rig, the arrangement being such that no rotational movement is permitted between the kelly and said rotary member, using corresponding keys and keyways. In the usual rig of this arrangement, the kelly has a substantially square-cross section and fits into a square hole in a rotary table assembly, but it will be appreciated that other embodiments are possible. In another arrangement, the kelly may be rotated by a motor or prime mover (e.g. hydraulic) mounted on the kelly itself, or even mounted on the rig but moving up and down with the kelly, e.g. driving the kelly by gearing. For the purposes of the present specification, the words rotary boring gear may be not only the kelly but may also be parts (e.g. the drill pipe) adapted to be fixed directly or indirectly to the kelly so as to rotate therewith.

Earth drilling rigs of the reverse circulation type are not normally used for very deep drilling, such as is used in drilling oil wells, but may for instance be used to drill to a depth of up to about 300 metres. It has been proposed to use jet eductors in order to produce the reverse circulation of the aqueous medium, but these jet eductors usually absorb 5 to 10 times the power absorbed by mechanical pumps powered by for instance, electrical or hydraulic prime movers.



It is an object of the present invention to provide rotary boring gear for use with an earth drilling rig of the reverse circulation type using a mechanical pump to produce the reverse circulation, wherein the disadvantages caused by flexible or rotating suction joints or connections can be eliminated.

This invention consists in rotary boring gear for use with an earth drilling rig of the reverse circulation type, a mechanical pump for producing the reverse circulation having its casing fixed to said gear. The reverse circulation pump casing may be fixed to the lower end portion of the kelly, such that when the drilling rig is operative and the drill hole is substantially full of aqueous medium, the pump casing can be immersed below the surface level of the aqueous medium.

Using the gear of this invention, it can be arranged that there are no rotating or flexible suction joints or connections, and using the preferred embodiment it can be arranged that in use none of the suction part of the circulation system is above the surface level of the aqueous medium, and the depth of drill hole can be increased, the suction losses being largely dependent on the frictional losses in the drill pipe and the advantages to be gained by using this embodiment can offset the disadvantages of perhaps having to enlarge the top end of the drill hole to accommodate the pump casing and having to power the pump through lengthy power connections. The pump casing may be fixed to any portion of the drill pipe, providing the diameter of the drill hole is sufficiently large to accommodate the pump casing; thus in some embodiments, the pump casing could be fitted adjacent to the drilling bit itself.

The mechanical pump will be associated with a prime mover, and this prime mover can be arranged to lie adjacent to the pump, or more remote from the pump. For example, the prime mover may be fixed to the upper end portion of the boring gear and arranged to drive a pump fixed to the lower end portion of the boring gear by way of a shaft lying substantially parallel to the boring gear, suitably, a flexible shaft. Two preferred forms of prime mover are an electric motor and a hydraulic motor, the electric motor being advantageous in that the supply of electric power through rotating contacts to the kelly would present little problem, though the electric motor would normally have to be considerably larger than a hydraulic motor to obtain a comparable power output. Though large diameter rotary hydraulic connections are not commonly known in the art, suitable connection can be arranged. The rotary connections, whether electrical or hydraulic will normally be at the top end portion of the kelly so as always to be above the surface level of the aqueous medium in the drill hole. If the prime mover is fixed at the lower end portion of the kelly adjacent to the pump, the power leads (e.g. hydraulic or electrical) can be conducted down the kelly in housings parallel with the kelly formed between channel members fixed to embrace opposite sides of a circular tube, thereby also providing keys on the kelly.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheets of drawings, wherein like references refer to like parts, in which:

FIGURE 1 is a side view, partly in section and partly cut-away of a rotary boring gear in accordance with this invention;

FIGURE 2 is a cross-section along the line II—II of FIGURE 1;

FIGURE 3 is a side view of part of drilling rig incorporating the kelly shown in FIGURE 1 with a slight modification, the ground being partly cut-away and shown in section; and

FIGURE 4 is a side view, somewhat schematic and partly in section and partly cut-away, of another rotary boring gear in accordance with this invention.

The sliding portion of the kelly **1** shown in FIGURE 1 is formed by a pipe **2** having attached thereto (e.g. by welding) right angle channel members **3**, **4** so as to embrace the opposite sides of the pipe **2**, the length of the sliding portion usually being in accordance with the size of drilling rig to be used. The channel members or angle bars **3** and **4** serve to provide generally V-shaped keys for slidably engaging in complementary keyways in the rotary table of the drilling rig.

At its lower end, the kelly **1** is attached to a pump casing **5**, e.g. by bolting and making use of the flanges shown; the drill pipe **6** is attached to the lower end of the casing **5**, e.g. by bolting and making use of the flanges shown.

The internal arrangement of the pump is not shown in detail, suitable mechanical pumps being well known in the art; however, the pump is of the centrifugal type having a rotary impeller **5*a*** arranged to permit the passage of large pieces of solid, preferably, if this is possible, having a width up to the internal diameter of the drill pipe **6**. A hydraulic prime mover **5*b*** is mounted within the casing **5** above the mechanical pump and connected to the mechanical pump by way of a shaft **5*c*** coaxial with the kelly **1**.

A flexible discharge pipe **7** is connected to an elbow pipe **8** which in turn is connected to the kelly **1** by way of a rotary seal **9**. This seal **9** is of a conventional type having an annular gasket **10** and need not be described in detail. An eye **11** is provided on the elbow pipe **8** for hoisting and suspending the drill pipe **6**.

Hydraulic pressure leads **12** and **13** are shown connected to a rotary connection **14**, the hydraulic power being provided by any suitable hydraulic pump. The connection **14** would be well understood by one skilled in the art, it having annular channels **12*a*** and **13*a*** whose side walls make contact with U-section gaskets **12*b*** and **13*b***, an outlet being provided in the gaskets **12*b*** and **13*b*** leading to hydraulic pipes **12*c*** and **13*c***; these hydraulic pipes **12*c*** and **13*c*** are taken along the side of the pipe **2** within the channels or angle bars **3** and **4**. A yoke **15** is shown connecting the outside of connection **14** to the elbow pipe **8** in order to prevent rotation of the connection **14**. The hydraulic leads **12** and **13** can be secured to the elbow pipe **8** or to the upper end portion of the discharge pipe **7**, if desired.

FIGURE 3 shows the kelly **1** of FIGURES 1 and 2 in position on a drilling rig. The drilling rig is not shown or described in detail, but would be well understood by one skilled in the art. The kelly is shown in a position just below its uppermost position, with the pump casing **5** lying just below a rotary table (not shown) on the rig, and above the surface level of the aqueous medium in the drill hole **17**. During drilling, the casing **5** will normally be immersed below the surface level of the aqueous medium, though the usual requirement is that only the part of the casing **5** containing the mechanical pump should be immersed. It will be appreciated that it will normally be necessary to hoist the casing **5** above the surface level when attaching a further pipe length to the drill pipe, but this is not essential as the casing **5** may be lowered down the well by attaching further pipe lengths above the casing **5**.

In FIGURE 4, the impeller **21** of a rotary mechanical pump is attached to the lower end portion of a kelly **22**, the impeller **21** being drivable by a prime mover **23** at the upper end portion of the kelly **22** and connected to the impeller **21** by a shaft **24** lying substantially parallel to the kelly **22**. The discharge pipe **25** from the rotary pump is connected by means of a rotary seal **26** to an elbow pipe **27**, and this seal **26** and elbow pipe **27** may be the same as the rotary seal **9** and elbow pipe **8** shown in FIG. 1. The prime mover **23** is indicated as a hydraulic prime mover, though other forms of prime mover may be used. The discharge pipe **25** from the rotary pump and the power leads **28** for a hydraulic prime mover have a rotary seal **9** and a rotary connection **14**, respectively, substantially identical with the corresponding parts shown in FIGURE 1, making connection with an elbow pipe **27** and flexible discharge pipe **7**, and with hydraulic pressure leads **12** and **13**, respectively.

Although an eye **29** is shown on the elbow pipe **27**, the means for supporting the kelly **22** on this elbow pipe **27** are not shown, but such means could readily be provided by one skilled in the art.

The upper end of a drill pipe **30** is shown attached to the lower end of the kelly **22**. However, it will be appreciated that the boring gear can be arranged so that the casing of the rotary pump is lowered down the well, being attached to the lower end of a drill pipe, the impeller **21** being driven by the prime mover **23**, fixed to the kelly **22**, by way of the shaft **24**, which may be flexible and run up the drill pipe.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

I claim:

**1.** A rotary boring gear for use with an earth drilling rig of the reverse circulation type and said rig having a driven rotary member for engaging and rotating said boring gear to drill a well in the earth by a rotary drilling operation, said boring gear comprising an elongated tubular kelly, means on said kelly for slidably and non-rotatably engaging said rotary member, a pump casing secured to the lower end of said kelly for vertical and rotary movement therewith, a centrifugal pump impeller rotatably mounted in said casing adjacent the lower end, said casing having a fluid inlet in the lower end disposed axially of said impeller, means for securing a drill pipe carrying a drilling tool to the lower end of said casing, said pipe communicating with said inlet, fluid discharge means connecting the upper end of said casing and the interior of said kelly, a drive motor disposed in said casing and drivingly connected to said impeller, and power supply means connected to said motor, whereby upon lowering said kelly, casing and drill pipe into the earth and rotation thereof the drilling tool will operate to drill a well, and upon operation of said impeller well fluid will flow upwardly through said drill pipe and inlet into said casing and be pumped upwardly through said casing, said discharge means and said kelly to the surface.

**2.** A rotary boring gear as defined in claim **1** in which the means on said kelly for slidably and non-rotatably engaging said rotary member comprises elongated angle bars disposed on diametrically opposite sides of said kelly and extending longitudinally thereof, the legs of each angle bar being secured to said kelly and said angle bars providing generally V-shaped keys for slidably engaging in complementary keyways in said rotary member.

**3.** A rotary boring gear as defined in claim **2** in which said angle bars serve to provide closed channels and in which said drive motor is electrically driven, said power supply means comprising cables disposed in said channels.

**4.** A rotary boring gear as defined in claim **2** in which said angle bars serve to provide closed channels and in which said drive motor is hydraulically driven, said power supply means comprising conduits disposed in said channels.


**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 701,547 | 6/1902 | Davis | 175—323 X |
| 1,894,393 | 1/1933 | Bigelow. | |
| 2,234,454 | 3/1941 | Richter | 175—324 X |
| 2,605,083 | 7/1952 | Collins | 175—324 X |
| 2,839,272 | 6/1958 | Colquitt | 175—324 X |
| 2,849,213 | 8/1958 | Failing | 175—213 |
| 3,024,853 | 3/1962 | Herbold | 175—213 |
| 3,112,800 | 12/1963 | Bobo | 175—217 X |


CHARLES E. O'CONNELL, *Primary Examiner.*

BENJAMIN BENDETT, *Examiner.*