

June 18, 1940.

J. F. CHAPPELL

2,204,844

DRILLING AND CORING APPARATUS

Filed Dec. 5, 1938

5 Sheets-Sheet 1

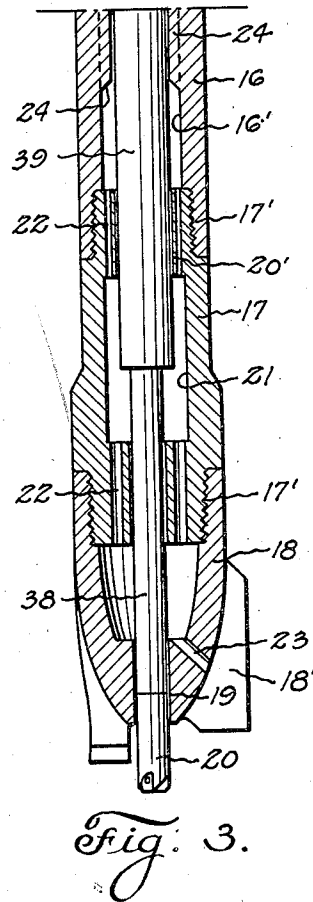
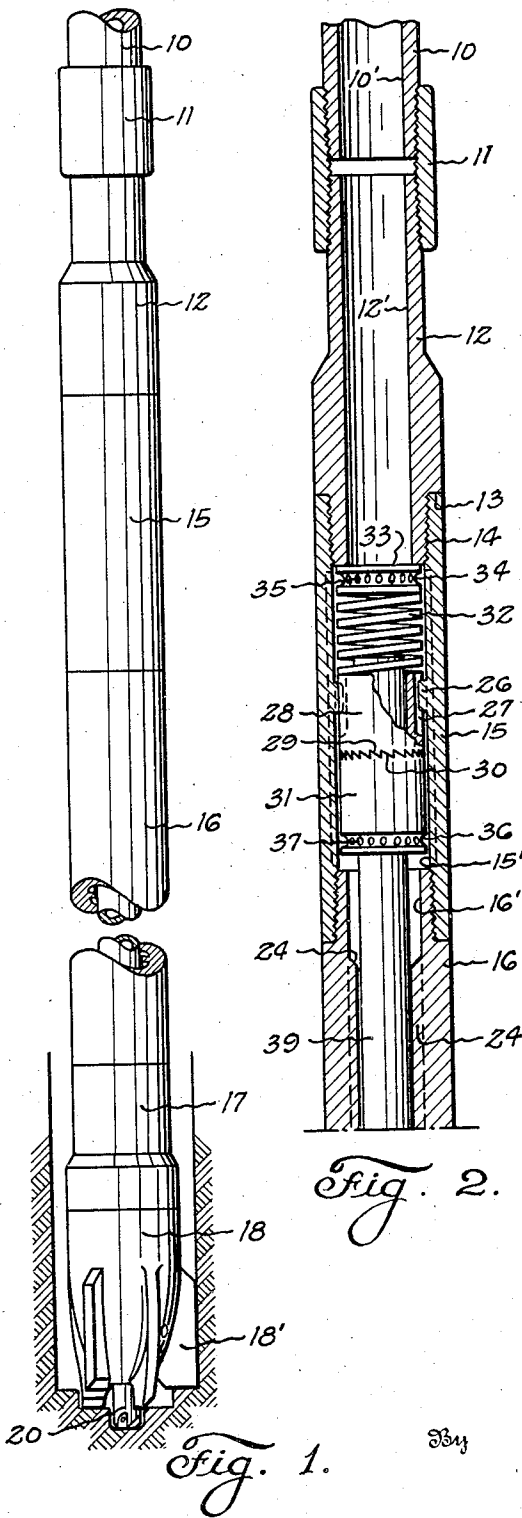


Fig. 3.

Inventor  
James F. Chappell

Jack A. Chappell  
Attorney

June 18, 1940.

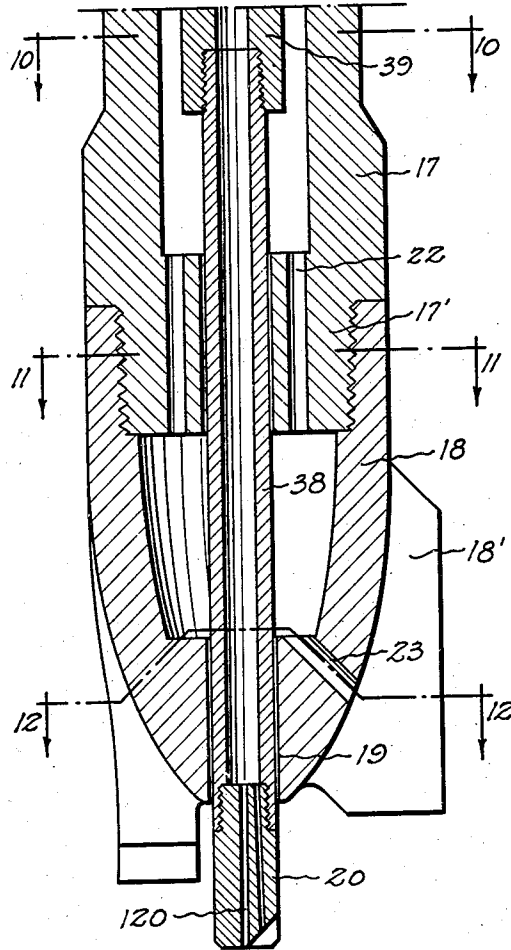
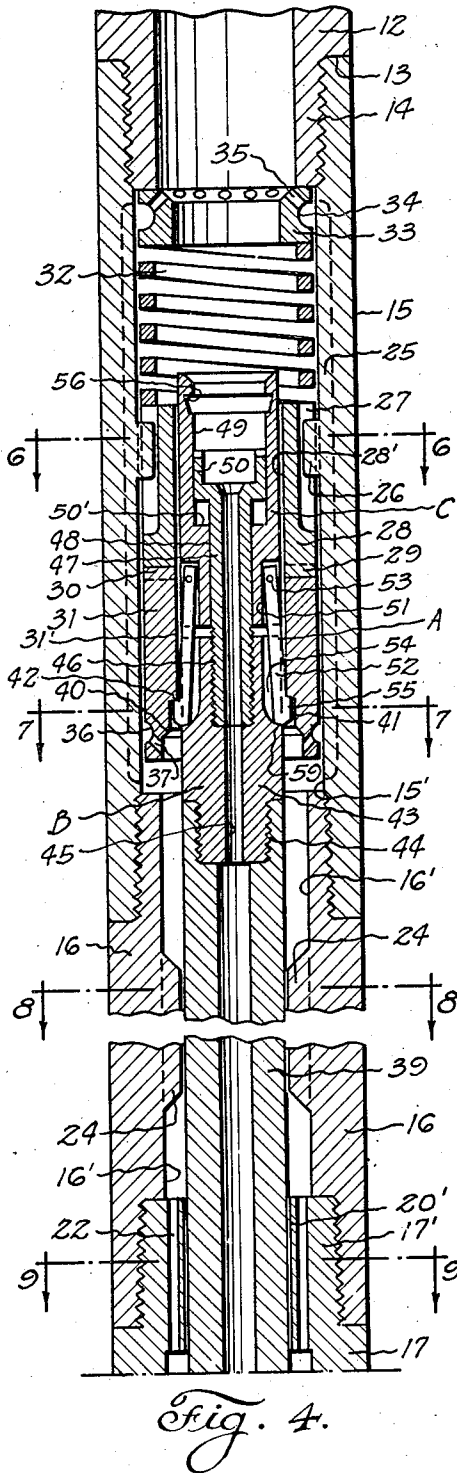
J. F. CHAPPELL

2,204,844

DRILLING AND CORING APPARATUS

Filed Dec. 5, 1938

5 Sheets-Sheet 2



Inventor  
James F. Chappell

By *Jack Athley*  
Attorney

June 18, 1940.

J. F. CHAPPELL

2,204,844

DRILLING AND CORING APPARATUS

Filed Dec. 5, 1938

5 Sheets-Sheet 3

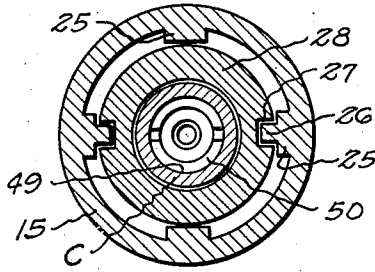


Fig. 6.

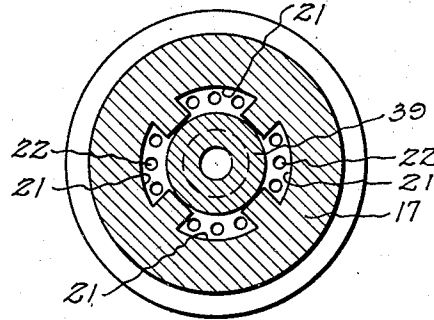


Fig. 10.

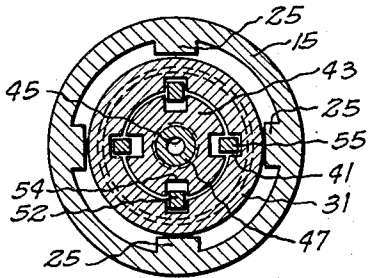


Fig. 7.

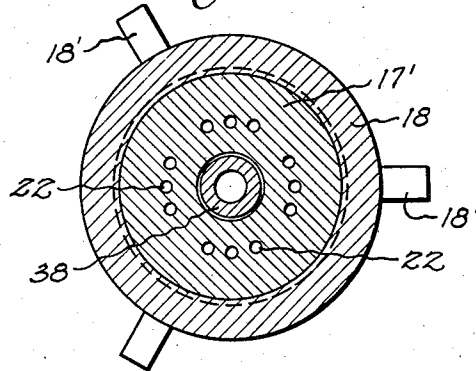


Fig. 11.

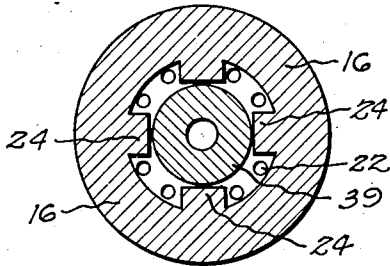


Fig. 8.

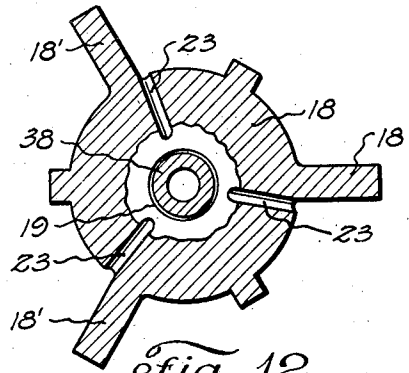


Fig. 12.

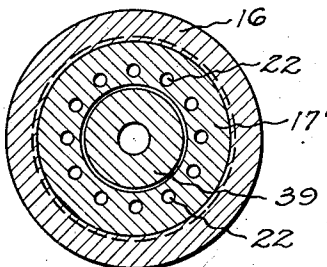


Fig. 9.

Inventor  
James F. Chappell

By

Jack A. H. Luy  
Attorney

June 18, 1940.

J. F. CHAPPELL

2,204,844

DRILLING AND CORING APPARATUS

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5 Sheets-Sheet 4

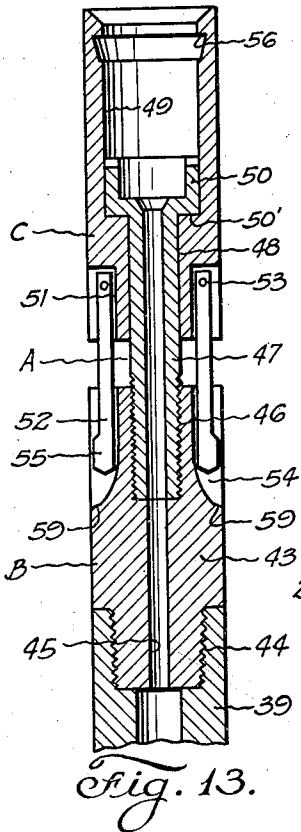


Fig. 13.

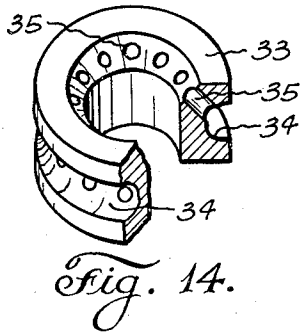


Fig. 14.

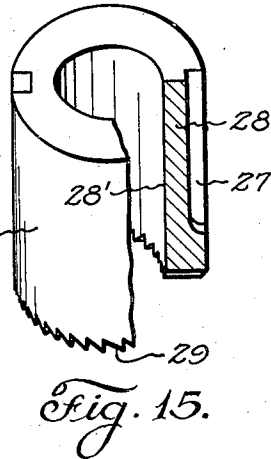


Fig. 15.

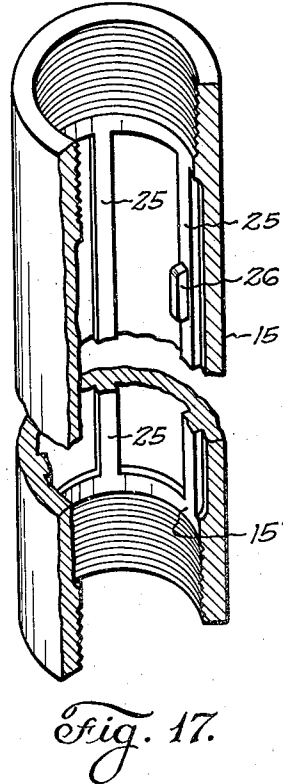


Fig. 17.

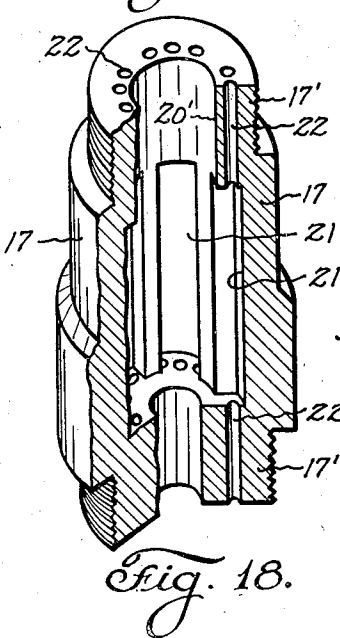


Fig. 18.

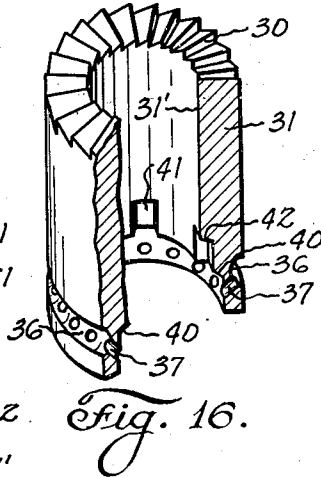


Fig. 16.

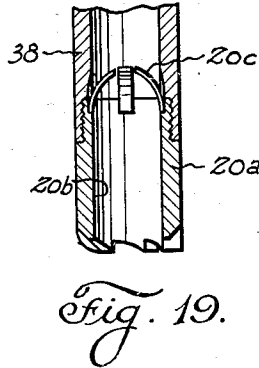


Fig. 19.

Inventor  
James F. Chappell

By

Jack A. Kelly  
Attorney

June 18, 1940.

J. F. CHAPPELL

2,204,844

DRILLING AND CORING APPARATUS

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5 Sheets-Sheet 5

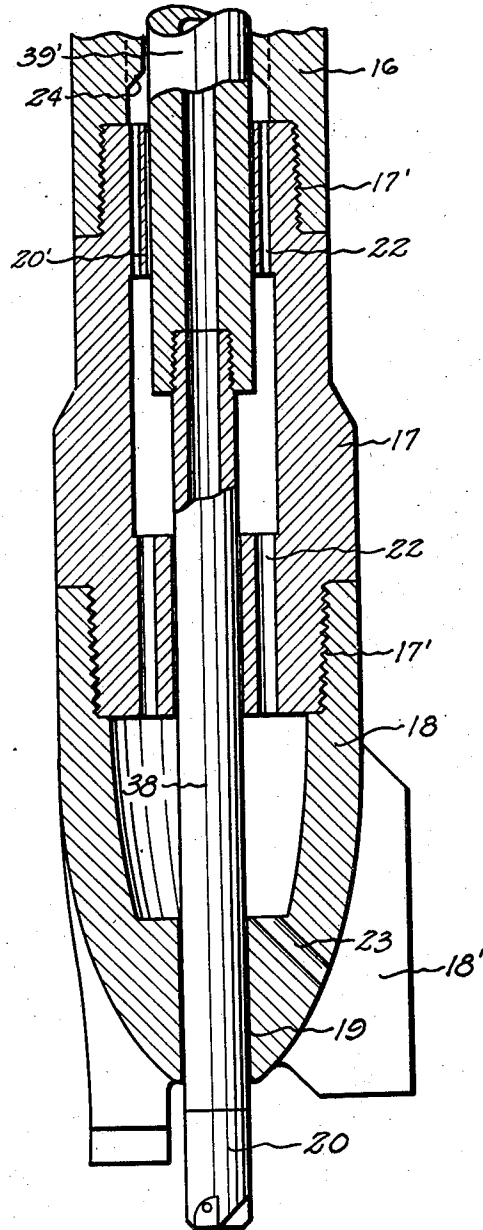
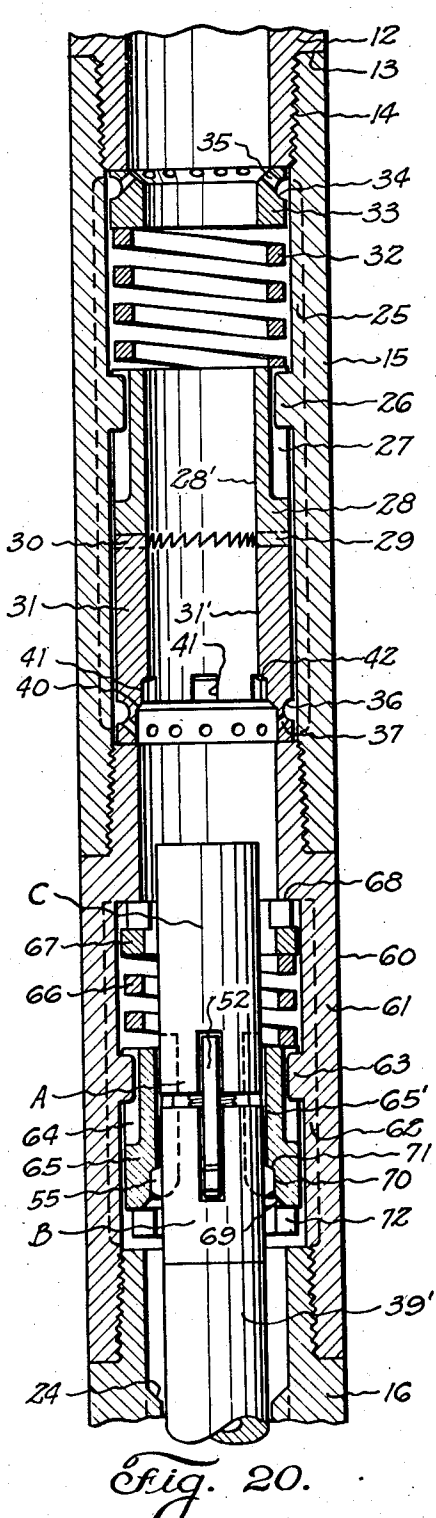


Fig. 21.

Inventor  
James F. Chappell

Jack A. Shley  
Attorney

## UNITED STATES PATENT OFFICE

2,204,844

## DRILLING AND CORING APPARATUS

James F. Chappell, Mineola, Tex.

Application December 5, 1938, Serial No. 244,002

15 Claims. (Cl. 255—72)

This invention relates to new and useful improvements in drilling and coring apparatus.

This application is filed as an improvement on my prior Letters Patent No. 2,120,240, issued June 14, 1938.

One object of the invention is to provide an improved apparatus which is particularly adapted for use in drilling through hard formations and which is so constructed that cores may be readily taken in such hard formations.

An important object of the invention is to provide an apparatus for drilling wells which includes an outer rotatable drill bit, and an inner pilot or guide bit which extends below the outer bit, with improved means for imparting a hammering or reciprocating action to said inner bit, whereby drilling through hard formations is facilitated.

A particular object of the invention is to provide an improved drilling or coring apparatus of the character described, wherein the inner bit element is readily insertable within and removable from the outer bit; said inner bit element being either a solid cutting bit and acting as a pilot or guide bit during the drilling operation or being a tubular core bit, whereby a core may be taken if desired.

Still another object of the invention is to provide an improved apparatus for drilling and coring wells which includes a drill stem having an outer bit secured to its lower end and having an improved spring actuated, reciprocating means therein, which means is reciprocated when the stem is rotated, together with a removable inner bit adapted to be lowered through the drill stem and connected with the reciprocating means, whereby the inner bit is reciprocated as the outer bit is rotated; the construction of the stem and associate parts being such that drilling fluid may be conducted to and circulated through and around said bits.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is an elevation of a drilling and coring apparatus, constructed in accordance with the invention,

Figure 2 is a view, partly in elevation and partly in section, of the upper portion of said apparatus,

Figure 3 is a continuation of the parts shown in Figure 2 and illustrating the lower portion of said apparatus,

Figure 4 is an enlarged transverse, vertical, sectional view taken through the upper portion of the device,

Figure 5 is a continuation of the parts shown in Figure 4 and illustrating the lower portion of the device,

Figure 6 is a horizontal, cross-sectional view, taken on the line 6—6 of Figure 4,

Figure 7 is a horizontal, cross-sectional view, taken on the line 7—7 of Figure 4,

Figure 8 is a horizontal, cross-sectional view, taken on the line 8—8 of Figure 4,

Figure 9 is a horizontal, cross-sectional view, taken on the line 9—9 of Figure 4,

Figure 10 is a horizontal, cross-sectional view, taken on the line 10—10 of Figure 5,

Figure 11 is a horizontal, cross-sectional view, taken on the line 11—11 of Figure 5,

Figure 12 is a horizontal, cross-sectional view, taken on the line 12—12 of Figure 5,

Figure 13 is a transverse, vertical, sectional view taken through the coupling element of the inner drill bit and showing the same removed from the drill stem,

Figure 14 is a partial isometric view of the follower ring,

Figure 15 is a partial isometric view of the upper ratchet collar,

Figure 16 is a partial isometric view of the lower ratchet collar,

Figure 17 is a partial isometric view of the elongate sleeve which receives the ratchet element,

Figure 18 is a partial isometric view of the drill collar which is interposed between the lower end of the drill stem and the outer drill bit,

Figure 19 is an enlarged transverse, vertical, sectional view taken through the core bit,

Figure 20 is a view partly in section and partly in elevation showing a modified form of the invention, whereby the inner bit may be rotated with the outer bit, and

Figure 21 is a continuation of Figure 20, showing the lower end of this arrangement.

In the drawings, the numeral 10 designates a tubular drill pipe which has its upper end connected to the usual square kelly or other drive member (not shown), whereby said pipe may be rotated. The pipe extends downwardly within the well bore and has its lower end connected by means of a coupling collar 11 with an elongate coupling member 12, which member has a bore

12' of substantially the same diameter as the bore 10' of the drill pipe. The lower end or portion of the member 12 is enlarged so as to form an external, annular shoulder 13 and that portion of the member below said shoulder is externally screw-threaded at 14, whereby the upper end of an elongate sleeve 15 may be connected thereto. The lower end of the sleeve is internally screw-threaded to receive the upper end of a tubular guide member or sleeve 16 and the lower end of this guide sleeve has a drill collar 17 threaded therein (Figure 3). An outer drill bit 18 of any suitable construction is connected to the drill collar 17 and, with this arrangement, it will be seen that when the drill pipe 10 is rotated, a rotation is imparted to the drill bit 18 through the medium of the coupling element 12, sleeves 15 and 16 and the drill collar 17. An axial opening 19 is formed in the drill bit 18 and an inner or pilot bit 20, which is insertable through the drill stem 10, is arranged to project or extend through this opening. The lower end of the pilot bit 20 is in a plane below the blades 18' of the outer bit 18 and, as will be explained, the inner bit is so connected to the drill stem that when said drill stem is rotated to rotate the outer bit 18, a hammering or reciprocating action is imparted to the inner bit.

The bottom drill collar 17 is clearly shown in Figures 3 to 5 and 18 and this collar is provided with an axial bore 20' extending entirely there-through. Connecting nipples 17' are formed at each end of the collar and are externally screw-threaded so as to be connected with the guide sleeve 16 and the drill bit 18 respectively. The wall of the bore 20' of the drill collar is formed with vertical recesses or channels 21, which recesses extend between the nipples 17' (Figure 18). Each nipple is formed with a plurality of vertical ports 22, which ports have their inner ends communicating with the recesses or channels 21. The outer ends of the ports in the lower nipple communicate with the interior of the drill bit body, while the outer ends of the ports 22 in the upper nipple communicate with the bore 10' of the guide sleeve 16. With this arrangement, fluid from the bore of the sleeve 16 may flow downwardly through the ports 22 and the vertical channels or recesses 21, then through the ports in the lower nipple 17' and into the interior of the body of the drill bit 18. From the body, this fluid flows through inclined ports 23 formed in the bit body adjacent the bit blades 18', whereby the fluid escaping through the ports 23 serves to lubricate and cool the blades 18', as well as to wash the cuttings removed during rotation of the bit.

The bore 10' of the guide sleeve 16 is larger in diameter than the bore 20' of the drill collar 17 (Figure 3). Elongate guide ribs 24 extend outwardly from the wall of the bore 10' of said sleeve and the vertical faces of said ribs terminate in vertical alignment with the bore 20' of the drill collar, whereby the distance between the diametrically opposite ribs 24 is substantially equal to the diameter of the bore 20', as is clearly shown in Figure 8. The ribs 24 terminate short of the upper and lower ends of the guide sleeve 16 and manifestly, fluid may flow through the sleeve 16 between the guide ribs thereof.

The bore 15' of the elongate sleeve 15 is of a larger diameter than the bore 16' of the guide sleeve (Figures 2 and 4). The wall of the bore 15' is recessed so as to form a plurality of vertical ribs 25, four of which have been shown. As is

clearly shown in Figures 6 and 17, the ribs 25 are located diametrically opposite each other and the space between said ribs provides a flow channel for the fluid flowing through the sleeve 15, as will be explained. A pair of diametrically opposed lugs 26 are formed on two of the ribs 25, being located nearer the upper ends of said ribs. These lugs are for the purpose of imparting the reciprocating action to the inner bit 20, as will be explained. The lugs 26 are adapted to engage and ride within vertical grooves 27 which are formed in the outer surface of an upper ratchet collar 28 (Figure 4). The grooves 27 are located diametrically opposite each other in the exterior surface of the collar. The lower edge portion of said collar is formed with a plurality of ratchet teeth 29, which teeth are adapted to engage the teeth 30 formed on the upper end of a lower ratchet collar 31. The collar 28 is formed with a vertical bore 20', while the collar 31 is formed with a similar bore 31' and the diameter of said bores is substantially equal. For holding the ratchet collars 28 and 31 in engagement with each other, whereby the ratchet teeth 29 and 30 contact each other, a coiled spring 32 has its lower end engaging the upper edge of the collar 28 (Figure 4). A follower ring 33 rests on the upper end of the spring 32 and said ring is confined between the spring and the lower edge of the coupling member 12. The spring exerts its tension to constantly urge the ratchet collar 28 downwardly into engagement with the collar 31. It is pointed out that the follower ring 33 is formed with an external, annular groove 34 and inclined ports 35 extend through the ring and communicate with the groove. With such arrangement, fluid flowing downwardly through the drill pipe 10 and the member 12 may flow downwardly through the ports 35 and enter the recesses between the ribs 26 within the sleeve 15. From the bore 15' of the sleeve 15, the fluid may enter the guide sleeve 16 and then flow downwardly through the drill collar 17 and drill bit body 18, as has been explained.

Normally, the lower end of the lower ratchet collar 31 rests on the upper edge of the guide sleeve 16 and to permit a flow of fluid from the sleeve 15 to the sleeve 16 when the member 31 is seated on said sleeve, the ratchet collar 31 is formed with an external, annular groove 36 and inclined ports 37 lead from the groove to the bore of the collar 31. The provision of the groove 36 and ports 37 permits a flow of fluid from the sleeve 15 to the guide sleeve 16 when the collar 31 is seated on the upper end of the guide sleeve.

From the above, it will be seen that when the drill pipe 10 is rotated, a rotation is imparted to the outer drill bit 18, whereby the cutting blades 18' thereof may perform the drilling operation. Rotation of the drill pipe 10 will impart a rotation to the coupling member 12 and the sleeve 15, since said sleeve and said member are directly connected to the drill pipe. As the sleeve 15 rotates, a rotation is imparted to the upper ratchet collar 28 due to the connection between said sleeve and said collar formed by the engagement of the lugs 26 in the vertical grooves 27 of said collar. If the lower ratchet collar 31 is held stationary against rotation, it will be manifest that as the upper collar is rotated, the engagement of the ratchet teeth 29 and 30 riding over each other, will impart a hammering or reciprocating action to the lower collar 31. This vertical reciprocation of the col-

lar 31 occurs within the sleeve 15 between the teeth 29 of the upper collar 28 and the upper edge of the guide sleeve 16. Therefore, as the outer drill bit 18 is rotated by a rotation of the drill pipe 10, the upper ratchet collar 28 is also rotated. The lower ratchet collar 31 is vertically reciprocated by means of the ratchet teeth 29 and 30.

For connecting the inner or pilot bit 20 with the lower ratchet collar 31 so that a vertical reciprocation is imparted to this bit, said bit is attached to the lower end of a tubular sleeve stem 38, which stem has a diameter substantially equal to the diameter of the axial opening 19 in the outer drill bit 18 (Figure 5). The upper end of the stem 38 is secured to a tubular mandrel 39 which has an outer diameter greater than the outer diameter of said stem. It is pointed out that the diameter of the mandrel is greater than the diameter of the bore of the lower nipple 17' on the drill collar 17, whereby said mandrel cannot pass through this nipple. The stem 38, however, has a diameter sufficiently small to pass through this lower nipple of the collar 17 and, therefore, when the lower end of the mandrel 39 strikes the nipple 17', further downward movement of the inner bit 20 is prevented.

For connecting the tubular mandrel 39, which carries the inner bit 20, to the lower ratchet collar 31, a coupling member A is connected to the upper end of said mandrel and this coupling element is insertable within the bore 28' of the upper ratchet collar 28 and also within the bore 31' of the lower ratchet collar 31. The lower end of the bore 31' of the collar 31 is formed with an internal, annular shoulder 40 which is located immediately above the inclined ports 37. As clearly shown in Figure 16, the shoulder 40 is bevelled and a plurality of notches 41 extend upwardly from said shoulder, the notches being formed in the wall of the bore 31'. Although four notches have been shown, it is to be understood that any desired number may be provided and the top of each notch is bevelled as shown at 42.

The coupling member A, which is arranged to be connected with the ratchet collar 31, is constructed in two sections B and C. The lower section B comprises a cylindrical, bored body 43 which has an externally screw-threaded nipple 44, whereby the body may be connected with the mandrel 39. The axial bore 45 of the body extends vertically therethrough. The upper end of this bore is internally screw-threaded at 46 so as to receive the lower threaded end of a tubular shank 47, which shank extends upwardly through an axial bore 48 of the upper member C of said coupling. The upper end of the bore 48 of the member C is enlarged as shown at 49 and the shank is formed with an annular head 50 which is slidable vertically within the enlarged portion 49 of this bore.

With this arrangement, it will be seen that the lower member or section B of the coupling member A is rigidly fastened to the upper end of the mandrel 39. The upper section C of said coupling member is slidable on the tubular shank 47, which is rigidly connected to the lower section B and, therefore, the upper section is movable a limited distance with relation to the lower section.

The lower end of the upper section C is provided with a plurality of vertical grooves 51 which receive the upper ends of elongate vertical dogs 52, which upper ends are pivoted

within the grooves on pins 53. The lower ends of the dogs depend upon the upper section C and engage in vertical slots 54 which are formed in the lower section B of the coupling. The rear face of each slot 54 is curved upwardly and the extreme lower end of the slot is formed with a shoulder 59 (Figure 4). It is obvious that when the upper section is moved with relation to the lower section, with the rear faces of the dogs 52 riding on the curved faces of the slots 54 in the lower section B, said dogs will be expanded or retracted, depending upon which way the upper section C is moved. In other words, if the lower ends of the dogs engage the upper ends of the slots 54 in the lower section B, said dogs will be retracted so that their outer edges do not extend beyond the outer periphery of the lower section B. However, if the upper section C is lowered with relation to said lower section, the rear faces of the dogs 52 riding on the curved faces of the slots 54, will be expanded.

The lower end of each dog is formed with an outwardly extending lug 55 and the upper edge of this lug is inclined so as to be complementary to the upper bevelled surface 42 of the notches 41 in the ratchet collar 31. When the coupling member A is lowered through the drill pipe 10, coupling member 12 and into the sleeve 15 so as to pass through the bore 28' of the upper ratchet collar and into the bore 31' of the lower ratchet collar 31, the downward movement of said member A may continue until the lower edge of the mandrel 39 strikes the nipple 17' of the lower end of the drill collar 17. The length of the mandrel 39 is such that when its lower edge is resting on said nipple, the dogs 52 have their lugs 55 located below the lower end of the ratchet collar 31. The coupling element is then raised to expand the dogs 52, as will be presently explained, so that the lugs 55 of said dogs may enter the notches 41 in the collar 31, whereby the coupling element is connected to said collar. When the lugs 55 are engaged in the notches 41, it will be seen that the mandrel 39 which carries the inner bit 20 is connected to the lower ratchet collar 31 and when the upper ratchet collar 28 is rotated to impart a reciprocating motion to the collar 31, the mandrel 39 is also reciprocated. Since the inner bit 20 is carried by the mandrel 39, such reciprocation will impart a vertical reciprocating movement or hammering action to the inner bit 20.

In the operation of the apparatus, the outer drill bit 18 is connected to the coupling collar 17 and the guide sleeve 16 is connected to the upper end of said collar. The sleeve 15 and coupling element 12 are also connected to the lower end of the drill pipe 10, as has been explained. At this time, the ratchet collars 28 and 31, together with the spring 32 and follower ring 33, are located within the elongate sleeve 15. This assembly is lowered through the well bore to a point near the bottom of the hole.

After the drill pipe has been positioned within the bore, the inner bit 20 which is carried by the mandrel 39 and which has the coupling member A secured to its upper end is lowered within the drill pipe. This lowering operation may be accomplished by dropping, or by a suitable lowering tool which may be engaged with an undercut shoulder 56 provided at the upper end of the section C of the coupling member A. The downward movement of the inner bit assembly is continued until the lower end of the mandrel strikes the upper end of the nipple 17' which is formed

at the lower end of the drill collar 17 and, at this time, the inner bit 20 is projecting from the axial opening 19 in the outer bit 18.

Since the tool by which the mandrel 39 is lowered is secured to the upper section C of the coupling member A, this upper section C will be separated as far as possible from the lower section B. This is true because the weight of the mandrel and the bit 20, which are secured to the lower section B of the coupling A, will pull the shank 47 downwardly until the head 50 of said shank rests on the shoulder 50' formed between the bore 48 and the enlarged portion 49 of said bore of the upper section C. Thus, it will be seen that the lower section B which carries the mandrel 39 is suspended from the upper section C during the lowering operation and, at this time, the lugs 55 formed on the lower ends of the dogs 52, which are carried by the upper section C, are located at the upper end of the slots 54 in the lower section B, whereby said lugs are in their retracted position which permits them to clear the bores of the ratchet collars 28 and 31. Therefore, so long as the lowering operation of the inner bit and the mandrel 39, together with the coupling A at the upper end thereof, continues the dogs are in their retracted position.

The length of the mandrel 39 is such that when its lower edge strikes the lower nipple 17' of the drill collar 17 to prevent further downward movement of the inner bit assembly, the lugs 55 of the dogs 52 have moved downwardly beyond the lower end of the lower ratchet collar 31. The lowering tool (not shown) is then released from the shoulder 50 of the upper element C of the coupling A, whereby said element may move downwardly with relation to the lower section B. As this occurs, the dogs 52 engaging the curved faces of the slots 54 are moved to an expanded position, whereby the lugs 55 of said dogs move outwardly in a radial direction.

To establish the connection between the ratchet collar 31 and the coupling member A, it is only necessary to lower the drill pipe until the inner bit 20 strikes the bottom of the hole. When this occurs, a continued lowering of the drill pipe will cause the pipe and the sleeve 15 carried thereby to move downwardly, whereby the ratchet collar 31 moves downwardly with relation to the dogs 52 which are, of course, held stationary due to the fact that the inner bit 20 is resting on the bottom of the hole. As the ratchet collar 31 moves downwardly with relation to the dogs, the bevelled shoulder 40 within the lower end of said collar will strike the upper surface of the lugs 55 of said dogs and, by rotating the drill pipe and the sleeve 15, a rotation is imparted to the ratchet collars 28 and 31, whereby the notches 41 may be registered with the lugs 55. As soon as such registration occurs, continued downward movement of the collar 31 causes the dogs to enter the notches 41, as is clearly shown in Figure 4.

After the dogs have engaged in the notches 41, a connection between the mandrel 39 which carries the inner bit 20, and the lower ratchet collar 31, is established. Rotation of the drill pipe 10 will impart a direct rotation to the outer drill bit 18, whereby the drilling operation will be performed. At the same time, the drill pipe 10 will rotate the sleeve 15 and said sleeve will rotate the upper ratchet collar 28 through the medium of the lugs 26 and the grooves 27. The lower ratchet collar 31 is directly connected to

the mandrel 39 through the dogs 52 and, since said mandrel is attached to the inner bit, said inner bit engaging the formation will prevent a rotation of the mandrel 39 and the collar 31. Therefore, as the upper ratchet collar 28 is rotated and the lower ratchet collar 31 is held stationary, it will be manifest that the engagement of the ratchet teeth 29 and 30 will cause the lower ratchet collar to be reciprocated or moved vertically within the sleeve 15. This reciprocating movement of the ratchet collar 31 will be transferred to the mandrel 39 and to the inner bit 20. Thus, it will be seen that as the outer bit 18 rotates, the inner bit 20 is reciprocated.

Water, or other drilling fluid, is pumped downwardly through the drill pipe and is supplied to the inner bit by passing through the tubular shank 47, then downwardly through the tubular mandrel 39 and outwardly through ports 120 provided for this purpose in the bit 20. In passing to the outer bit 18, the water passes downwardly around the coupling A and ratchet collars 28 and 31 through the vertical recesses formed in the wall of the bore 15' of the sleeve 15. This water then flows downwardly through the guide sleeve 16 and through the ports 22 in the drill collar and finally escapes through the outlets 23 provided in the bit body 18. As has been explained, the ports 23 are located adjacent the cutting blades 18' of the outer bit.

When it is desired to remove the inner bit 20 for any purpose whatever, it is only necessary to lower a suitable tool (not shown) which may be engaged beneath the shoulder 56 at the upper end of the coupling member A. When this is done, the drill pipe 10 is then raised a slight distance so as to relieve the lugs 55 of the dogs 52 of the weight imposed thereon. This causes the lugs to move downwardly within the slots 41 and an upward pull on the upper section C of the coupling member will immediately cause the dogs to be retracted along the inner curved surface of each slot 54. As soon as the dogs are retracted, the coupling member A may be readily removed and the mandrel 39 with the bit 20 at its lower end raised upwardly through the drill pipe. The bit 20, which has heretofore been described, is adaptable when drilling through hard formations as it provides a pilot or guide bit to lead the large or outer bit 18 through the formation. However, if it is desired to take a core, it is only necessary to substitute a core bit 20a as shown in Figure 19, for the bit 20. This core bit is connected to the lower end of the mandrel 39 and is provided with an axial bore 20b and as the hammering action is imparted to said core bit the core will travel upwardly into the bore of said bit. To retain the core within said bore, the usual spring finger 20c may be provided. To prevent downward circulation of the drilling fluid through the mandrel 39 and the core bit 20a, a ball (not shown) may be dropped through the drill pipe 10 so as to engage and close the upper end of the head 50 of the shank 47, whereby the bore of the mandrel is closed.

In many instances, it might be desirable to rotate the inner bit 20 with the outer bit 18, in which event the inner bit must be directly connected with the drill so as to rotate therewith. For this purpose, a construction such as is illustrated in Figures 20 and 21 is employed. A connecting unit 60 is interposed between the lower end of the sleeve 15 and the tubular guide sleeve 16 and this unit includes an elongate sleeve 61

which is constructed in a manner similar to the sleeve 15, with the exception that it is shorter in length. The bore of the sleeve 61 is provided with vertical ribs 62, similar to the ribs 25 of the sleeve 15, and also has diametrically opposed lugs 63 therein. The lugs are arranged to engage within vertical grooves 64 which are formed in the exterior surface of a coupling collar 65. The lower end of the collar normally rests on the upper end of the sleeve 16, being held in such position by a coiled spring 66 which has its lower end engaging the upper end of the collar. The upper end of the spring contacts a follower ring 67, which, in turn, engages an internal annular shoulder 68 formed within the bore of the sleeve 61.

The bore 65' of the collar 65 is of substantially the same size as the bores 28' and 31' of the ratchet collars 28 and 31 respectively, and its lower end is constructed in a manner similar to the lower end of the lower ratchet collar 31. As shown in Figure 20, the bore 65' has an internal annular shoulder 69, similar to the shoulder 40 of the collar 31, and a plurality of notches 70, similar to the notches 41 of said collar 31. The top of the notches 70 provide shoulders 71. Below the internal shoulder 69, the lower end of the collar 65 is slotted at 72, such slots being provided in place of the groove 36 and openings 37 in the collar 31 to permit by-pass of drilling fluid. It is noted that if desired, the collar 31 could also be formed with the slots or, if desired, the collar 65 could have the openings 37.

Since the collar 65 is connected directly to the drill stem through the lugs 63, it is manifest that said collar will be rotated therewith at all times. When the inner bit 20 is connected with the ratchet collars 28 and 31 by means of the stem 39 and coupling element A, as has been described, the stem extends through the bore 65' of the collar 65 and no connection is set up between the stem 39 and said collar 65, whereby the inner bit reciprocates with a hammering action. At this time, the collar 65 is not functioning, being rotated with the drill stem.

When it is desired to rotate the inner bit 20, it is only necessary to remove the inner bit from the drill pipe, as has been explained, and replace the stem 39 with a stem 39' of a shorter length, whereby when the inner bit is again lowered through the drill pipe, the coupling A, instead of being opposite the ratchet collar 31, is disposed opposite the collar 65. The dogs 52 of the coupling element are then engaged with the notches 70 of the collar 65 and a connection is made between the stem 39' and said collar. Since the collar 65 is constructed in the same manner as the ratchet collar 31, this connection is established in the same manner as hereinbefore described. After such connection, a rotation of the drill pipe will impart rotation to the inner bit 20. Thus, it will be seen that by interposing the unit 60 in the drill pipe, the inner bit 20 may be reciprocated or rotated, as desired, by merely changing the length of the stem which carries said inner bit.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A drilling and coring apparatus including,

a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening threaded onto the lower end of the drill pipe and rotatable therewith, a reciprocating element mounted within the drill pipe, an inner bit insertable through the drill pipe and adapted to extend below the outer bit, means for connecting the inner bit with the reciprocating element, and means for imparting a reciprocating motion to said element to reciprocate the inner bit when the drill pipe is rotated.

2. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening threaded onto the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly insertable through the drill pipe and element and having a bit at its lower end which projects through the opening in the outer bit, and means for attaching the inner bit assembly to the reciprocating element, whereby a vertical reciprocating movement is imparted to the inner bit when the drill pipe is rotated to rotate the outer bit.

3. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening threaded onto the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly insertable through the drill pipe and element and having a bit at its lower end which projects through the opening in the outer bit, and means for removably connecting the inner bit assembly to the reciprocating element, whereby a vertical reciprocating movement is imparted to the inner bit when the drill pipe is rotated to rotate the outer bit.

4. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening threaded onto the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly adapted to be run into the drill pipe and through the reciprocating element on a flexible line and having a bit at its lower end which projects through the outer bit so as to be in a plane therebelow, and a coupling on the upper end of the inner bit assembly arranged to engage the reciprocating element to connect said element to the assembly, whereby the inner bit is reciprocated vertically when the drill pipe is rotated to rotate the outer bit.

5. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening threaded onto the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly insertable through the drill pipe and element and having a bit at its lower end which projects through the opening in the outer bit, means for attaching the inner bit assembly to the reciprocating element, whereby a vertical recip-

rotating movement is imparted to the inner bit when the drill pipe is rotated to rotate the outer bit, and means for delivering a drill fluid from the drill pipe to both the inner and outer bits.

6. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening attached to the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly adapted to be run into the drill pipe and through the reciprocating element on a flexible line and having a bit at its lower end which projects through the outer bit so as to be in a plane therebelow, a coupling on the upper end of the inner bit assembly arranged to engage the reciprocating element to connect said element to the assembly, whereby the inner bit is reciprocated vertically when the drill pipe is rotated to rotate the outer bit, and means for delivering a drill fluid from the drill pipe to both the inner and outer bits.

7. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, an outer drill bit having an axial opening secured to the lower end of the drill pipe and rotatable therewith, a reciprocating collar confined within the drill pipe, a rotatable collar above the reciprocating collar and engaging the same, means for connecting the rotatable collar with the drill pipe whereby said collar is rotated therewith, means on the engaging surfaces of the collars for reciprocating the lower collar when the upper collar is rotated by the drill pipe, an inner bit insertable through the drill pipe and collars and arranged to extend through the opening in the outer bit, and means for connecting the inner bit with the reciprocating collar, whereby the inner bit is reciprocated vertically when the drill pipe is rotated to rotate the outer bit.

8. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, an outer drill bit having an axial opening secured to the lower end of the drill pipe and rotatable therewith, a reciprocating collar confined within the drill pipe, a rotatable collar above the reciprocating collar and engaging the same, means for connecting the rotatable collar with the drill pipe whereby said collar is rotated therewith, means on the engaging surfaces of the collars for reciprocating the lower collar when the upper collar is rotated by the drill pipe, an inner bit insertable through the drill pipe and collars and arranged to extend through the opening in the outer bit, and a coupling for detachably connecting the inner bit with the reciprocating collar, whereby said inner bit is reciprocated when the drill pipe is rotated to rotate the outer bit.

9. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening attached to the lower end of the drill pipe and rotatable therewith, a reciprocating element mounted within the drill pipe, an inner bit assembly insertable through the drill pipe and including a tubular core bit which projects below the outer bit, means for connecting the bit assembly with the reciprocating element, and means for imparting a reciprocating motion to the inner bit assembly when the drill pipe is rotated, whereby the core bit is reciprocated when the outer bit is rotated.

10. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe,

a drill bit having an axial opening attached to the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly insertable through the drill pipe and element and having a tubular core bit at its lower end which projects through the opening in the outer bit, and means for attaching the inner bit assembly to the reciprocating element, whereby a vertical reciprocating movement is imparted to the inner tubular core bit when the drill pipe is rotated to rotate the outer bit.

11. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening attached to the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, an inner bit assembly insertable through the drill pipe and element and having a tubular core bit at its lower end which projects through the opening in the outer bit, and means for removably connecting the inner bit assembly to the reciprocating element, whereby a vertical reciprocating movement is imparted to the inner tubular core bit when the drill pipe is rotated to rotate the outer bit.

12. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, an outer drill bit having an axial opening secured to the lower end of the drill pipe and rotatable therewith, a rotatable collar within the drill pipe and connected therewith so as to be rotated thereby, a collar confined within the drill stem adjacent the rotatable collar and capable of a limited axial movement therein, the collars having ratchet teeth on their contiguous edges which are in engagement with each other, whereby rotation of one collar imparts a vertical reciprocating movement to the other collar, an inner bit assembly insertable through the drill stem and collars and including an inner bit which extends through the opening in the outer bit, and means for connecting said assembly to the reciprocating collar, whereby a hammering action is imparted to the inner bit when the drill pipe is rotated to rotate the outer bit.

13. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, an outer drill bit having an axial opening secured to the lower end of the drill pipe and rotatable therewith, a rotatable collar within the drill pipe and connected therewith so as to be rotated thereby, a collar confined within the drill stem adjacent the rotatable collar and capable of a limited axial movement therein, the collars having ratchet teeth on their contiguous edges which are in engagement with each other, whereby rotation of one collar imparts a vertical reciprocating movement to the other collar, an inner bit assembly insertable through the drill stem and collars and including an inner bit which extends through the opening in the outer bit, and a coupling for detachably connecting the inner bit with the reciprocating collar, whereby said inner bit is reciprocated when the drill pipe is rotated to rotate the outer bit.

14. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening attached to the lower end of the drill pipe and

- rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, a rotatable element within the drill pipe and rotatable therewith, an inner bit assembly insertable through the drill pipe and having a bit at its lower end which projects through the opening in the outer bit, and means carried by the inner bit assembly arranged to be connected with the reciprocating element or with the rotatable element, whereby the inner bit may be reciprocating or rotated by the rotation of the drill pipe and outer drill bit.
- 15 15. A drilling and coring apparatus including, a rotatable drill pipe, means for rotating said pipe, a drill bit having an axial opening attached

to the lower end of the drill pipe and rotatable therewith, an annular reciprocating element within the drill pipe, means for connecting said element with the drill pipe so as to reciprocate the same when the pipe is rotated, a rotatable element within the drill pipe and rotatable therewith, an inner bit assembly adapted to be run through the drill pipe on a flexible line and having a bit at its lower end which projects through the outer bit so as to be in a plane therebelow, and a coupling on the upper end of the inner bit assembly arranged to be removably connected with either the reciprocating element or the rotatable element, whereby the inner bit may be reciprocated or rotated by the rotation of the drill pipe and outer drill bit.

JAMES F. CHAPPELL.