The invention relates to new and useful improvements in a system of drilling wells by use of drilling apparatus which may be transported through pipe sections and attached and detached to a chuck connected to said pipe sections, without removing the chuck and pipe sections from the well hole.

An object of the invention is to provide a method by which drilling apparatus may be transported to and from a chuck through pipe sections connected thereto, said drilling apparatus being attached, detached and removed from the chuck and pipe sections by use of moving fluid under pressure, without removing the chuck and pipe sections from the well hole.

A further object of the invention is to provide a method whereby moving fluid under pressure may be utilized to replace a drilling apparatus and means to regulate the pressure within the well hole while the drilling apparatus is in transit, to hold wild pressures, such as oil and gas pressures in abeyance and prevent heaving and slumping formations of the earth from freezing the piping in the well hole.

A further object of the invention is to provide a method whereby drilling apparatus may be controlled within the pipe sections by means regulating the flow of the moving fluid.

A still further object of the invention is to provide a grapple apparatus which may be used in case of necessity to be dispatched through pipe sections by moving fluid under pressure to engage a drilling apparatus of the above type, and means whereby moving fluid under pressure may be utilized to dislodge said drilling apparatus and transport the same and said grapple apparatus upwardly through the chuck and pipe sections without removing the chuck and pipe sections from the well hole.

Another object of the invention is to provide drilling apparatus which may be interchangeably attached and detached of a chuck through pipe sections by use of moving fluid under pressure to carry out my system of drilling wells.

These and other objects of the invention will in part be obvious and will in part be more fully disclosed.

In the drawings, which show by way of illustration one embodiment of the invention:

Fig. 1 is a vertical side view, partly sectional, showing the surface casing cemented in the earth forming a support for the well cap attached thereto with the upper portion of the pipe sections disposed therethrough and sealing members surrounding the pipe sections allowing the pipe sections to be rotated and fed forward therethrough by the well known rotary system of drilling, with catcher stationed within the upper portion of the pipe sections and turn table joint and swivel connection thereabove for connection with regulating valve, also well cap connection provided with regulating valve by which the flow of the fluid may be regulated, the single arrow heads denoting the course of the fluid downwardly through the pipe sections returning upwardly externally of said pipe sections and internally of the well hole to be discharged through the valve connection in the well cap; the double arrow heads denoting the course of the fluid in opposite direction passing downwardly through the valve connection into the well cap and downwardly through the well hole exteriorly of the pipe sections and upwardly internally of the pipe sections to be discharged through the valve connections attached to the swivel thereabove.

Fig. 1b is a vertical side view, partly sectional, showing the lower portion of the pipe sections and chuck with the drilling apparatus seated on the chuck in operative position for drilling, the single arrow heads indicating the course of the fluid passing downwardly through the pipe sections directed through the fluid passageways in the drilling apparatus in communication with the interior of the pipe sections, to be expelled at the lower end thereof and forced upwardly exteriorly of the chuck and pipe sections to be discharged through valve connections in the well cap.

Fig. 1c is a vertical side view, partly sectional, showing the lower portion of the pipe sections and chuck with the drilling apparatus being forced upwardly therethrough by moving fluid under pressure, the course of the fluid being indicated by double arrow heads.

Fig. 1d is a vertical side view, partly sectional, showing the lower portion of the pipe sections and chuck with the sample drilling apparatus seated on the chuck in operative position for drilling, the single arrow heads indicating the course of the fluid passing downwardly through the pipe sections and directed through the sample drilling apparatus to be expelled at the lower end thereof and forced upwardly exteriorly of the chuck and pipe sections to be discharged through valve connections in the well cap.

Fig. 1e is a vertical side view, partly sectional, showing the lower portion of the pipe sections with the sample drilling apparatus being forced upwardly therethrough by moving fluid under
pressure, the course of the fluid being indicated by double arrow heads.

Fig. 1g is a continuation of Fig. 1e, showing the lower portion of the sample drilling apparatus being a view similar to Fig. 1e.

Fig. 2 is a fragmentary view, in part section, illustrating the upper portion of the spear tube head of the drilling apparatus in engagement with the catcher casings within the upper portion of the pipe sections.

Fig. 3 is an enlarged vertical side view, partly sectional, of the grapple apparatus being forced downward through pipe sections, the single arrow heads denoting the course of the fluid.

Fig. 4 is an enlarged vertical side view, partly sectional, of the grapple apparatus, illustrating the grapple stem in engagement with the upper portion of the spear tube head of the drilling apparatus, the single arrow heads showing the course of the fluid downward.

Fig. 5 is a cross-section on the line 5—5 of Fig. 1b.

Fig. 6 is a cross-section on the line 6—6 of Fig. 1b.

Fig. 7 is a cross-section on the line 7—7 of Fig. 1b.

Fig. 8 is a cross-section on the line 8—8 of Fig. 1b.

Fig. 9 is a cross-section on the line 9—9 of Fig. 1b.

Fig. 10 is a cross-section on the line 10—10 of Fig. 1b.

Fig. 11 is a sectional view on the line 11—11 of Fig. 1c.

Fig. 12 is a sectional view on the line 12—12 of Fig. 3.

Fig. 13 is a fragmentary view showing the lower end of the chuck with the drill bits and wedges seated thereon and in edge view.

Fig. 14 is a sectional view on the line 14a—14a of Fig. 1d.

Fig. 15 is a side elevation of the central cutter of the drilling apparatus.

Fig. 16 is a top view of a wedge member.

Fig. 17 is a vertical side view, partly sectional, of an elongated spear tube head used in connection with the drilling apparatuses and grapple apparatus in pipe sections and coupions having irregular internal bores, illustrating the elongated spear tube head passing through pipe sections and couplings of irregular internal bores with sealing rings seated within the couplings whose openings conform substantially to the outer periphery of the elongated spear tube head.

Fig. 18 is a sectional view taken on the line 18—18 of Fig. 1d.

The invention is directed to a system of drilling wells by the use of drilling apparatuses adapted to drill a complete well without removing the piping from the well hole. By use of the novel drilling devices, unexplored depths can be reached by reason of the principles involved in replacing the desired type of drill through the pipe sections and attaching and detaching the same interchangeably, the desired type of drill connected to the pipe sections by force of moving fluid under pressure without removing the chuck and pipe sections from the well hole, and without resort to mechanical means acting as a conveyor for the drilling apparatuses, although mechanical means may be employed to perform the functions of replacing the drills by inserting and withdrawing the means through the pipe sections and attaching and detaching the drills of the chuck connected to the pipe sections without removing the chuck and pipe sections from the well hole.

In the drawings, I denotes plurality of casing members joined by threaded engagement with each other and cemented in the earth to form a permanent surface casing for the well hole 11, with the upper portion of the surface casing protruding above the earth's surface, generally indicated at 16. The surface casing serves as a conduit for the drilling fluid employed in the rotary system of drilling wells as well as providing a support for a well cap 2 through which the pipe sections 3 and chuck 4 attached to the pipe sections may be inserted and revolved, said well cap being utilized as a sealing member through which the pipe sections may be rotated and fed forward by the use of the well known turn-table and machinery adapted for such purposes, said well cap being provided with a valve 6 and suitable connections 8 through which the drilling fluid may be passed and the flow thereof regulated. A turn-table joint 7 having suitable connections 3 and valve 9 attached thereto. The turn-table joint is joined in threaded engagement with the pipe sections through which the drilling fluid may be passed and the flow thereof regulated by the valve 9. Thus it will be seen that circulation of the drilling fluid under high pressures may be forced by slush pumps, (not shown here) connected to either of the two connections and valves above, in either direction to suit the purpose of the operator in carrying out a method hereinafter disclosed of replacing the drilling apparatuses through pipe sections and attaching and detaching the same on a chuck connected to said pipe sections by use of moving fluid under pressure without removing the chuck and pipe sections from the well hole. Drilling apparatus as hereinafter described are adapted to be inserted into the pipe sections 3 and the turn-table joint 7 is connected to the pipe sections and fluid under pressure is forced into said turn-table joint through connections 6 and valve 5 by slush pumps in communication therewith, which forces the drilling apparatus down to a seated and locked operative position on the chuck 4 located at the bottom of the pipe sections. While the drilling apparatus is in transit downward movement through the pipe sections the drilling apparatus is effective as a piston-like member within the pipe sections. No fluid can pass the drilling apparatus on its downward movement through the pipe sections as members are provided to substantially conform to the inner circular bore of the pipe sections and chuck and will not permit the passage of fluid through until the drilling apparatus is positively seated in operative position on the chuck. During the above operation as the apparatus enters the chuck a shoulder 40 is provided therein to stop the downward movement of the apparatus at which time the locking devices are free to be seated in operative position on the chuck 4 by the force of the moving fluid under pressure exerted against the apparatus. When seated in operative position on the chuck fluid passageways communicating with the interior of the pipe sections are automatically opened in the drilling apparatus through which the moving fluid under pressure passes to wash the cuttings from the bottom of the well hole as the cuttings are drilled and to force the same upwardly exteriorly of the pipe sections to be discharged through connections 6 and valve 5 in the well cap. By manipulation of the valve 6 the amount of the fluid to
pass therethrough may be regulated to hold the desired pressure within the well hole, thereby keeping the walls of the well hole from caving or slumping and freezing the piping. It is apparent that in forcing a drilling apparatus through pipe sections depended within a well hole that the fluid pressure may be controlled by the manipulation of the valve 8 and the drilling apparatus may be transported downwardly through the pipe sections at the desired speed and the desired fluid pressure within the well hole may be maintained. This is a very essential factor in my method of drilling in that the pressure in the pipe sections is regulated and it is necessary to replace a drilling apparatus it can be done with safety and dispatch by holding the high pressures in abeyance within the well hole by regulated continuous circulation of the fluid under pressure and the pipe sections and chuck may be rotated to prevent their becoming fast in the earth. By converting the line 6 in the well cap 2 and the well hole 1 into an intake line with suitable connections to the slush pumps and by conversion of the chuck 4, pipe sections 3, turntable joint 7 and the connections there af the discharge line for the fluid the following procedure may be adopted in forcing a drilling apparatus upwardly through the pipe sections and chuck without removing the chuck and pipe sections from the well hole by the use of moving fluid under pressure. As moving fluid under pressure is forced downwardly into the well hole 11, exteriorly of the pipe sections 3 a fluid pressure will be exerted against the drilling apparatus from the bottom thereof and as the arrangement of the parts in the apparatus are so constructed that a back-pressure valve 17d in the spear tube head 17 closes the fluid passage 17g to prevent communication of the moving fluid under pressure from below with the interior of the pipe sections thus preventing passage of fluid upwardly through the drilling apparatus and again the apparatus is effective as a piston like member within the chuck and pipe sections. The locking members are constructed to be dislodged by the force of upwardly moving fluid under pressure and the drilling apparatus is unscrewed from the chuck free to be moved upwardly through the pipe sections. In detachment of a drilling apparatus from a chuck and transporting it upwardly through the pipe sections connected to said chuck by the use of moving fluid under pressure in the manner described, the speed of the drilling apparatus and the desired pressure may be maintained within the well hole by the manipulation of the valve 8. A catcher 12 is stationed within the pipe sections at or near top thereof to receive the drilling apparatus which has been forced up through the pipe sections by the moving fluid, which holds the same for the convenience of the operator. Where pipe and couplings having irregular internal bores are used in drilling wells by the system herein described it may be necessary to make an extension or elongation of the members and parts of the drilling apparatus, as shown in Fig. 17, to make the same effective as a piston like member in transporting the drilling apparatus through the pipe sections, said extension or elongation having a length greater than the distance between two irregularities within the bores of the couplings and the pipe sections. Where the bores of said fluid extension or elongation conforming substantially to the reduced bore of the couplings and the pipe sections. Sealing rings 30 may be stationed within the coupling members 3a and pipe sections 3 to positively prevent the bypassing of fluid between the outer periphery of the extension or elongation and the opening within the sealing rings as the drilling apparatus thus constructed is in transit within the pipe sections, thus it will be seen that the elongation, being the spear tube head 17 on the drilling apparatus and 33 on the sample drilling apparatus or 25 on the grapple apparatus, is at all times disposed through one or more coupling members and/or sealing rings to form the piston like member necessary to be formed for the drilling apparatus and grapple apparatus are forced through the pipe sections and couplings having irregular bores by the use of moving fluid under pressure. A grapple apparatus such as shown in Fig. 3 may be employed to be forced by moving fluid under pressure downwardly through the pipe sections to which the chuck is connected to engage a drilling apparatus and transport it from the well hole. The grapple apparatus is constructed to be effective as a piston like member within the pipe sections and chuck when in transit from the earth's surface to its objective. The grapple apparatus is used in case of emergency should the back-pressure valve in the spear tube heads of either the drilling apparatus or sample drilling apparatus become ineffective to render the method of detachment and movement of the drills upwardly through the pipe sections of themselves by the utilization of moving fluid under pressure. Having thus described the method wherein a drilling apparatus may be transported and forced through pipe sections and attached and detached to a chuck connected thereto by the use of moving fluid under pressure without removing the chuck and pipe sections from the well hole, a detailed description of the unit employed to drill and sample the earth's formations in carrying out my system of drilling wells is hereinafter set forth.

Upon engagement of the grapple apparatus with the spear tube head 17 of the drilling apparatus the shoulder 23 on the depending grapple stem 24 stops the downward movement of the grapple stem and the ball bearings 24a which have receded upwardly and inwardly in inclined raceways 24b upon the grapple stem entering the spear tube head are now free to fall and race downwardly in said inclined raceways 24b, (three in number) permitting a portion of the ballbearings to protrude outwardly of said grapple stem thereby securing the grapple stem within the spear tube head for engagement with the upper internal beveled shoulder wall 17c of the spear tube head 17. Spear tube head 25 of the grapple apparatus is adapted to sleeve downwardly over the body 25 for which the grapple stem is attached until the spear tube head rests on top of the shoulder 23 of the grapple stem as shown in Fig. 4, at which time the fluid passages 27, 27 in body 26 have been raised within the chamber 26 of the spear tube head 25 which is of larger diameter than the body 25, to allow free passage of fluid under pressure to pass through the fluid passages 27, 27 in body 26 and downwardly through the fluid passages 25 in the grapple stem 24 thereby allowing the moving fluid under pressure to pass downwardly through a drilling apparatus smoothly and that circulation of fluid downwardly may be maintained. By a reversal of the course of the fluid, that is, by forcing the same downwardly
exteriorly of the pipe sections and the chuck and within the well hole proper a fluid pressure is exerted against the spear tube head 26 of the grapple apparatus which is effective as a piston-like member within the chuck and the pipe sections in that the back-pressure valve in the bore 28 of the grapple apparatus will close the fluid passages 30b with the aid of the spring 30c, thereby preventing fluid from passing upward therethrough while the corrugated sealing packer 31 will prevent any fluid to by-pass the outer periphery of the grapple and the inner periphery of the chuck and pipe sections as the grapple apparatus is being forced upwardly through the chuck and pipe sections. By carrying a grapple apparatus which the grapple apparatus has engaged and detached from a chuck the same may be transported upwardly to or near the top of the pipe sections to be received by a catcher stationed therein to engage and hold the same for the convenience of the operator. This is one form of grapple apparatus that may be used to carry out the above method of forcing a grapple apparatus through pipe sections and chuck having substantially uniform internal bores by use of moving fluid under pressure in engaging a drilling apparatus and withdrawing the same from a well hole without removing the pipe sections and the chuck from the well hole. However, it will be understood that the grapple apparatus may be changed in construction and be used for transporting any object upwardly or downwardly through pipe sections within a well hole by the utilization of moving fluid under pressure. Where pipe and couplings of irregular internal bores are used in drilling a well the spear tube head of the grapple apparatus may be extended or elongated as in the case of the drilling apparatuses indicated at 50 of Fig. 17.

The grapple apparatus as shown in Figs. 1b and 1c is comprised of two movable cutters 12, 13 used to drill the outer portion of the hole while the central cutter 14 which is rigidly connected to a supporting head 15 is used to drill the inner or center portion of the hole. The movable sections are similar in construction and are attached to the central cutter by pins 16, 16 which are a part of the upper portion of the shank of the movable cutters 12, 13 said cutters being swung from separate axes. The pin joint connections are so arranged to allow the movable cutters and shank portions free bodily pendulous movement in opposite directions outwardly when being seated on the chuck in operative position for drilling and free bodily pendulous movement inwardly of the chuck to an inoperative position. A spear tube head 17 is provided, which carries the wedge bars 18, 18, the upper rounded portion 18b, 18b of the wedge bars being connected into spear tube head 17 by pin 19. The rounded portion of the wedge bars are free to slide through head 15, and the lower portion of the wedge bars extend below head 15 and being provided with shoulders 18a, 18a by which head 15 is carried while the drilling apparatus is in transit within the pipe sections as shown by Fig. 1c, and form a support for head 15 and central cutter 14 which is attached thereto by bolts 20 and the movable cutters 12, 13 at the pins 16, 16. Thus it will be seen that while the drilling apparatus is in transit within the pipe sections that spear tube head 17 forms a support for the entire apparatus. When triangular shaped shoulders 18a on the stopping head 18 intermesh with corresponding shaped shoulders 4a of the chuck the downward movement of the head 15 and the parts attached thereto, namely the central cutter 14 and the movable cutters 12, 13 are stopped and positioned on the chuck to be locked into engagement 4b and the inclined rounded notches 4c, 4c of the chuck. Between shoulders 18a, 18a on the upper rounded portions 18b, 18b of the wedge bars and the bottom of the spear tube head 17 a packing gasket 21 and plate 22 are securely mounted. The inclined rounded gasket 17a surrounding the outer periphery thereof to prevent the by-passing of fluid between the spear tube head 17 and the inner bore of the pipe sections and chuck. The sealing packer 17a has corrugations on its outer periphery which are cupped upwardly when the drilling apparatus is moving downwardly within the pipe sections and chuck and are held yieldingly against the inner bore thereof. The corrugations remain in an upwardly cupped position while the drilling apparatus is in its downward position on the chuck and aids packing gasket 21 to prevent by-passing of the fluid and to positively direct the fluid through the fluid passageways 18a, 18a of the wedge bars. When the drilling apparatus is unseated from the chuck and forced upwardly into the rod 1c the said gasket 21 becomes inverted as sealing packer 17a passes the first coupling which positively cup the corrugations downwardly in which position they remain and are held yieldingly against the inner bore of the pipe section as the moving fluid under pressure from below forces the same upwardly through the pipe sections. Inwardly within the spear tube head 17, valve rods 17b, 17b are provided for the fluid passageways 18a, 18a of the wedge bars said valve rods being rigidly connected to trip rods 1c, 1c which are slidably disposed through spear tube head 17 and extend therebelow, said valve rods serve to close the fluid passageways 18a, 18a of the wedge bars while the drilling apparatus is passing downwardly through the pipe sections and prior to the full extent of the downward movement of the movable cutters 12, 13 said cutters being swung outwardly of the chuck. To accomplish the wedging action the spear tube head 17 to which the wedge bars are connected is forced down by moving fluid under pressure to rest on head 15 when the tool is stopped and placed in position for locking engagement with the chuck by the wedge bars. The enlarged portions 18a, 18a on the shanks of the movable cutters 12, 13 are urged into locking engagement with the recesses 4b, 4b of the chuck by the fluid pressure exerted against the spear tube head whereby positive rotation of the cutters will be imparted upon rotation of the pipe sections and chuck. As the spear tube head 17 is near the full extent of movement thus to the chuck, however, depending trip rods 17c, 17c which are slidably mounted within spear tube head 17 and through packing gasket 21 and plate 22 and extend therebelow to engage the head 15 prior to plate 22. As the trip rods 17c, 17c contact the head 15 the plate 22, packing gasket 21 and spear tube head 17 slide downwardly over the trip rods and valve rods, to rest and stop on the head 15 and in so doing the valve rods which are shorter than the trip rods clear the top of the fluid passageways 18a, 18a of the wedge bars in which they were disposed and are
held in this distended position by the trip rods which rest on the head 15. This places the drilling apparatus into positive locked operative position on the chuck as shown in Fig. 1b. The course of the fluid denoted by the single arrow heads which is now free to pass downward through the fluid passage and valve body 11 as the valve 11d and springs 11h will yield to the downward pressure applied on the flushing fluid and rush to the opened fluid passageways 18d, 18d of the wedge bars to be expelled at the lower end thereof. The relative position of each wedge bar to its respective movable cutter and shank portion is such that the wedge bar that actuates its respective movable cutter into locked operative position on the chuck is provided with fluid passageways 18d, 18d through its members and when said wedge bars are in operative position on said chuck, fluid under pressure may be directed therethrough to wash the cuttings from the faces of the cutters and to force the cuttings upwardly exteriorly of the chuck and pipe sections to be discharged through the connections 6 and valve 5 in the well ram 2.

From Fig. 1c the drilling apparatus is shown being transported upwardly through the pipe sections having been dislodged from the chuck by the force of moving fluid under pressure. The drilling apparatus is transported upwardly through the pipe section to be received by catcher 12 stationed within the pipe sections at or near the top thereof.

A sample drilling apparatus such as shown in Figs. 1d, 1e and 1e' may be employed to sample the earth formations and is adapted to an inter-changeably connected to the chuck 4 in replacing the drilling apparatus as shown in Figs. 1b and 1c by the force of moving fluid under pressure and transported in like manner through the pipe sections 3 and constructed to be transported through the sections of substantial uniform internal bores or pipe sections of irregular internal bores. The grappling apparatus likewise is suitably arranged to be used in connection with the sample drilling apparatus as in the case of the drilling apparatus. It is thought that the details may be better understood from a detailed description thereof. An expander 32 is provided which is carried by a spear tube head indicated here at 33, being similar in construction to spear tube head 17 of the drilling apparatus. A shank 34 is carried by the expander to which the sample drill 35 is attached. When triangular shaped shoulders 36 on the shank 34 engage and intermesh with corresponding shaped stopping shoulders 4a, 4a of the chuck 4 the downward movement of the shank is arrested and positioned so that the windows 37, 37 in said shank and the floating key members 38, 38 disposed therein are in alignment with the recesses 4b, 4b of the chuck 4. Thus positioned said floating key members are free to be actuated into locking engagement with said recesses 4b, 4b of the chuck by the positively 5d said shank 34 in non-rotatable within said chuck. The bottom faces of the windows 37—37 of the headed tubular sleeve or shank 34 are inclined outwardly and downwardly to form a seat for the lower inclined portions of the locking keys 38—38 and for bearing the thrust of the locking keys when the same are in extended operative position on the drill stem and the weight of the drill stem is applied as during coring operations in drilling with a drilling instrument of this character.

The upper inclined portions of the locking keys are adapted to bear against correspondingly shaped seats 4d—4d of the chuck when the locking keys are in extended operative position. Also the bottom faces of the windows 37—37 are inclined outwardly and downwardly to act as guides for deflecting the locking keys which slide downwardly and outwardly on the bottom inclined faces of the windows 37—37 in response to the downward movement of the central wedge bar. An upward movement of the central wedge bar will cause the locking keys to move upwardly and inwardly to retracted position within said windows 37—37 and thereby unlock said drilling instrument or core barrel from the chuck and drill stem. The expander has longitudinal grooves 39, 39 on its outer periphery with the face at the bottom of said grooves being inclined downwardly and inwardly on which relative inclined faces on the key members race. When the expander is actuated downwardly to move said key members outwardly through windows 37, 37 into locked engagement with the recesses 4b, 4b in the chuck. Engaged seats 4d, 4d at the top of the recesses 4b, 4b bear the upward thrust of the corresponding inclined shoulders 38b, 38b on the top of the key members 38, 38 during the sample drilling operation. When the expander reaches its full downward movement, plate 40 rests on top of bushing 41 attached to the top of shank 34. The plate 40 and packing gasket 42 are sleevably mounted on the upper portion of the expander, said expander being actuated to and carried by spear tube head 33 with the packing gasket and the plate mounted below said spear tube head. The spear tube head is surrounded by a corrugated sealing packer 43 to prevent the by-passing of fluid as the spear tube head is forced through the pipe sections by moving fluid under pressure. Within spear tube head 33 a back pressure valve 44 is provided in body 44a which is screwed onto the spear tube head, and a spring 44c to normally hold said back-pressure valve seated in said body 44a, thereby closing the fluid passages 44b in body 44a to resist an upward pressure. Trip rods 45 are provided within said head and extend through said head, the packing gasket and plate with a valve rod 46 attached to said head rigidly carried by said rods by a cross member. The valve rod is disposed within the fluid passageway 47 through the expander 32 to close said fluid passageway giving the spear tube head the effect of a piston-like member while being forced downwardly through the pipe sections by moving fluid under pressure. As the downward movement of the shank 34 is arrested by stopping shoulders 4a of the chuck the fluid pressure on the spear tube head forces said head downwardly which in turn forces the expander downwardly within the shank to actuate the floating key members outwardly into locked engagement with the recesses 4b of the chuck. As the expander 32 reaches its full downward movement within the shank the depending trip rods 45 contact flushing 41 attached to the top of the shank which stops the downward movement of the trip rods and valve rod and a further downward movement of the spear tube head and expander causes said bushing, packing gasket and plate to slide downwardly over said trip rods until plate 40 rests on bushing 41, at which time the valve rod attached to the trip rods is held distended away from the fluid passageway 47 to allow the fluid under pressure
to pass downwardly through the communicating
holes 38a to wash the cuttings from the cutters
and carry the same upwardly within the well
hole without injury to the core formed within
the sample drill and receptacle. Fig. 1d shows
the sample drilling apparatus in locked opera-
tive position on the chuck.
In Figs. 1e and 1f the same drilling appara-
tratus is shown being forced upwardly through
the pipe sections having been detached from
the chuck by moving fluid under pressure the
course of which is indicated by the double arrow
heads. The moving fluid under pressure is forced
downwardly exteriorly of the pipe section and chuck
which are depended within the well hole which
exerts an upward pressure against the spear tube
head 33, the fluid passing thru the communicat-
ing holes 35a thereby forcing said head upwardly
carrying the expander to unlock the key
members from engagement with the recesses of the
chuck. A body 48 with packer 43 is attached
to the lower end of the expander and is provided
with an inwardly beveled annular shoulder 48a to
engage corresponding beveled faces 38c of the
inner extending portion of the crotches of the
key members at the bottom thereof and as the
expander is lifted upwardly the inclined grooves 38, 39 allow the key members to be lifted
upwardly and inwardly to a retracted position
within the windows to disengage the shank from
the chuck, thus permitting the sample drilling
apparatus to be moved upwardly of the chuck
and the pipe sections by the force of the moving
fluid under pressure, the spear tube head again
being effective as a piston like member within
the chuck and pipe sections in that the back-
pressure valve 44 will close and prevent the mov-
ing fluid under pressure from passing upwardly
there through while the corrugated sealing packer
43 will prevent the moving fluid under pressure
to by-pass between the outer periphery of the
sealing packer and the inner periphery of the
bore of the chuck and pipe sections.

A catcher comprising a stem 12 with inclined
raceways 12a is part of the body 12d which is
screwed into the Kelley sub-coupling 1a for re-
cieving the spear tube head of the drilling appa-
ratuses or the grapple apparatus all of which
are similar in construction. Ball bearings 12b are
provided for said inclined raceways 12a with a
pin 12c to hold the same within the respective
raceways. Fluid passages 12c permit fluid to
pass through the body 12d in either direction.
As the spear tube head is forced into engage-
ment with the stem 12 of the catcher the por-
tion of the ball bearings which protrude out-
wardly of said stem are forced inwardly and up-
wardly in the raceways to permit the spear tube
head to elevate over the entire stem at which
time the ball bearings will fall back to normal
position and that portion which protrudes out-
wardly of said stem will engage the upper in-
ternal shoulders 17c, 25a and 33c of the collars
17a, 25b and 33b screwed to the tops of the spear
tube heads 17, 25 and 33 respectively to hold the
apparatuses. After the upward pressure has
been released the operator may easily withdraw
the apparatuses from the pipe sections by un-
 screwing the Kelley sub-coupling 1a and lift the
same from the pipe sections.
It is apparent that a very simple means has
been provided to carry out my system of drilling
wells which will be useful in reducing the cost
of drilling deep wells by a safe and expedient
method as well as being able to drill at great
depths hereofore unexplored.
It is obvious that many changes in the detailsof construction and arrangement of the parts
can be made without departing from the spirit
of the invention as set forth in the appended
claims.

To wit:
1. In a drilling instrument a jolted drill stem
pipe having constrictions therein at said joints,
sealing rings at said constrictions, an inner tube
sizable longitudinally of said drill stem and
through said sealing rings and constrictions the
full length of said drill stem, the said inner tube
being longer than the drill stem, driven between
the constrictions whereby fluid may act on said tube
to move the same longitudinally of said drill stem.
2. In drilling wells by rotary method, the
method of operation including the steps of in-
serting a drilling instrument into the upper end of
a drill stem pipe extending in a well and moving
said instrument downwardly and locking it
in operative position at the lower end of said
drill stem, operating said drill stem and instru-
ment to drill the well, and then reversing the
route of the fluid by sealing between the sur-
face casing and the drill stem to effect a recovery of said instrument without
removing said drill stem from the well.
3. An apparatus of the character described
comprising a drill stem pipe extended in a well,
a removable drilling instrument having cutter
members thereon adapted to be driven within said
said drill stem and allow drilling instru-
ment to be elevated by said circulating fluid
upwardly through said drill stem to the surface
without removing said drill stem from the well.
4. In drilling wells by rotary method, the
method of operation including the steps of in-
serting a grapple device into the top end of a drill stem pipe extending in a well and mov-
ing said grapple downwardly to engage a remov-
able device at the lower end of said drill stem,
then reversing the course of the fluid by sealing
between the surface casing and the drill stem
and pumping fluid downwardly between the sur-
face casing and said drill stem and into the well
below so as to act on said grapple to carry said
grapple and removable device upwardly through
the drill stem to effect a recovery of said grapple
and removable device without removing said
drill stem from the well.
5. An apparatus of the character described
comprising a drill stem pipe extended in a well,
a removable sampling device adapted to be
 moved through said drill stem, including an up-
der locking device having locking keys thereon,
hydraulically operated means to extend said keys
to engage said drill stem, a sample tube below
said locking device with a receiving chamber
therein, said locking keys being releasable by an
upward circulation of fluid in said drill stem
for release said sampling device from said drill
stem and allow said sampling device to be ele-
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vated by said circulating fluid upwardly through said drill stem to the surface without removing said drill stem from the well.

6. A drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a removable core barrel assembly adapted to be moved through said drill stem to the seat therein and including a headed shank having locking keys thereon and a core receiving tube therebelow, a seat on said drill stem inclined outwardly and downwardly to bear the thrust of said keys, a guide on said shank inclined outwardly and downwardly adapted to deflect said keys outwardly to engage said drill stem, an expander mounted on said shank and adapted to control said keys and movable relative to said shank and said keys and adapted to cause said keys to engage said drill stem upon the downward movement of said expander relative to said shank.

7. A drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a surface casing set in the well and having a casing head thereon adapted to seat between the drill stem and said surface casing, a removable core barrel assembly adapted to be moved through said drill stem to the seat therein and including a headed shank having locking keys thereon and a core receiving tube therebelow, a seat on said shank inclined outwardly and downwardly to bear the thrust of said keys, an expander mounted on said shank and adapted to control said keys and movable relative to said shank and said keys and adapted to cause said keys to become disengaged from said drill stem upon an upward movement of said expander relative to said shank.

8. In a drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a surface casing set in said well and having a casing head thereon adapted to seat between the drill stem and said surface casing, a removable drill bit assembly including drill bits adapted to be moved through said drill stem and seated thereon, means adapted to move said drill bits one by the other to an opened extended operative position on said drill stem, a piston head provided with means to open a passageway whereby flushing fluid pumped downwardly through said drill stem may pass to the exterior of said drill stem for maintaining circulation of the flushing fluid during drilling operations, a packing member on said piston head, said assembly adapted to be forced upwardly through said drill stem in response to flushing fluid pumped downwardly between said surface casing and said drill stem acting on said assembly to force said drill bits one by the other to the inwardly to closed position and causing said assembly to be moved upward through said drill stem to the surface without removing said drill stem from the well.

10. A drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a surface casing set in said well and having a casing head thereon adapted to seat between the drill stem and said surface casing, a removable drill bit assembly including drill bits adapted to be moved through said drill stem and seated thereon, means adapted to move said drill bits one by the other to an opened extended operative position on said drill stem, a piston head provided with means to open a passageway whereby flushing fluid pumped downwardly through said drill stem may pass to the exterior of said drill stem for maintaining circulation of the flushing fluid during drilling operations, a packing member on said piston head, said assembly adapted to be forced upwardly through said drill stem in response to flushing fluid pumped downwardly between said surface casing and said drill stem acting on said assembly to force said drill bits one by the other to the inwardly to closed position and causing said assembly to be moved upward through said drill stem to the surface without removing said drill stem from the well.

11. The method of taking core samples from drilled wells, which comprises forcing a sample taking device through a set tubular drill stem to the lower end of the latter by pumping mud into the stem behind the device, then operating the stem and drill in the usual manner to effect the movement of a core into the device, then driving a plug down the stem by means of mud pumped thereinto and effecting the coupling of the plug and device together, and finally pumping mud into the well around the outside of the stem for entrance thereinto beneath the device and plug to effect the raising of the device.

12. An apparatus of the character described comprising a drill stem pipe extended in a well, a removable sampling device adapted to be moved through said drill stem including an upper locking device having locking keys thereon and a core receiving tube therebelow, hydraulically operated means to extend said keys to engage said drill stem, a cut-off member on said core receiving tube, said locking keys being releasable by an upward circulation of fluid through said drill stem to the surface without removing said drill stem from the well.

13. A drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a removable core barrel assembly adapted
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to be moved through said drill stem to the seat therein and including a headed shank having locking keys thereon and a core receiving tube therebelow, a cutter member on said core receiving tube, a seat on said drill stem inclined outwardly and downwardly to bear the thrust of said keys, and expander mounted on said shank adapted to control said keys and movable relative to said shank and said keys and adapted to cause said keys to engage said drill stem upon the downward movement of said expander relative to said shank and adapted to cause said keys to become disengaged from said drill stem upon an upward movement of said expander relative to said shank.

14. A drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a removable core barrel assembly adapted to be moved through said drill stem to the seat therein and including a headed shank having locking keys thereon and a core receiving tube therebelow, a seat on said shank inclined outwardly and downwardly to bear the thrust of said keys, a guide on said shank inclined outwardly and downwardly adapted to control said locking keys and movable relative to said shank and said locking keys and adapted to cause said locking keys to engage said drill stem upon the downward movement of said expander relative to said shank and adapted to cause said locking keys to become disengaged from said drill stem upon an upward movement of said expander relative to said shank.

15. A drilling apparatus comprising a drill stem pipe extended in a well, a seat in said drill stem, a removable core barrel assembly adapted to be moved through said drill stem to the seat therein and including a headed shank having locking keys thereon and a core receiving tube therebelow, a cutter member on said core receiving tube, a seat on said shank inclined outwardly and downwardly to bear the thrust of said keys, a guide on said shank inclined outwardly and downwardly adapted to control said locking keys and movable relative to said shank and said locking keys and adapted to cause said locking keys to engage said drill stem upon the downward movement of said expander relative to said shank and adapted to cause said locking keys to become disengaged from said drill stem upon an upward movement of said expander relative to said shank.

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