

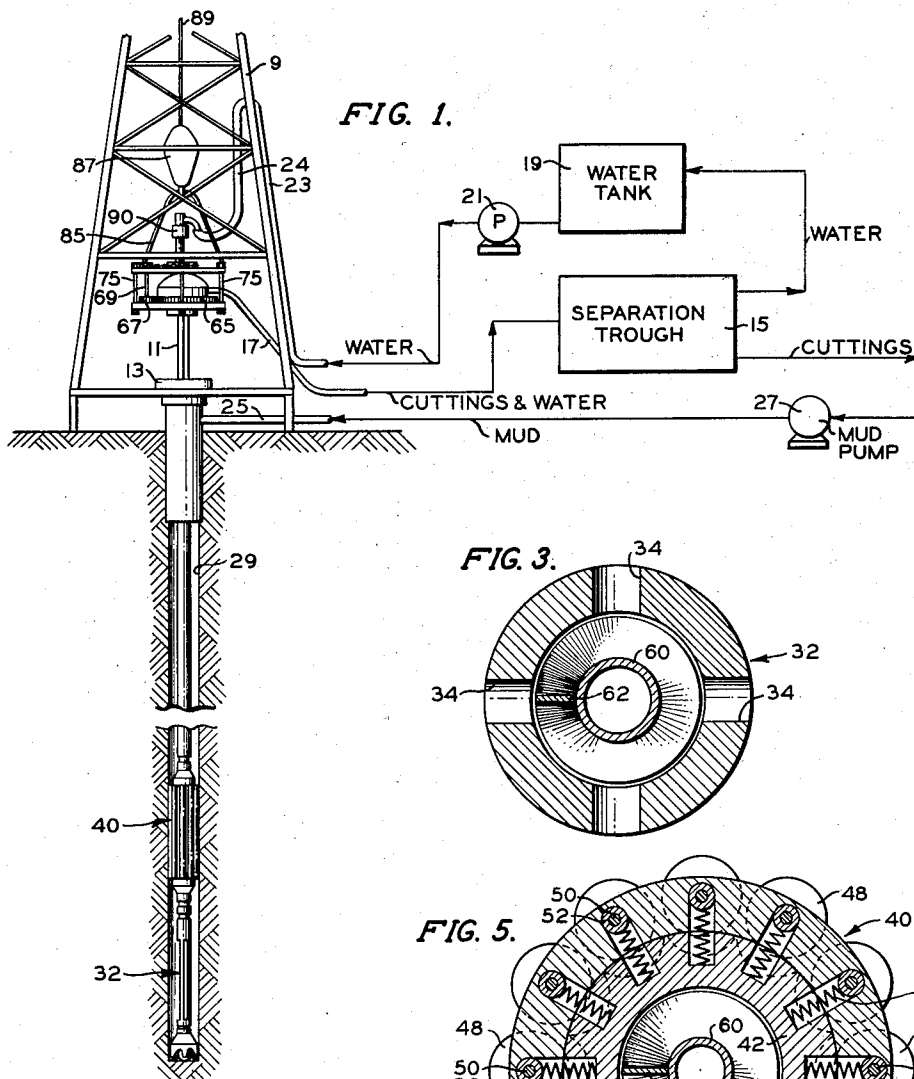
May 12, 1959

H. A. GEHRKE
OIL WELL DRILLING MEANS

2,886,288

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3 Sheets-Sheet 1



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FIG. 2.

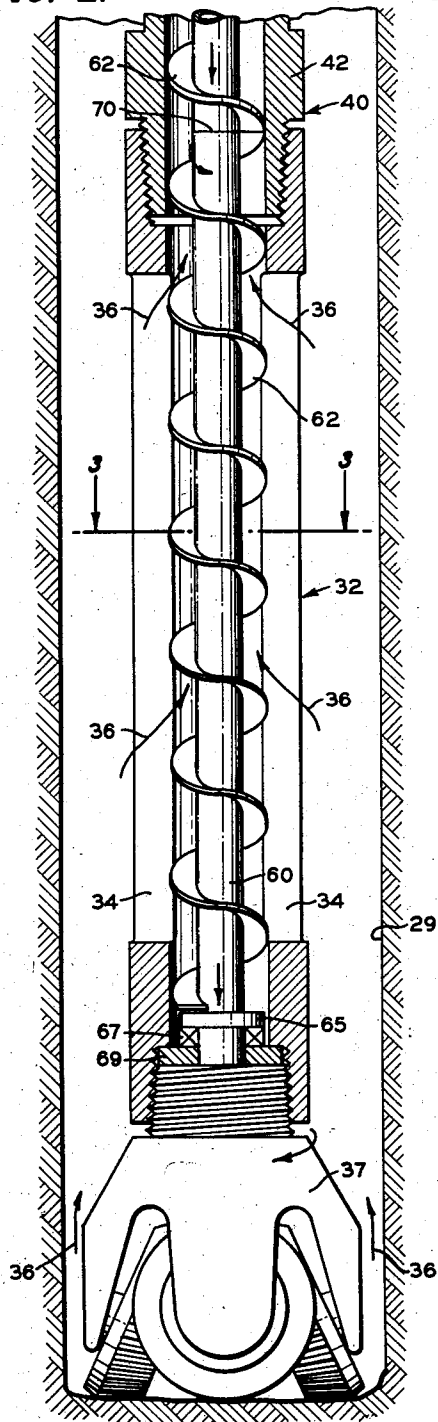
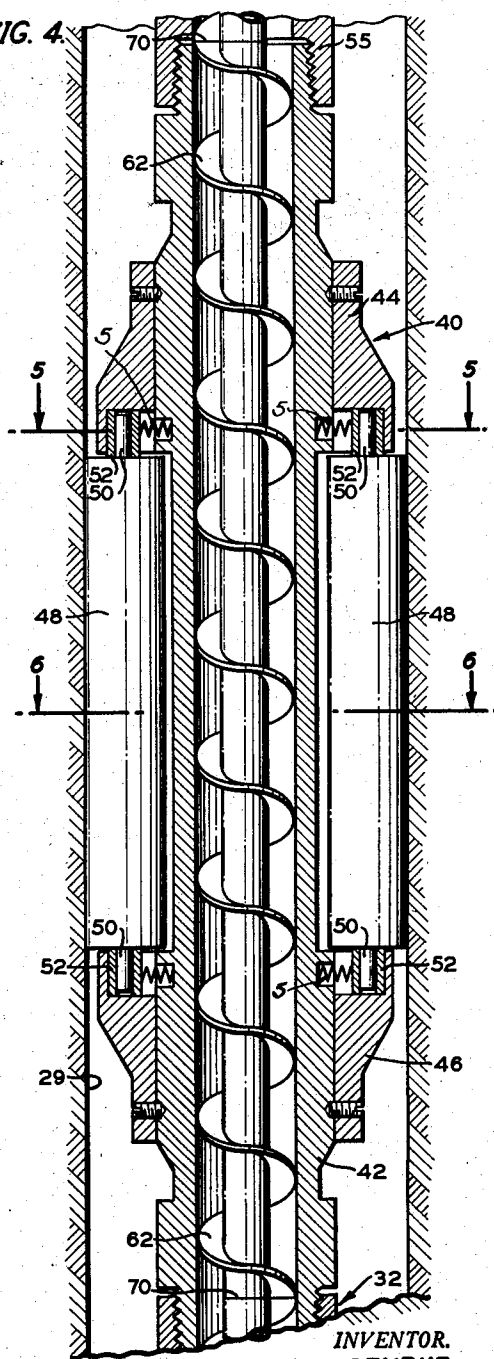


FIG. 4.



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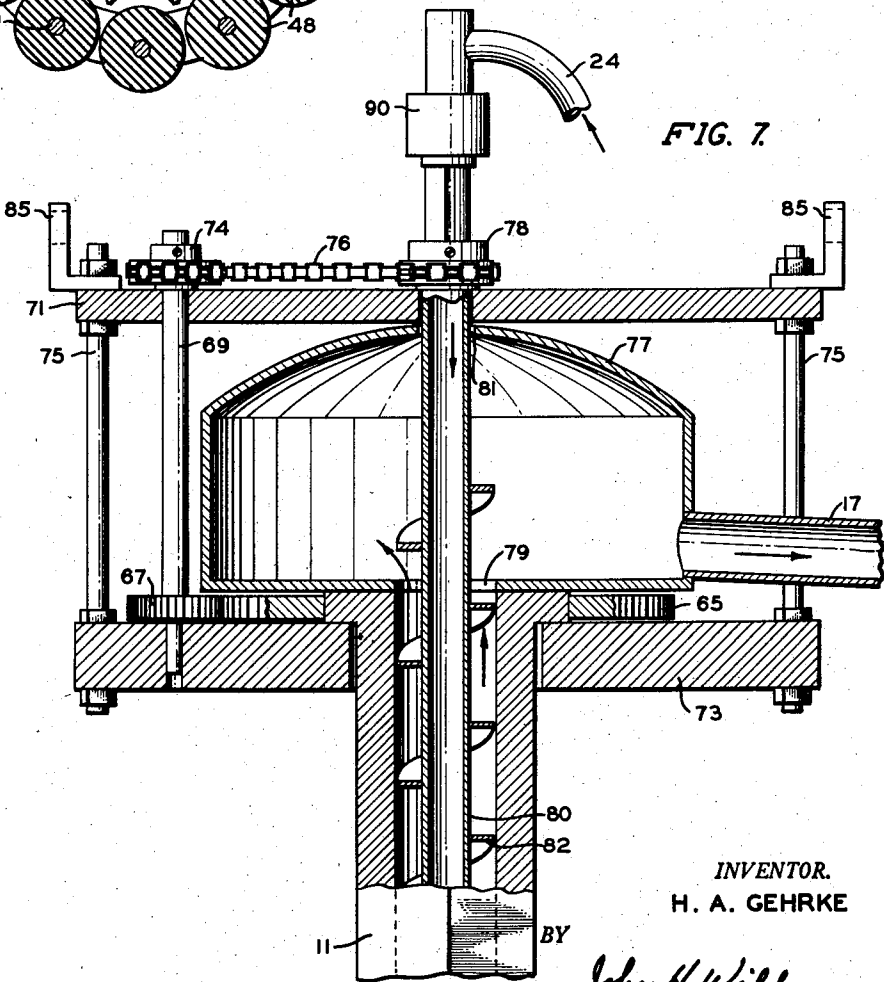
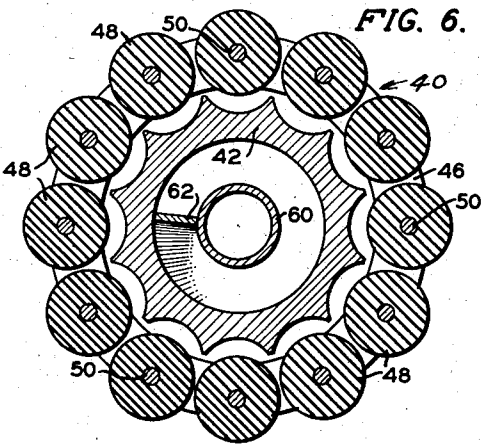
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OIL WELL DRILLING MEANS

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8 Claims. (Cl. 255—21)

This invention relates to the drilling of wells. In a more specific aspect this invention relates to the drilling of oil wells. In a still more specific aspect this invention relates to the drilling of oil wells in which operation a drilling fluid is passed down into the bottom of the well hole during drilling wherein it picks up material removed from the bottom of the hole and carries same to the surface. In yet a more specific aspect this invention relates to the drilling of oil wells using rotary drill equipment in which operation a liquid drilling mud is passed down into the bottom of the well hole being drilled wherein cuttings removed by the rotary bit are picked up and carried to the surface. And, still more specifically this invention relates to changing the usual rotary drill equipment to more efficiently and effectively handle the drilling mud and cuttings removed from bottom hole in drilling, and to so handle the well drilling process and means.

In the common and usual rotary well drilling apparatus for drilling oil wells, a drill string of threadedly joined sections of drill pipe is rotated at the surface by a rotary table and power means therefor and by a Kelly tool which is operatively connected to the table to be turned thereby, and which in turn is connected to the top section of pipe of the drill string to rotate the string. The lower end of the lower section of drill pipe mounts the usual rotary bit which cuts material from bottom hole when the drill string is rotated to in turn rotate the bit. Drilling mud is pumped from the surface through the drill pipe and central conduit in the rotary bit out around the bit cutting cones where the mud picks up the cuttings removed from bottom hole by the bit, and these cuttings and drilling mud are passed up to the surface in the annular space between the drill pipe and well hole. The cuttings are separated from the mixture, the mud diluted and/or treated as otherwise desired, and passed back into the drill pipe for further use to pick up cuttings. Relatively high pressure and large equipment are necessary to handle this usual mud circulation method, and enough pressure must be put on the mud stream at the surface to overcome the entire frictional loss due to flow down the drill pipe and back up the space between the drill pipe and well hole. Needless to say these losses are great due to the nature of the mud and the rough well hole walls. Also, the well walls are in some instances such that loss of mud into formations is great, and large cavities, etc., in formations have resulted in loss of practically the entire mud supply. In addition, the mud in contact with the well wall has caused producing formations to be missed, or damaged to the extent that flow area from the formation is substantially decreased and the ultimate recovery from the field drastically curtailed. I have invented new means and methods for drilling wells using drilling fluids wherein the drilling fluid is always contained in the ground in the drill pipe or a conduit within the drill pipe except in the very bottom of the hole. The many disadvantages of the usual drilling method and means are over-

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come by the new devices, apparatus and methods of my invention.

The new means of my invention for drilling an oil well utilizes a drill string whereon a lower member is mounted which has a chamber to receive drilling fluid and material removed from bottom hole, and the lower member has a passageway therein which communicates between bottom hole and the chamber. This chamber member is adapted to mount the tool or tools which remove material from the bottom of the well hole in operation. The drill string has an upper drill pipe assembly in conduit communication with the chamber of the lower member. In this drill string is mounted means to deliver drilling fluid to the bottom of the hole during drilling, and means to convey the drilling fluid plus the material removed from the bottom of the hole and picked up by the fluid to the surface. The drill string has means therewith by which it can be operated by suitable power means. The new means for drilling an oil well of my invention is adapted upon operation to pass the drilling fluid to bottom hole, to receive drilling fluid and material removed from bottom hole in the chamber of the lower member via the passageway therein, and to pass the mixture of fluid and material up to the surface through the drill string. I prefer that a compacting member be included in the drill string and positioned therein above the lower member having the chamber. In operation by the string operation, this compacting means moves in contact with the walls of the well hole to shape and condition them, as desired.

It is an object of this invention to provide new methods and means for drilling wells.

It is another object of this invention to provide new methods and means to drill oil wells where drilling fluids are employed to bring material removed from the well hole to the surface.

It is a further object of this invention to provide new means to drill oil wells by the rotary method where drilling mud is used to carry drill cuttings from bottom hole to the surface.

Still a further object of this invention is to provide new means to cooperate in combination with the usual rotary drill bit, pipe string, and powering assembly, with only slight change, to provide a new rotary method and means wherein the usual disadvantages associated with handling drilling mud are eliminated.

Yet a further object of my invention is to provide new means for drilling an oil well which are efficient, easy to operate, less expensive to manufacture and to use than the common type, and which are particularly reliable in operation.

Other objects and advantages of the new drilling means of my invention will become apparent to those skilled in the art upon reading this disclosure.

Drawings accompany and are a part of this disclosure. These drawings depict preferred specific embodiments of the new drilling means of my invention as applied to rotary drilling, and it is to be understood that such are not to unduly limit the scope of my invention. In the drawings,

Fig. 1 is a schematic view in elevation of a preferred specific embodiment of the new drilling means of my invention in relation to auxiliary derrick means, and drilling mud handling means.

Fig. 2 is a longitudinal elevation view partly in cross-section of the new lower receiving means of the drill string which has a chamber therein and which mounts the drill bit.

Fig. 3 is a view taken on line 3—3 of Fig. 2.

Fig. 4 is a longitudinal elevation view partly in cross-section of the new packer of the drill string which is mounted in the string above the receiving member.

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Fig. 5 is a view taken on line 5—5 of Fig. 4.

Fig. 6 is a view taken on line 6—6 of Fig. 4.

Fig. 7 is an elevation view partly in cross section of the superstructure of the drill string which operates same and which provides for introduction and outlet of the drilling fluids.

Following is a discussion and description of the new drilling methods and means of my invention made with reference to the drawings whereon the same reference numerals are used to indicate the same or similar parts or structure. The discussion and description is of preferred specific embodiments of the new drilling means of my invention, and it is to be understood that such is not to unduly limit the scope of my invention.

Referring to Fig. 1, the new drilling means of my invention is used with the usual derrick structure 9, Kelly tool 11, and rotary table 13 which are employed in the usual manner. A common separating trough 15 is used for settling and separating the bottom hole cuttings from the drilling mud returned via preferably flexible line 17 to trough 15. These cuttings are suitably disposed of and the low viscosity drilling mud, preferably substantially water, is returned to water supply tank 19 for reuse and reinjection into the well by pump 21 and via line 23. Line 23 is connected to a preferably flexible hose or line 24 which flexes in use as the drill string and operating equipment move up and down. A line 25 and small mud pump 27 are preferably provided to introduce mud into the well hole 29 between the drill string and well wall for sealing purposes, etc., if desired or required in operation.

Referring now to Figs. 2 and 3, the new drill string of my invention has a lower hollow receiving member 32 which is preferably elongated and which has a plurality of longitudinal slots 34 therein which in operation communicate with the chamber within member 32 and the space in the bottom of well hole 29. These slots 34 are preferably narrow to prevent large size pieces of cuttings from entering the chamber within member 32, and I have found a slot width of from $\frac{5}{8}$ to $\frac{7}{8}$ inch to be preferable. The lower end of member 32 is threaded to receive the drill bit 37 which can be any suitable and known drill bit such as the rotary three cone cutter shown. In operation member 32 rotates along with the rest of the drill string and bit 37, and cuttings removed from bottom hole by rotary bit 37 are picked up and passed by the drilling fluid through slots 34 into the chamber of member 32, and thence to the surface as will be set forth hereinafter.

Referring now to Figs. 4, 5 and 6, the compacting member 40 of my invention is inserted in the drill string, preferably just above the receiving member 32 and threadedly secured thereto to rotate therewith in operation. Compacting means 40 has an inner elongated and hollow housing 42 which is in conduit communication with the hollow or chamber of receiving member 32. Around housing or pipe 42 is mounted an upper sleeve 44 and a lower sleeve 46. These sleeves mount roller compacting members 48 which have the ends of the shafts 50 therethrough mounted in bearings 52. These bearings are mounted in recesses therefor in sleeves 44 and 46. Member 42 is preferably longitudinally grooved on its outside to provide recesses wherein roller compacting members turn in operation as housing 42 is rotated with the drill string. Spiral springs 5 are mounted in and backed by housing 42, with their outer ends in contact with bearings 52 to urge same outwardly. In operation this provides for roller compacting members 48 to be pressed into contact with the wall hole 29, so that the surface of the rollers pack and shape the wall hole. And, compacting means 40 can be used to seal formations, etc., during operation with relatively heavy mud introduced through line 25 into the space between the drill string and well hole 29. As many compacting members 40 can be used as desired.

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Next in the string and above the compacting member 40 is the usual drill pipe 55, and as many sections of same are used as is necessary to reach the surface for joining with the Kelly tool 11 which rotates the drill string to rotate rotary bit 37. The lower pipe 55 is threadedly secured to the upper end of compacting means 40 to turn therewith as tool 11 turns the string, and the drill pipe is in conduit communication with compacting member 40 and receiver 32.

In the new drilling means of my invention the cuttings removed from bottom hole by bit 37 are picked up by drilling mud supplied through pipe 60 to the usual central mud conduit (not shown) in bit 37. The cuttings and mud pass upwardly and into the chamber of receiver 32 through slots 34 therein as indicated by arrows 36 (Fig. 2). Pipe conduit 60 rotates in operation preferably counter to the drill string, and the pipe has a spiral flange 62 fixed thereto to provide a flight conveyor which picks up the cuttings and drilling mud and carries them to the surface, pipe 60 and flange 62 extending from the lower end of receiver 32 to the surface within the drill string. The conveyor is preferably made in sections approximately the same length as the drill pipe sections and suitably joinable, preferably threadedly joinable as the drill pipe sections, so additional flight conveyor sections can be added along with each drill pipe section. Lines 70 indicate the points of joining the sections of conveyor. The pipe 60 has a flange 65 fixed thereto on the lower end which rides on a bearing 67 which in turn is supported by plate 69 fixed and held in the lower end of receiver 32.

At the surface the drill string is rotated in the usual manner by the Kelly tool 11, and in the preferred specific embodiment shown, the Kelly tool is modified and adapted to also rotate pipe 60 counter to the drill string. This is done by fixing a spur gear 65 to the top of the Kelly tool 11 to turn therewith. This spur gear turns spur gear 67 which is fixed to turn shaft 69 journaled in the supporting framework having upper and lower supporting members 71 and 73, respectively, such being connected and held together by threaded rods 75. Shaft 69 has a sprocket 74 fixed thereon to turn therewith. Chain 76 connects this sprocket to a sprocket 78, which is mounted on the upper end of the operating flight conveyor having a conduit 80 and a spiral flange 82. This drives pipe 80 counter the drill string and thus pipe 60 counter drill pipe 55 and the compacting means 40 receiver 32 and bit 37. I have found it preferable to gear such that the conveyor turns considerably faster than the drill pipe 55, a 4 to 1 ratio having been found preferable.

The lower platform supporting member 73 has a centrally located hole through which the Kelly tool 11 extends and in which it turns in operation. The usual mud header 77 can be employed, and is mounted in the framework above the gear 65 in any suitable manner. Header 77 has centrally located holes 79 and 81 therein through which the flight conveyor pipe 80 projects and in which it turns, and the cuttings and drilling mud are carried into header 77 and out outlet 17. This is reverse the flow of the usual mud header, but the usual header can be easily modified for the new use.

The whole of the framework is hung by U-bolt assembly 85 from block 87 operated by the tackle 89 and which is supported on the derrick 9. The block and frame work assembly lowers as the well is drilled, and the block and tackle are used to raise the assembly for insertion of new sections of drill pipe 55 and conveyor pipe 60 into the drill string.

In operation the drilling mud, preferably substantially water, is pumped by pump 21 into the top of pipe 80 through line 24 which is connected to rotating pipe 80 by any suitable water tight connector 90. The water flows down pipe 60 to bit 37 as indicated by the arrows, and out around the cones of bit 37 where it picks up cuttings from bottom hole. The water and cuttings flow through relatively narrow openings 34 into the chamber

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of receiver 32. These openings are narrow to exclude large pieces of cuttings which fall back to be ground smaller by the bit. The flight conveyor 60—62 picks up the cuttings and water and carries them to the surface and out line 17 to separating trough 15. The water separated is then recycled.

As will be evident to those skilled in the art, various modifications of this invention can be made, or followed, in the light of this disclosure and discussion, without departing from the spirit or scope of the disclosure or from the scope of the claims.

I claim:

1. Means for drilling an oil well by rotary drilling methods, comprising, in combination: bottom hole rotary drill means having a threaded receptacle in its lower end portion threadedly mounting for operation a rotary drill bit, said drill means having an outer elongated hollow housing with a plurality of spaced longitudinal slots therein, said housing adapted to turn in operation to rotate said rotary drill bit; compacting means threadedly secured in its lower end portion to the upper end portion of said drill means housing to rotate therewith, said compacting means having an elongated hollow housing with the conduit resulting from said housing in direct flow communication with said hollow and slots of said drill means housing, said compacting means housing having a plurality of spaced roller compacting members rotatably mounted around and longitudinal to said compacting means housing on the outside thereof, and spring means urging said roller compacting members outwardly and said roller compacting members adapted to rotate upon rotation of said compacting means with said roller compacting members in contact with the walls in drilling; a string of drill pipe threadedly secured together and threadedly secured in its lower end portion to the upper end portion of said compacting means to turn same in operation, the conduit of said string of drill pipe being in direct flow communication with the hollow of said compacting means; drilling mud conduit means having spiral flange flight conveyor means rotatably and coaxially mounted within and throughout the length of the conduit of said rotary drill means, compacting means and drill pipe string to turn counter thereto in operation, said mud conduit means comprising, a plurality of sections of pipe threadedly secured together to turn together, the lower end portion of said pipe being bearingly mounted in the lower end portion of said rotary drill means in position to seal said hollow of said rotary drill means from the drilling mud conduit of said rotary drill bit, and said sections of pipe each individually having spiral flight conveyor means on the outside thereof throughout its length; means to rotate said string of drill pipe and to rotate said mud conduit pipe in the opposite direction; means to introduce drilling mud into said mud conduit pipe at the surface; and means to remove said mud and cuttings returned to the surface; and said means for drilling an oil well adapted upon operation to remove material as cuttings from the well bottom with such being picked up by drilling mud passed to said bit through said mud pipe, and with the resulting mixture of mud and cuttings passing into said rotary drilling means through said slots and being conveyed to the surface by said flight conveyor within said drill pipe string, compacting means and rotary drill means.

2. Means for drilling a well, comprising, in combination, a rotary drill string having a lower hollow receiving member, a rotary well drilling bit having drilling teeth mounted on the lower end portion of said hollow receiving member, hollow compacting means in conduit communication with said receiving member, and an upper drill pipe in conduit communication with said hollow compacting means, said receiving member having openings therein communicating with the outside of said string and the hollow of said receiving member, said compacting means having a plurality of roller compacting mem-

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bers mounted on the outside thereof and constructed and operative to rollingly contact the hole wall to pack same during drilling operation, a drilling fluid conduit rotatably mounted for rotation within said drill pipe, compacting means and receiving member and constructed and operative to deliver drilling fluid to the fluid conduit of said drilling bit, said drilling fluid conduit having flight conveyor means therewith formed by a spiral flange around said conduit, means by which said drill string can be rotated and by which said drilling fluid conduit can be rotated, and said means for drilling a well constructed and operative in drilling operation to function in a substantially vertical position, to pass drilling fluid to bottom hole through said drilling fluid conduit, to pass drilling fluid and bottom hole cuttings upwardly around said rotary drilling bit, to receive said drilling fluid and bottom hole cuttings in said receiving member through said openings therein and pass same up to the surface by said flight conveyor means through said drill string.

3. Means for drilling an oil well, comprising, in combination, a rotary drill string having a lower member having a receiving chamber, a rotary drill bit having teeth thereon mounted on said lower member in the lower end portion of said member, said rotary drill string having an upper drill pipe in conduit communication with said receiving chamber, said receiving member having an opening therein communicating with the outside of said drill string and said chamber, a drilling fluid conduit mounted for rotation within said drill pipe and receiving chamber and constructed and operative to deliver drilling fluid to bottom hole in drilling operation, said drilling fluid conduit having conveyor means therewith, means constructed and operative to rotate said rotary drill string and said drilling fluid conduit in drilling operation, and said means for drilling a well constructed and operative in drilling operation to function in a substantially vertical direction, to pass said drilling fluid to bottom hole through said drilling fluid conduit, to pass drilling fluid and bottom hole cuttings upwardly around the rotary drill bit, to receive said drilling fluid and bottom hole cuttings in said receiving chamber through said opening, and pass same to the surface by means of said conveyor means through said drill string between said drill pipe and drilling mud conduit therein.

4. The drilling means of claim 3 wherein said drill string has compacting means therein above said receiving member, and said compacting means has rotatable means adapted in operation to rollingly contact the wall of the hole being drilled.

5. The drilling means of claim 3 wherein said conveyor means is a flight conveyor with a spiral flange on the outside of said drilling mud conduit.

6. The apparatus of claim 1 wherein said means to rotate said string of drill pipe and to rotate said mud conduit pipe in the opposite direction has a kelly operatable by a rotary table with a spur gear fixed to said kelly in the top end portion thereof to turn therewith, a second spur gear operatively positioned to turn with said Kelly spur gear, and a chain and sprocket drive operatively connecting the shaft of said second spur gear and said mud conduit so that upon rotation of said kelly said drill pipe is rotated in one direction and said mud conduit is rotated in the opposite direction.

7. The apparatus of claim 2 wherein said means by which said drill string can be rotated and by which said drilling mud conduit can be rotated has a kelly operatable by a rotary table with a spur gear fixed to said kelly in the top end portion thereof to turn therewith, a second spur gear operatively positioned to turn with said Kelly spur gear, and a chain and sprocket drive operatively connecting the shaft of said second spur gear and said mud conduit so that upon rotation of said kelly said drill pipe is rotated in one direction and said mud conduit is rotated in the opposite direction.

8. Means for drilling a well, comprising, in combination, a drill string having lower means having a chamber, rotary drill means having teeth thereon mounted on said lower means, said drill string containing an upper pipe in conduit communication with said chamber of said lower means, conduit means mounted within said chamber and pipe constructed and operative in drilling operation to deliver drilling fluid to bottom hole, a passageway in said lower means communicating between said chamber therein and a point outside said string, mechanical means within said chamber and drill pipe constructed and operative in drilling operation to convey material to the surface in the annular space between said drilling fluid conduit means and said pipe, means operatively connected to operate said rotary drill means, and said means for drilling a well constructed and operative to function in substantially vertical position, to in operation pass drilling fluid to bottom hole through

said drilling fluid conduit means, to pass drilling fluid and bottom hole cuttings upwardly around said rotary drill means, to receive said drilling fluid and cuttings removed from said bottom hole in said chamber in said lower means through said passageway therein and pass same to the surface.

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