March 11, 1941. H. F. RICHTER 2,234,454

APPARATUS FOR DRILLING WELLS

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Fig. 1.

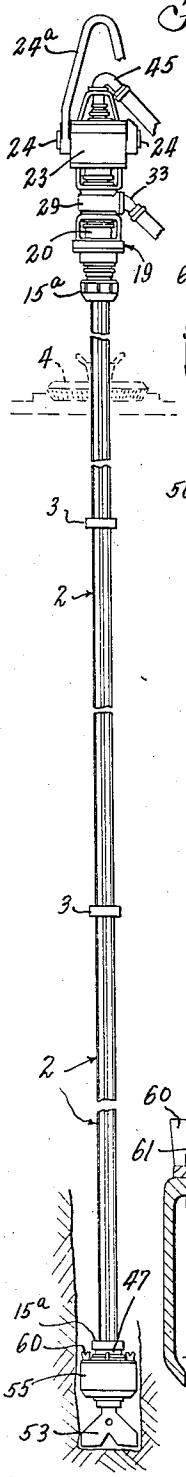
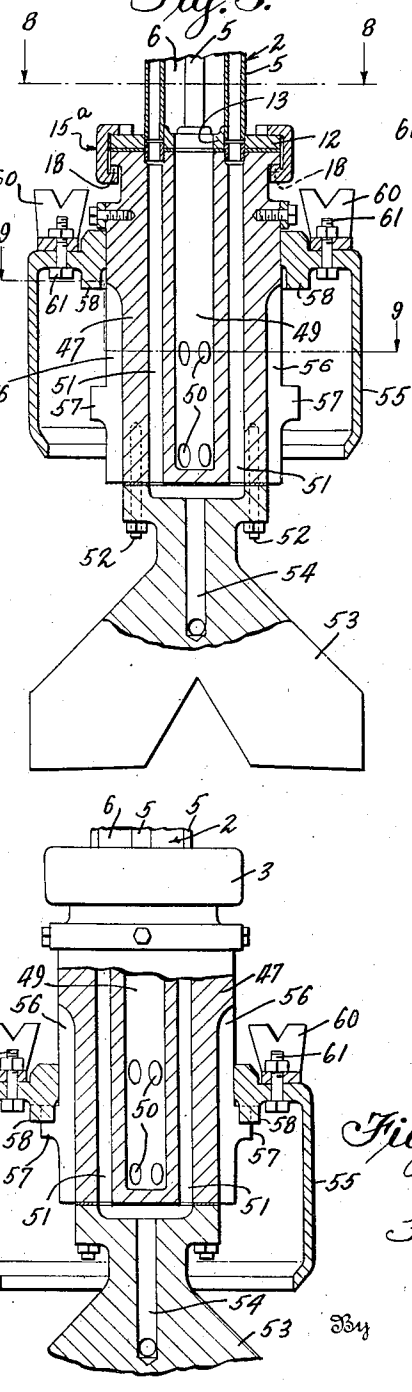


Fig. 3.



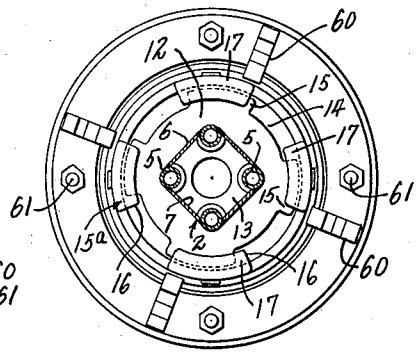
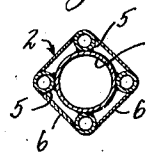


Fig. 8.

Fig. 10.



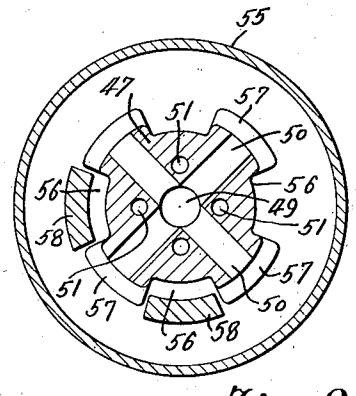


Fig. 9.

Fig. 4.

Inventor
Herman F. Richter

By Lyon & Lyon
Attorneys

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Fig. 2.

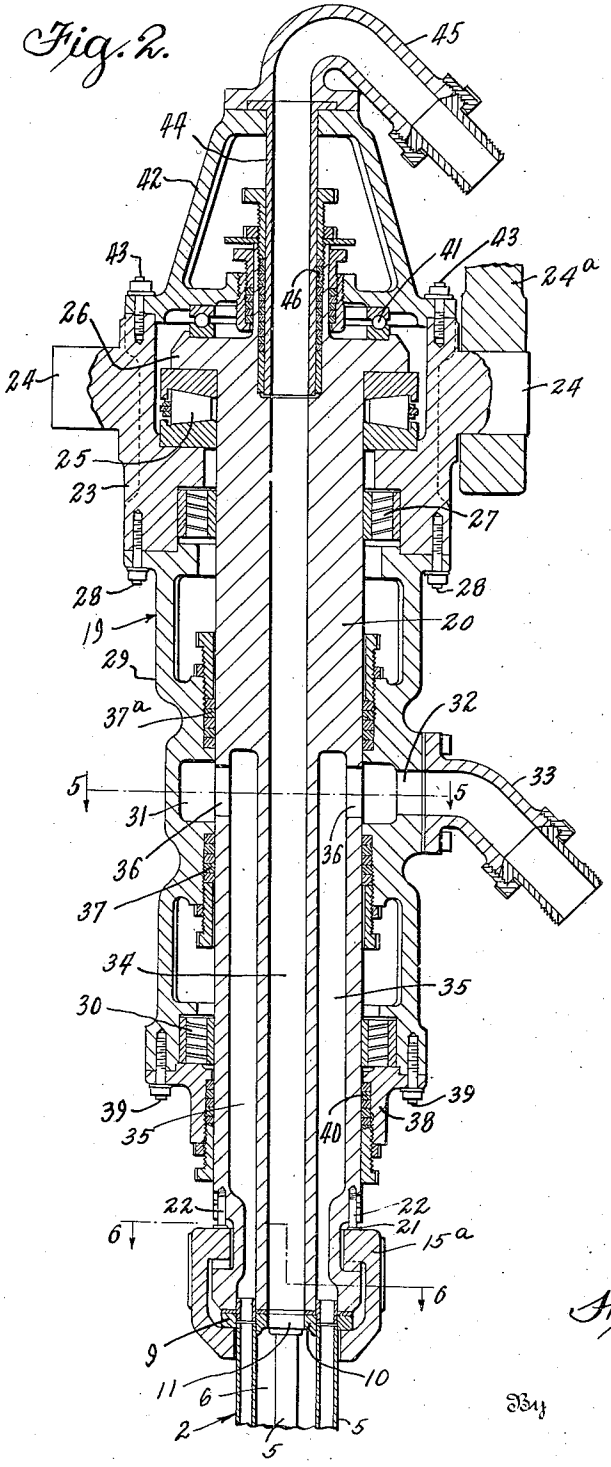

Fig. 5.

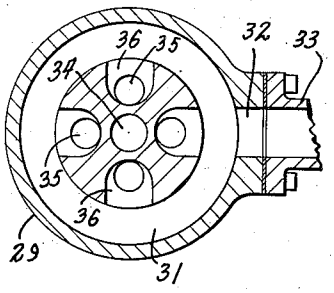

Fig. 6.

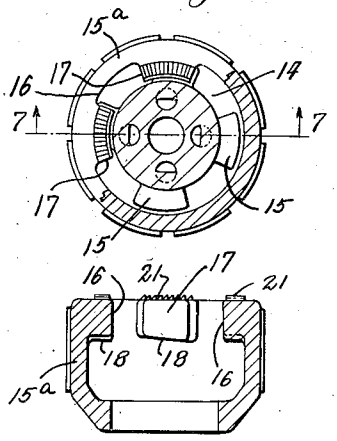

Fig. 7.

Inventor
Herman F. Richter

By Lyon & Lyon
Attorneys

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UNITED STATES PATENT OFFICE

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APPARATUS FOR DRILLING WELLS

Herman F. Richter, Los Angeles, Calif.

Application May 20, 1940, Serial No. 336,066

14 Claims. (Cl. 255—24)

This invention relates to the art of drilling wells by the rotary method, and has particular reference to the drilling of oil or gas wells.

With the present apparatus employed in the drilling of wells by the rotary method the drill pipe with the attached cutting bit is rotated within the well hole while mud fluid is pumped down the drill pipe to mix with the cutting of the bit, which returns to the surface of the well through the space between the walls of the well and outside of the drill pipe.

There are many disadvantages associated with the present drilling apparatus. Among such disadvantages is the fact that the returning drilling fluid brings to the surface of the well not only the cuttings from the particular formation being penetrated but portions of the other formations in the well which are encountered by the drilling fluid on its ascending motion to the top of the well. As a result, the returning drilling fluid can not be employed with an accurate indication of the character of the formation being drilled.

A further disadvantage of the present accepted apparatus for drilling wells resides in the fact that in order to rotate the drill pipe it is necessary to connect the same to a special square section of pipe, called a kelly, located at the top of the well, and, whenever it is desired to change the length of the pipe in the well, this kelly must be disconnected from the drill pipe while other sections are added or taken away from the same, after which the kelly must again be connected to the string.

Another disadvantage of the present apparatus employed in drilling wells is the fact that the same is provided with no reliable means by which the drill pipe may be withdrawn from the well hole in case the formations cave in around the pipe. Where the formations cave in around the pipe, with the present drilling apparatus it frequently becomes necessary to disconnect the several sections of the pipe and remove and fish the same out individually from the well hole. The various sections of drill pipe are usually made up by screw threads which turn in a right-hand direction for tightening the pipe so that the pipe is capable of being turned only in one direction without one or more of the sections being unthreaded and disconnected.

It is a general object of the present invention to provide a drilling apparatus capable of overcoming many of the deficiencies existing in the apparatus now in general use. More particularly, one object of the present invention is to provide a drilling apparatus in which both the passages for the downward movement of the drilling fluid and the return movement of the drilling fluid are provided by the drill pipe, and to provide means by which the drilling fluid immediately subsequent to its mixing with the cuttings of the drill bit will be taken again into the drill pipe so that the drilling fluid may be returned to the surface of the well substantially uncontaminated by the material from the other formations in the well where the mud fluid may be examined as an accurate indication of the characteristic of the particular formation being penetrated by the bit.

Another object of the present invention is to provide a drilling apparatus including such upward and downward mud passages in which the sections of the drill pipe are rendered square in cross section so that each individual section of the drill pipe is capable of being engaged by a square bushing for rotating the pipe, thereby eliminating the necessity of connecting into the system any special kelly or grief pipe.

A further object of the present invention is to provide a means for making connections between drill pipe sections having up and down mud passages, which coupling means is independent of any screw-threaded engagements and is capable of locking the different pipe sections quickly together in a manner permitting the drill pipe to be rotated in either direction as may be desired in drilling operations.

A further object of the present invention is to provide a suitable hood construction for surrounding the bit at the lower end of the apparatus capable of directing the mud fluid back into the return drilling passages of the pipe during normal operation of the apparatus but designed for operation to a second position where communication is allowed between the bottom of the drilling apparatus and the space surrounding the well hole, which communication facilitates certain operations of the apparatus, such as the movement of the apparatus to and from drilling position.

A further object of the present invention is to provide a drilling apparatus designed where the formation may tend to cave in on the drill pipe to be able to cut its way back to the surface of the well without requiring the usual operations of disconnecting portions of the apparatus fishing from the well such disconnected portions of the apparatus.

Many additional objects and advantages of the apparatus of the present invention will appear from a description of a preferred form or example of an apparatus embodying the inven-

tion. I have, therefore, hereinafter described a preferred form or example of the apparatus, the description being given in connection with the accompanying drawings.

In the drawings:

Figure 1 is an elevation of the drilling apparatus.

Figure 2 is an enlarged vertical section of the swivel employed for supporting and making suitable connections with the mud fluid passages.

Figure 3 is an enlarged vertical section of the lower portion of the apparatus showing the hood construction and cutting bits.

Figure 4 is a similar vertical elevation, partially broken away, showing a second position of the hood.

Figure 5 is a section on the line 5—5 of Figure 2.

Figure 6 is a section on the line 6—6 of Figure 2.

Figure 7 is a section on the line 7—7 of Figure 6.

Figure 8 is a top view of the hood construction indicated as taken partially on the line 8—8 of Figure 3.

Figure 9 is a section on the line 9—9 of Figure 3.

Figure 10 is a cross-sectional view of a somewhat modified form of drill pipe to be used in connection with the apparatus of the present invention.

Referring to the drawings, the apparatus of the present invention includes a plurality of drill pipe sections 2, any number of which may be employed and coupled together by couplings 3. Each drill pipe section is so constructed as to provide separate passages for flow of mud fluid down the drill pipe and separate passages for the return flow of the mud fluid. Furthermore, such drill pipe sections are constructed to present a square external appearance, so that each of the drill pipe sections may be rotated in the usual manner as by rotary table, indicated at 4 in dotted lines in Figure 1. For such purposes, I have indicated the drill pipe as formed of a plurality of tubes 5, four of which are indicated, one being positioned in each corner of the intended square. Such tubes 5 are joined together with plates 6, which in practice are to be welded to the tubes 5 so that the plates 6 define an inner return passage for the drilling fluid 7, the interior bore of the tube 5 forming the downward passage for drilling fluid.

Figure 10 indicates a modified form of construction in which there is added a central tube 8 for the purpose of further strengthening the construction and for providing a smoother return passage for the drilling fluid.

Each of the drill pipe sections at one end is connected (as indicated, for example, in Figure 2) to a coupling plate 9, which is to be understood as preferably welded to the pipe sections, and provides openings for receiving the tubes 5 of the drill pipe, and with a central portion 10 has an opening 11 for maintaining the return passage.

At its opposite end, as indicated in Figure 3, each of the drill pipe sections 2 is provided with a coupling plate 12, likewise welded in position and provided with openings for receiving the tubes 5, and with a portion 13 having a central bore. The coupling plates 9 and 12 are provided with openings 14 defining lugs 15 (four being indicated) by which provision is made for locking engagement between pipe sections, and a lock nut 15a. The lock nuts 15a at one end are indicated as provided with openings 16 and defining lugs 17 complementary to the lugs 14 and 15 on the coupling plates at the end of the drill pipe sections. The lower faces of the lugs 17 and of the lock nuts 15a are inclined, as indicated at 18, to act as wedges, so that when the lock nuts are placed over the corresponding coupling plates 9 and 12 on adjacent pipe sections by a partial turn the pipe sections may be quickly locked and wedged into position.

In Figure 2 of the drawings the upper section of the drill pipe is indicated as being connected by the same type of couplings to the lower end of a swivel 19. The swivel 19 is employed for the purposes of supporting the drilling apparatus for rotary movement and for providing for suitable intake and outlet connections therewith. The swivel includes a member 20 which at its lower end is provided with openings and lugs similar to those described in connection with the couplings, so as to be capable of receiving one of the nuts 15a. The nuts 15a in the case of the coupling at the lower end of the swivel are indicated as having ratchet faces 21 for engagement with the spring-pressed latch members 22 positioned in recesses in the member 20.

The member 20 of the swivel is carried by a supporting member 23, which supporting member is indicated as provided with the usual trunnions 24 for connection with the bale 24a, by means of which the drilling apparatus of the present invention may be supported in drilling operations. The supporting member 23 is indicated as mounting a main rotary thrust bearing 25, and the member 20 is indicated as having a flange 26 sitting over the main thrust bearing 25, by which the sleeve and connected apparatus may be supported. The supporting member 23 is further indicated as providing the radial bearing 27 engaging the member 20. To the lower end of the supporting member 23 is connected, as by bolts 28, a suitable intake housing 29, which intake housing carries a radial bearing 30 for engaging the member 20. The intake housing 29 is provided with an annular recess 31, which connects by a lateral port 32 with the coupling 33, by means of which connection may be made to a hose for supplying mud fluid to the drilling apparatus.

The member 20 of the swivel is provided with a central bore 34 adapted to make connection with the central passage of the drill pipe sections 2. The member 20 is further provided with bores 35 at its lower end for connecting with tubes 5 of the drill pipe 2, which bores 35 connect with ports 36 establishing communication with the recess 31 and intake housing 29.

The intake housing 29 is indicated as provided with suitable packing 37 below the intake and additional packing 37a above the intake. At the lower end of the intake housing there is indicated as preferably provided a cap 38 bolted to the intake housing, as indicated at 39, and carrying additional packing 40.

The upper end of the member 20 of the swivel engages a rotary bearing 41, the upper face of which is connected to a head 42 for the swivel, which is indicated as bolted at 43 to the supporting member 23. The head 42 carries a nipple 44 which makes connection with a coupling 45, which in turn is desired to be connected to a discharge hose for discharging the returning drilling fluid from the apparatus. The nipple 44 is indicated as engaging packing 46 carried

by the head 42 for making a fluid-tight connection with the central passage 34 of the swivel.

The particular swivel construction heretofore described will be seen to provide a simple and effective means for making two hose connections with the drilling pipe of the apparatus of the present invention, and by means of such swivel the apparatus is readily supported for free rotary movement while continuous connection is maintained with the desired inlet and outlet hoses for drilling fluid.

The lower section of drill pipe 2 is connected to a bit carrying member 47. For this purpose, the upper end of the bit carrying member 47 is indicated as provided with a flange which should be provided with lugs and openings similar to that described in connection with the coupling plate 9 of Figure 2, by means of which one of the lug nuts 15a may make locking connection with the lower end of the drill pipe. The bit carrying member 47 is provided with a central bore 49 extending to nearly its lower end, which central bore 49 connects through ports 50 to the exterior of the bit supporting member 47. From its lower end the bit supporting member 47 is bored, as indicated at 51, for making connection with the tubes 5 of the drill pipe sections 2. To the lower end of the drill bit supporting member 47 is attached in any suitable manner, as by bolts 52, any usual or desired form of cutting bit 53, the fluid passages 54 of which are designed to communicate with the bores 51 of the member 47.

By the construction thus described the downwardly moving drilling fluid from tubes 5 of the drill pipe sections passes through passages 51 of the supporting member 47 and through the passage 54 of the drilling bit where the same may mix with the cuttings formed by the drilling bit. The returning drilling fluid enters ports 50 and thence makes its way through the central passage 49 of the member 47 to the interior of the drill pipe sections 2.

To prevent the drilling fluid from rising upward around the drill pipe there is provided a hood member 55, which hood member is designed for movement into two operating positions. In its upper position the hood member is intended to prevent the upward flow of the drilling fluid and in its lower position it is intended to expose passages for the movement of drilling fluid to the outside of the drilling pipe. In its lower position the hood by by-passing the drilling fluid facilitates the insertion and removal of the apparatus from the well hole. Furthermore, in its lower position the hood positions the apparatus as later described in position for operation in cutting its way out of the drill hole where the holes of the drill hole may cave in upon the apparatus. For the purposes above indicated the member 47 is provided on its exterior with grooves 56, the upper ends of which grooves terminate below the top of the hood when the hood is in its upper position, but which grooves are adaped to be exposed on movement of the hood to its lower position. The member 47 is also indicated as provided with stops 57 for limiting the downward movement of the hood, which stops 57 interfit with lugs 58 on the hood 55, by means of which the hood is locked against rotary movement with respect to the apparatus in its lower position. The hood is indicated as provided with hood members 60 bolted to the hood, as indicated at 61, and facing upwardly, by means of which cutting members cutting action may be secured by rotating the apparatus while moving the apparatus upwardly in a well hole.

With the apparatus thus described it will be apparent that in a normal operation of drilling the upward flow of drilling fluid will maintain a hood in an upward position, so that the drilling fluid will be directed by the hood back into the center of the drill pipe to be returned to the top of the well. When the passage of drilling fluid down an apparatus is discontinued, the hood 55 may descend to the lower position, which lower position permits the drilling fluid to readily by-pass the apparatus. Furthermore, in the lower position any cuttings formed by the bit 60 in drilling the apparatus out of the well following a cave-in may pass through the grooves 56 and be discharged into the lower end of the well.

With the apparatus of the present invention it will be seen that it is totally unnecessary to employ special kelly sections during drilling operation as each of the pipe sections 2 is adapted for cooperation of the rotary table. In normal drilling operations the returning drilling fluid constitutes a reliable guide of the character of formation penetrated by the apparatus.

While the particular form of apparatus herein described is well adapted to carry out the objects of the present invention, it is to be understood that the invention is not limited to the particular form shown but includes all such modifications and changes as come within the scope of the appended claims.

I claim:

1. In an apparatus for drilling wells, a plurality of drill pipe sections each having a squared exterior and including an intake and outtake passage for drilling fluid.

2. In an apparatus for drilling wells, a plurality of drill pipe sections each having a squared exterior, intake and outake passages for drilling fluid, and means for coupling said sections whereby they may be turned in either direction without uncoupling.

3. In an apparatus for drilling wells, a plurality of drill pipe sections each having a squared exterior and composed of corner tubes defining fluid passages and with connecting plates defining therewith a fluid passage.

4. A drill pipe section for a well drilling apparatus comprising a plurality of tubes spaced apart in the form of a square and plates connecting said tubes to form a central passage, said coupling members secured to said plates and tubes at the end of said sections provided with lugs and notches.

5. In a well drilling apparatus, a plurality of pipe sections each composed of a plurality of tubes with connecting plates forming a squared exterior and an interior passage, said drill pipe sections being connected to coupling plates having lugs and notches, a coupling nut interconnecting adjacent pipe sections having lugs and notches complemental to those of said pipe sections.

6. In an apparatus for drilling wells, drill pipe sections coupled together, each pipe section comprising a plurality of tubes connecting corner plates forming squared exterior surfaces for the pipe sections and an interior passage, means for connecting a drilling bit to the lower end of said pipe sections, and a hood mounted to be positioned above such drilling bit and operative for directing returning drilling fluid into said pipe sections.

7. In an apparatus for drilling wells, drill pipe sections coupled together, each pipe section comprising a plurality of tubes connecting corner plates forming squared exterior surfaces for the pipe sections and an interior passage, means for connecting a drilling bit to the lower end of said pipe sections, a hood mounted to be positioned above such drilling bit and operative for directing returning drilling fluid into said pipe sections, mounting means for said hood being provided with a fluid passage, and said hood being movably mounted to in one position close and in the other position open said passage.

8. In an apparatus for drilling wells, drill pipe sections coupled together and having separate passages for carrying drilling fluid downwardly and upwardly, means for attaching the drilling bit in the lower end of said pipe sections, said means mounting a hood operative in one position for directing drilling fluid into the return passage of said pipe sections and movable to a second position to uncover a by-pass port for the drilling fluid.

9. In an apparatus for drilling wells, drill pipe sections coupled together and having separate passages for carrying drilling fluid downwardly and upwardly, means for attaching the drilling bit in the lower end of said pipe sections, said means mounting a hood operative in one position for directing drilling fluid into the return passage of said pipe sections and movable to a second position to uncover a by-pass port for the drilling fluid, said hood being provided with cutting elements facing upwardly.

10. In an apparatus for drilling wells, drill pipe sections having squared exteriors, means for coupling said drill pipe sections together, each of said drill pipe sections having passages for downflow of drilling fluid and separate passages for the return flow of drilling fluid, means at the lower end of said pipe sections for attaching the bit, said means movably mounting a hood member operative in one position for directing the turning drilling fluid into said pipe sections and movable to a second position to permit by-pass of the drilling fluid.

11. In an apparatus for drilling wells, drill pipe sections having squared exteriors, means for coupling said drill pipe sections together, each of said drill pipe sections having passages for downflow of drilling fluid and separate passages for the return flow of drilling fluid, means at the lower end of said pipe sections for attaching the bit, said means movably mounting a hood member operative in one position for directing the turning drilling fluid into said pipe sections and movable to a second position to permit by-pass of the drilling fluid, said hood being provided with cutting elements facing upwardly.

12. In an apparatus for drilling wells, a plurality of drill pipe sections coupled together, each of said drill pipe sections having a plurality of corner tubes with interconnecting plates forming a squared exterior of the pipe sections and separate passages for up and down flow of drilling fluid, means for swivelly supporting a drilling pipe for rotation of a well hole, said swivelly supporting means including a sleeve, bearings mounting said sleeve and provided with connecting passages to make separate connections to intake and outtake hoses.

13. In an apparatus for drilling wells, a swivel support having a supported member and a rotatably mounted sleeve member, means for coupling an intake hose and means for coupling an outlet hose to said supporting member, said rotatable sleeve having separate passages for communication with said inlet and outlet hoses, and a pipe section connected to said sleeve and having separate intake and outlet passages connecting therewith, said pipe sections having a squared exterior.

14. In an apparatus for drilling wells, a plurality of pipe sections having separate intake and outlet passages, said pipe sections being coupled together, means at the lower end of said pipe sections for connecting a drilling bit for downward cutting, a hood supported on said means movable into one position to direct the returned drilling fluid into said pipe sections and movable to a second position to allow said drilling fluid to by-pass said hood, said hood being provided with cutting elements cutting in an upward direction.

HERMAN F. RICHTER.