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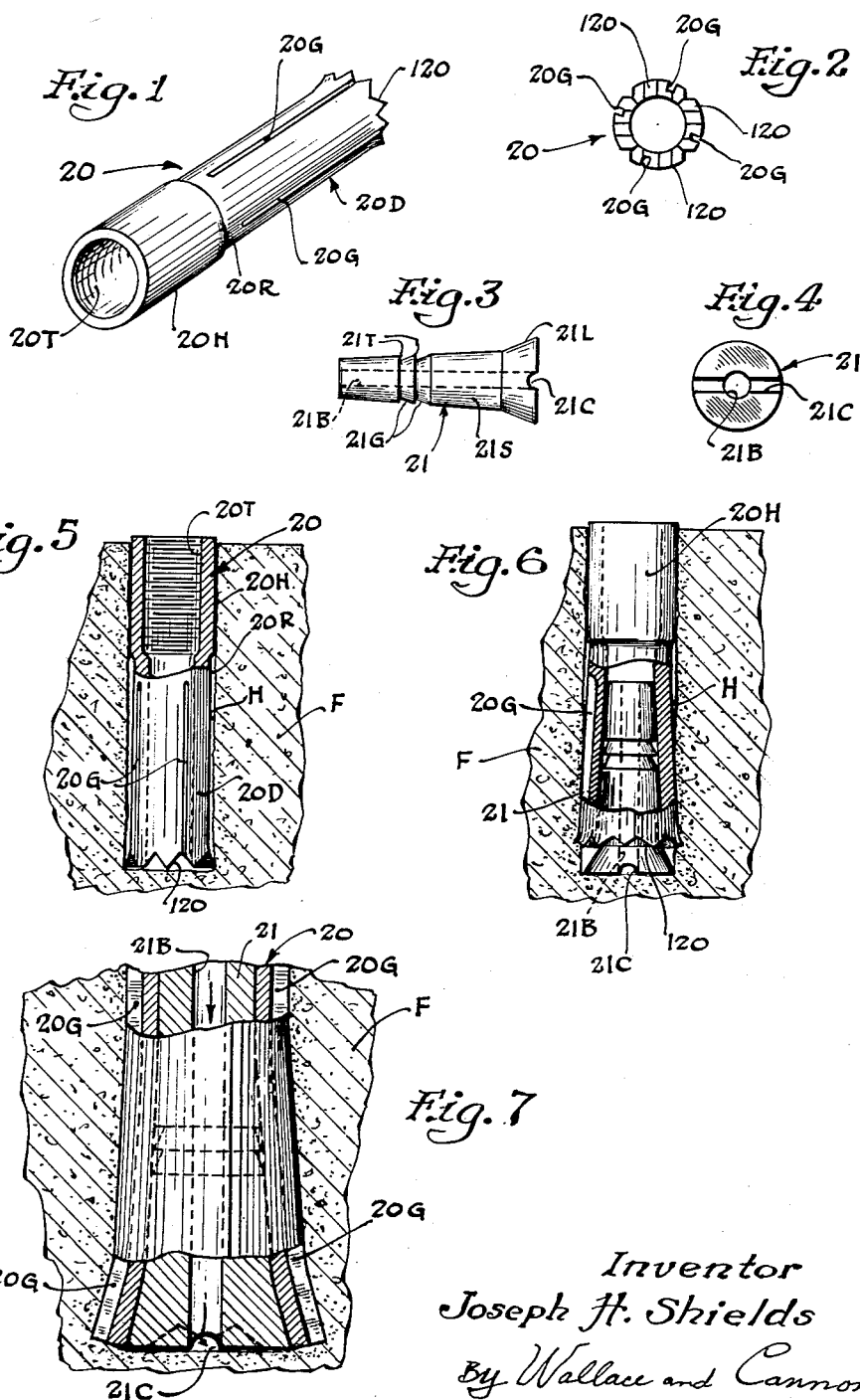
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EXPANDING ANCHOR AND PLUG WITH AN EXHAUST PASSAGE

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3 Sheets-Sheet 1



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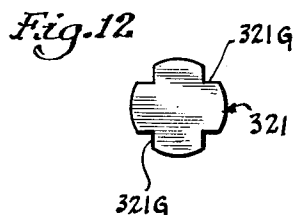
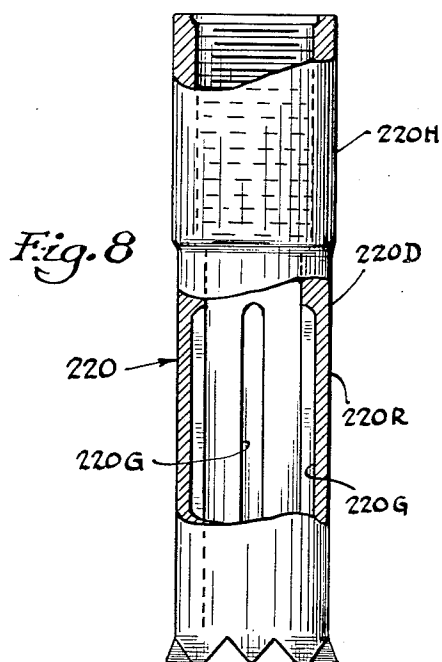


Fig. 11

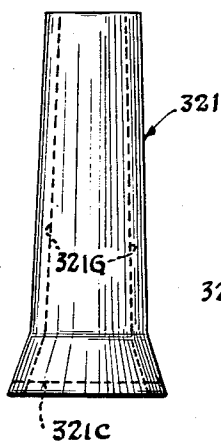
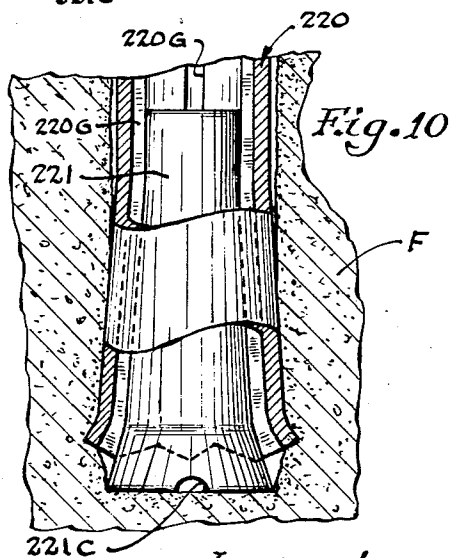
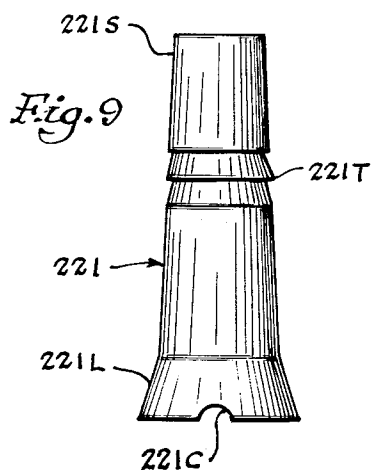
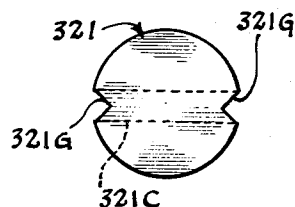


Fig. 13



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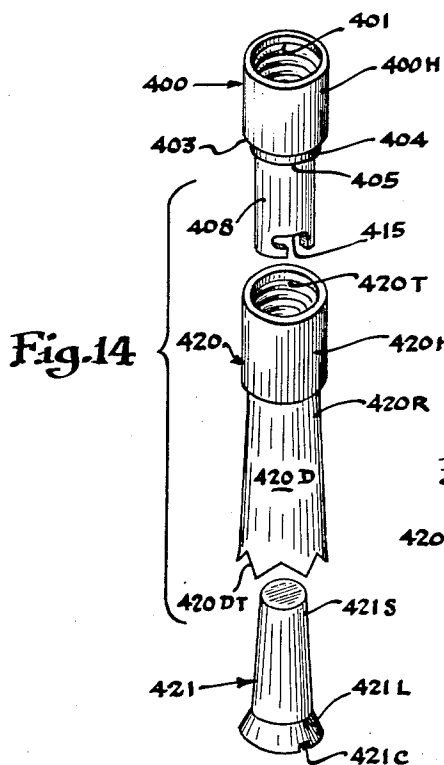
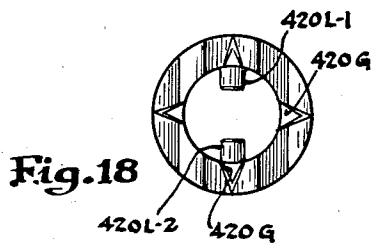
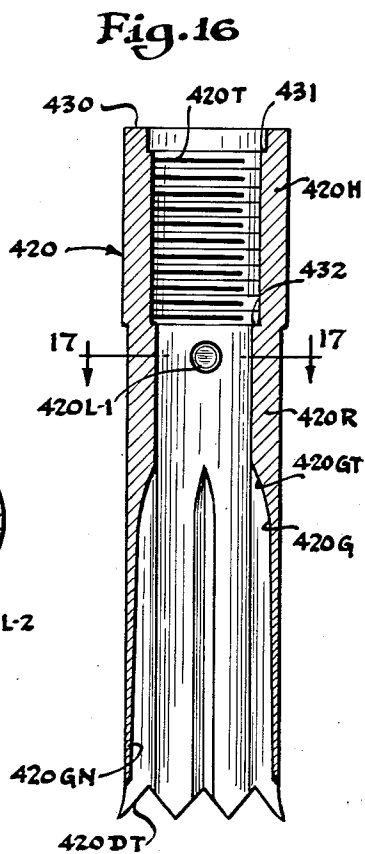
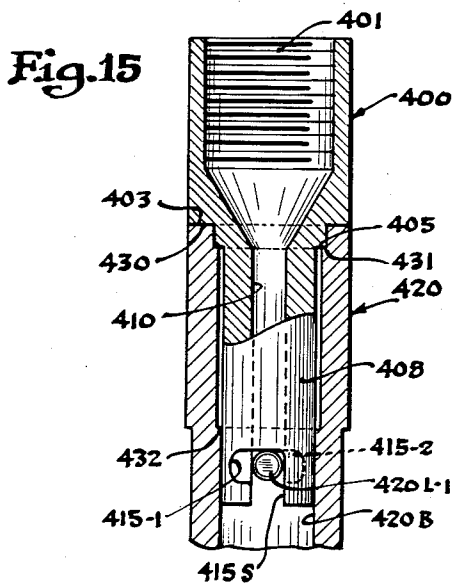
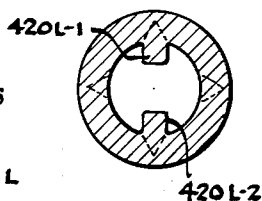


Fig. 17



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EXPANDING ANCHOR AND PLUG WITH AN EXHAUST PASSAGE

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8 Claims. (Cl. 85—2.4)

This invention relates to anchoring devices of a kind utilized in fastening anchor bolts in concrete, and particularly the invention relates to such devices having an anchoring shell that serves as a drill for drilling the necessary anchoring hole in the concrete. This is a continuation-in-part of Serial No. 438,748, filed June 23, 1954, and now abandoned.

While shell drill anchoring devices adapted to be inserted in concrete by drilling of anchoring holes in such concrete are relatively old, such devices have long been considered to be inefficient insofar as resistance to certain kinds of loosening or removing forces may be concerned. In particular, the shell drill type of anchoring devices heretofore used have afforded relatively inefficient anchoring forces against rotative or torsional forces that might be applied to the anchors, and in addition to this, the resistance of such devices to endwise withdrawing movement of the anchoring shell has not been particularly high. Because of this, it has been necessary to utilize relatively large anchoring devices in many instances where, insofar as the strength of the anchoring bolts might be concerned, the use of a smaller anchoring device would be indicated. In view of the foregoing, it is an important object of the present invention to improve the anchoring action that may be attained in anchoring devices of the aforesaid character, and particularly it is an object to materially improve the action of such anchoring devices insofar as endwise removal and torsional displacement thereof may be concerned. Further and related objects of the present invention are to enable the foregoing objects to be accomplished by a structure that is simple in character and economical insofar as manufacturing costs are concerned, and to adapt such anchoring devices for the application of anchoring forces by the usual type of air operated impact or driving tools, and to enable a shell drill to be operated in a novel way by an adapter having portions complementary to portions of the shell.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a perspective view of a shell drill anchoring device embodying the invention;

Fig. 2 is an end view of the shell drill anchoring device showing the tooth structure thereof;

Fig. 3 is a side elevational view of one form of expanding plug that may be utilized with the shell drill of Figs. 1 and 2;

Fig. 4 is an end view of the large end of the plug shown in Fig. 3;

Fig. 5 is a sectional view illustrating the shell drill of Fig. 1 as it is used in forming anchoring holes in material such as concrete;

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Fig. 6 is a view similar to Fig. 5 showing the shell drill after the expanding plug has been put in place in the drilled hole and after the shell drill has been driven through a portion of its expanding or anchoring movement;

Fig. 7 is an enlarged view similar to Fig. 6 and illustrating the lower end of the shell drill after further expansion of the inner end of the shell;

Fig. 8 is a side elevational view taken partially in longitudinal section and illustrating another form of shell drill embodying the features of the invention;

Fig. 9 is a side elevational view of an expanding plug embodying the features of the invention and adapted for cooperation with the shell drill of Fig. 8;

Fig. 10 is a view somewhat like Fig. 7 and showing the shell of Fig. 8 in its cooperating and substantially anchored relationship with respect to the plug of Fig. 9;

Fig. 11 is a side elevational view of an alternative form of expanding plug adapted for use with the shell drill of Fig. 1 under the present invention;

Fig. 12 is a top plan view of the plug of Fig. 11;

Fig. 13 is a bottom plan view of the plug of Fig. 13;

Fig. 14 is an exploded view of a shell drill assembly, including an adapter;

Fig. 15 is a sectional view of the shell and adapter shown in Fig. 14;

Fig. 16 is a sectional view of the shell;

Fig. 17 is a sectional view taken in the line 17—17 of Fig. 16; and

Fig. 18 is a view at the drill end of the shell.

For purposes of disclosure, the invention is illustrated in Figs. 1 to 7 of the drawings as embodied in an anchoring device of the self drilling type that comprises a generally cylindrical drill shell 20 and a tapered anchoring plug 21. The drill shell 20 is formed from a relatively hard metal such as steel, and comprises an outer end or head portion 20H and a relatively long inner drill end 20D. In the form illustrated, the internal cylindrical surface of the head 20H is internally screw threaded as at 20T to receive an anchoring bolt after the anchoring device has been anchored in position in a structure such as a concrete road, wall, floor F or the like. At its inner or leading end, the drill portion of the anchoring shell 20 is provided with a plurality of drill teeth 120, and the wall portion of the anchoring device 20 between the head 20H and the predetermined cutting diameter of the teeth 120 is relieved or reduced somewhat in diameter, as indicated at 20R, so that the drill teeth project slightly outwardly with respect to the surface 20R, and will drill a hole H in the wall or floor F that is somewhat larger in diameter than the diameter of the reduced portion 20R. This affords an annular clearance space through which the dust produced in the drilling operation may be ejected from the hole H as will be described hereinafter.

The drilling portion 20D of the anchoring drill sleeve 20 has a plurality of longitudinally extending weakened lines formed thereon so that when the drill end of the sleeve 20 is expanded, the drill portion 20D may be fractured or split along these lines, thus to form separated longitudinal sections of the drilling portion 20D which may then be forced firmly into contact with the walls of the hole H. In the form of the invention illustrated in Figs. 1 to 7 of the drawings, such weakened lines are afforded in the portion 20H of the shell 20 by a plurality of longitudinally extending grooves 20G that are formed in the external cylindrical surface of the shell 20 throughout substantially the entire length of the drill portion 20D.

A shell drill 20 of the form that is thus afforded may be used in a conventional manner as a drill to form the hole H by attaching the same to the operating head of

an air operated hammer or sinker that is of conventional form. Such a sinker operates with a percussive action that in each cycle imparts a longitudinal blow to the shell drill 20 as well as a minor component of rotative force so that the drilling action that is attained is comparable to that obtained through the use of a star drill. In such sinkers, it is customary to exhaust air from the operating cylinder thereof longitudinally and into the hole that is being drilled, and such exhaust air is under high pressure and passes downwardly through the drill shell 20. This air escapes around and between the teeth 120 and passes outwardly in the annular exhaust space that is afforded between surface 20R and the wall of the hole H, and the exhaust of such air serves to blow the dust and refuse out of the hole H.

After the hole H has been drilled to the desired depth, as for example to the depth illustrated in Fig. 5, the shell drill 20 is withdrawn, and tapered expanding plug 21 is put in place in the hole H with the small end of the plug facing outwardly of the hole. The shell drill 20 is then inserted into the hole so that its leading or toothed end edge surrounds the small end of the plug 21, and under and in accordance with the present invention, the tapered expanding plug 21 is so formed as to attain a novel expanding action on and with respect to the drill end of the shell drill 20, and this action is such that the anchoring strength of the device is exceptionally high, particularly insofar as rotative forces and endwise withdrawing forces may be concerned.

In attaining the improved anchoring action under the present invention, the tapered expanding plug 21 is formed with a varying taper so that a relatively slight taper is afforded throughout the major portion of the length of the plug 21, while a greatly increased taper is afforded near the base of the plug. Thus, as will be evident particularly in Figs. 3 and 6 of the drawings, the plug 21 has a relatively long forward tapered portion in which the taper is relatively small, and near the base of the plug the taper 21S merges with a portion 21L that has a greater taper. The forward portion of the plug 21 is also provided with one or more annular grooves 21G that afford sharp annular teeth 21T facing toward the base end of the plug and which serve to afford an increased locking action between the anchoring shell 20 and the plug 21. The plug 21 has a longitudinal passage or bore 21B formed so as to extend from end to end thereof on its central axis, and a cross slot 21C is formed in the head or large end of the plug 21 so that the exhaust air from the sinker may pass downwardly through the bore 21B and then laterally through the cross slot 21C, so that during the driving operation that is required for expanding the shell drill 20, the additional dust and refuse produced as the forward or toothed end of the shell is expanded may be discharged from the hole H by the exhaust air.

The proportioning of the shell drill 20 and the expanding plug 21 may, of course, be varied to a considerable extent, but I prefer to so proportion these elements that the plug 21 is engaged by the inner surfaces of the teeth 120 at substantially the point where the first one of the grooves 21G is located, and hence, during further inward driving movement of the shell drill 21, the end portion of the shell drill will be continuously expanded and a further slight drilling operation will be accomplished by the teeth 120 to somewhat enlarge the lower portion of the hole H. In the course of such driving of the shell drill, the portion 20D thereof will be fractured along the lines defined by the grooves 20G to form a plurality of arms that may bend outwardly as the driving operation progresses. When the tooth end of the drill 20 engages the larger taper 21L, the ends of the drill will be directed outwardly at a relatively steep angle, as illustrated in Fig. 7 of the drawings, and in this further driving movement, the drilling action will, of course, be increased and the ends of the arms that have been formed

by splitting of the drill end 20D along the lines 20G will be projected substantially beyond the radial limits of the outer portion of the hole H thus to effectually anchor the drill shell 20 against endwise withdrawal. In the event that the final driving forces are applied to the drill shell 20 without the rotative component of force hereinabove described, the ends of the separated arms of the drill portion 20D will effect an unusually efficient rotative interlock with the material of the wall or floor F.

It will be recognized that the outside surfaces of the shell drill 20 will be engaged with the walls of the holes H throughout a substantial portion of the length or the depth of the hole H, and by reason of the double taper of the expanding plug 21, this engagement is even more effective at the inner end of the shell 20, where the distance between the outer surface of the floor or wall F is greatest so as to utilize the strength of the material of the wall or floor to obtain maximum anchoring strength.

In Figs. 8 and 9 of the drawings, the invention is illustrated in a modified embodiment that comprises a shell drill 220 and a double tapered expanding plug 221. In most respects, the shell drill 220 is identical with the shell drill 20, but in this instance, the reduced outer surface 220R is smooth or unbroken, and the weakened longitudinal lines are provided by affording the internal surfaces of the shell 220 in a non-circular or non-cylindrical cross sectional form. Thus as shown in Fig. 8, such weakened lines are afforded by longitudinal grooves 220G that are formed in the inner surface of the drill end of the shell drill, as will be evident in Fig. 8 of the drawings, and such grooves 220G serve additionally as air passages as will appear hereinafter. A cross slot 221C is also afforded across the lower end of the plug 221 so as to aid in preventing accumulation of dust and refuse in the bottom of the hole in which the plug 221 is used.

With the shell drill thus formed, the double taper plug 221 is identical with the plug 21 except that the plug is solid or, in other words, does not have longitudinal and transverse openings or passages such as the passages 21B and 21C hereinabove described. With this arrangement, the shell drill 220 is operated as a drill in the same manner as hereinabove described, but when the drilling operation has been completed and the plug 221 is put in place, the downward passage of the exhaust air from the sinker is taken care of by the longitudinal internal grooves 220G that are formed in the shell drill 220. In other respects, this embodiment of the invention is identical in its operation with the structure illustrated in Figs. 1 to 7.

The expanding plug may also have the requisite longitudinal air passage means afforded in the manner illustrated in Figs. 11 to 13, wherein a double tapered plug 321 is formed that is solid insofar as its internal form may be concerned, and a plurality of longitudinally extending grooves 321G are provided along the outer surfaces of the plug 321. This plug 321 may be utilized as the expanding plug for a shell drill such as that shown in Figs. 1 and 2, and in the expanding operation, the grooves 321G afford an inward or downward passage for the exhaust air so that this exhaust air may function to discharge the dust and refuse from the hole H during the expanding or anchoring operation. A cross slot 321C is also provided in the large end of the plug 321 for the same purpose as the slot 221C.

From the foregoing description, it will be apparent that the present invention affords an anchoring device wherein the anchoring action is superior to the anchoring action heretofore attained, and the devices herein disclosed under the present invention are of such a character that the final driving or anchoring operation may be performed by a percussive sinker without altering the advantageous operation of such a tool.

It is important to point out that the final driving or anchoring operation is greatly enhanced by provision of

the reduced diameter of the shell as at 20R and 220R. Thus, as was mentioned, there is afforded in the present instance a novel kind of expansion at the drill end of the shell centered on the expanded plug, and this is attained through the sharp taper as 21L and 221L of the plug. A great deal of friction and resistive binding would normally be expected during this operation, but by reducing the diameter of the shell in the manner mentioned full expansion is allowed at the bottom or sunk portion of the shell since there is space between the hole H and the sides of the shell where the aforesaid reduction in shell diameter is afforded. In other words, gradual and completely effective expansion at the bottom of the shell is allowed to occur, inasmuch as the entire reduced diameter portion of the shell has room to expand within the hole H. This condition is apparent in Figs. 6 and 10 wherein spacing yet exists between the hole and the portion of the shell just below the head thereof even though expansion of the shell has already been attained.

In Figs. 14 to 18, the present invention has been further modified to accommodate in a novel way a highly advantageous kind of drive adapter. The shell 420, Fig. 14, is similar to the shell 220 described above, including drill teeth 420DT at the lower end of the intermediate drill portion 420D. The head 420H of the shell in this instance is modified as will be explained to cooperate with a complementary drive adapter 400, and the drill portion 420D below the head 420H is reduced in diameter at 420R for the purposes mentioned above.

The plug 421 is solid and includes an upper tapered portion 421S and a base that has a greater taper imparted thereto at 421L. Thus, the plug 421 is similar to the plug 321 described above except that grooves as 321G are not employed, and the base 421L is slotted at 421C for the purpose described above.

The shell 420, like the shell 220, is weakened internally by circumferentially spaced and axially extended grooves 420G which, as shown in Fig. 18, are triangular in shape, having vertical side walls that converge from the inner wall of the shell toward the outer wall of the shell. To facilitate initial and then easily continued fracture or splitting of the shell during the final anchoring operation, the grooves 420G are tapered from a thick upper end 420GT downwardly to a thin or weakened lower end 420GN as shown in Fig. 16.

The shell 420 is threaded internally at 420T, these threads being provided in the head portion 420H. The upper end of the head 420H is defined by an annular thrust bearing seat or surface 430, and an internal annular centering seat or shoulder 431, which is of less diameter than the bearing seat 430 and is spaced below the bearing seat. The threads 420T terminate at another internal shoulder 432 which is of smaller diameter than the shoulder 431, and the shoulder 432 is spaced above a pair of drive lugs 420L-1 and 420L-2, Fig. 17, formed in diametrically opposite positions on the internal wall of the drill portion 420D of the shell.

The shell 420 is to be driven by an adapter 400, Figs. 14 and 15 which is adapted to impart percussive action to the shell drill 420 during formation or drilling of a hole as H, Fig. 6. The adapter 400 is also adapted to drive the shell 420 during the shell anchoring operation at the time when the plug 421 has been placed in the hole drilled by the shell. Thus, the adapter 400 includes a head 400H which is threaded internally at 401 enabling the adapter 400 to be operatively mounted on a conventional type of air driven tool. The lower end of the head 400H of the adapter is defined by an annular shoulder 403 which affords a collar 404 of reduced diameter in comparison to the head 400H. The collar 404 is further reduced to afford another shoulder 405, and depending from the shoulder 405 is a stem or shank 408 of reduced diameter in comparison to the collar 404. As best shown in Fig. 15, the adapter 400 is

formed with an internal bore 410, and when the adapter has been inserted into the shell 420, the bore 410 enables compressed air to be driven downwardly through this bore and the internal bore of the shell so as to sweep dust or like debris from the hole being drilled by the drill shell.

The lower end of the adapter shank 408 is provided with a pair of bayonet locking slots 415, Fig. 14. Two such slots 415-1 and 415-2 are afforded as shown in Fig. 15 in diametrically opposite positions at the lower end of the shank 408 of the adapter 400. The shank portion 408 and the collar 404 of the adapter are complementary to related parts of the shell 420 so that the adapter 400 can be inserted into the head 420H of the shell with the shoulders 403 and 405 of the adapter reposing on the thrust bearing face 430 and the centering shoulder 431, respectively, of the shell. As will be observed in Fig. 15, the dimensioning of the parts is such that the outer wall of the shank 408 of the adapter in the intermediate portion thereof is spaced inwardly of the threaded portion 420T of the drill shell 420, thereby preventing damage to the threads of the drill shell which, it will be recalled, serve to anchor a bolt after the drill shell has been expanded within a drilled hole as H. It will be further observed that the shank of the adapter at the lower end portion extends past the shoulder 432 of the drill shell, and this portion of the adapter approximates the diameter of the bore 420B, Fig. 15, of the drill shell, and in this manner the adapter is accurately centered in and in circumferential bearing engagement with the drill shell at the aforesaid shoulder portions and the portion of the adapter shank extended beyond the drill shell shoulder 432.

When the adapter has thus been mounted in the drill shell, this is accomplished by so aligning the adapter that the open ends of the bayonet slots 415 are aligned with the lugs 420L-1 and 420L-2. Then, by turning the adapter in the proper direction, the lugs 420L-1 and 420L-2 repose in the dead end portions of the bayonet slots. It will be appreciated that impacts delivered to the shell 420 through the adapter 400 have a rotary component, and this component will be of such direction as to tend to tighten the bayonet slots of the adapter on the lugs of the shell, and such action occurs without damage to the threads 420T of the drill shell.

While I have illustrated the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a shell drill anchoring device, a drill shell having a longitudinally externally grooved expansible cutting end terminating in drilling teeth capable of cutting concrete and having a predetermined cutting diameter, said shell member having a head portion opposite the drilling end and an intermediate portion with a reduced diameter in comparison to said head portion and said cutting diameter, said intermediate portion extending from the head to the drilling end and the diameter thereof being reduced for the full length thereof, and a tapered expanding plug insertable into the bottom of a hole to extend into and fracture and expand the cutting end of the shell upon inward driving of the shell, said plug having a longitudinal central passage from end to end and an intersecting transverse slot across its inner end through which exhaust air from a pneumatic driving tool may pass inwardly of such a hole toward the bottom of the hole and then outwardly of the hole about the expanded shell.

2. A tapered expanding plug insertable into the bottom of a hole to extend into and fracture and expand the cutting end of an anchoring drill shell upon inward driving of the shell, said plug having a gradual frusto-conical taper adjacent its outer end and a greater frusto-

conical taper adjacent its inner end, and said plug having a transverse slot across its inner end through which exhaust air from a pneumatic driving tool may pass outwardly of the hole about an expanded shell.

3. In an anchoring device, a hollow tubular shell member having an internal surface conforming to a substantially constant diameter for a substantial portion of its length and an externally tapered expansion plug member, said shell member having a head at one end of predetermined outside diameter and which head is internally threaded, said shell member having a toothed drilling end of predetermined cutting diameter approximately the same diameter as the outside diameter of said head and the external surface of said shell member between said head and of said toothed end being of uniform reduced diameter for substantially the full length thereof, one of said surfaces of said shell member being weakened by longitudinal grooves, said tapered expansion plug member being adapted to be disposed in a previously drilled hole ahead of the shell member to fracture and expand the shell upon inward driving of the shell member, said plug member having a gradual frusto-conical taper extending from its outer end for a substantial distance and having an increased frusto-conical taper adjacent the other end of the plug member, and said plug member having a transverse slot in the face of said other end.

4. In an anchoring device, a hollow tubular shell member having an internal surface conforming to a substantially constant diameter for a substantial portion of its length, and a tapered expansion plug member, said shell member having a toothed drilling end capable of cutting concrete and having a predetermined cutting diameter, said shell member having a head portion opposite the drilling end and an intermediate portion with a reduced diameter in comparison to said head portion and said cutting diameter, said intermediate portion extending from the head to the drilling end and the diameter thereof being reduced for the full length thereof, said tapered expansion plug member being adapted to be disposed in a previously drilled hole ahead of the shell member to expand the shell upon inward driving of the shell member, and said plug member having a gradual frusto-conical taper extending from its outer end for a substantial distance and having an increased frusto-conical taper adjacent the other end of the plug member, one of said members having passages through which exhaust air from a driving tool may pass through said shell member inwardly toward the bottom of the hole for discharge about inner portions of the shell member and outward discharge about the outside of the shell member, and the face of said other end of the plug member having a transverse slot therein.

5. In an anchoring device, a tubular shell having drilling teeth capable of cutting concrete formed thereon at one end and having internal screw threads formed in its inner cylindrical surface adjacent the other end, said drilling teeth having a predetermined cutting diameter, said shell having a head with a diameter approximately equal to that of said cutting diameter, said shell having the diameter of its external cylindrical surface reduced uniformly and substantially for the full length thereof between said head and said drilling teeth, said shell having a plurality of laterally spaced longitudinal grooves formed in the inner one of its cylindrical surfaces to enable subsequent longitudinal fracture of the shell along such grooves in the course of expansion of the drilling end of the shell and to allow passage of exhaust air therealong, and a solid tapered expansion plug adapted to be disposed in a previously drilled hole ahead of the shell to fracture and expand the shell upon inward driving of the shell, said plug having a gradual frusto-conical taper extending from its outer end for a substantial distance and having an increased frusto-conical taper adjacent the other end of the plug, and said plug having flat end faces with the

face at the increased taper end provided with a transverse slot.

6. In an anchoring device, a tubular shell member and a tapered solid expansion plug member, said shell member having a toothed drilling end capable of cutting concrete and having a predetermined cutting diameter, said shell member having a head portion opposite the drilling end and an intermediate portion with a reduced diameter in comparison to said head portion and said cutting diameter, said intermediate portion extending from the head to the drilling end and the diameter thereof being reduced for the full length thereof, said tapered expansion plug member being adapted to be disposed in a previously drilled hole ahead of the shell member to fracture and expand the shell upon inward driving of the shell member, and said plug member having a gradual frusto-conical taper extending from its outer end for a substantial distance and having an increased frusto-conical taper adjacent the other end of the plug member, said shell member having a plurality of longitudinal grooves formed in its inner surface for fracture upon expansion of said shell member and through which exhaust air from a driving tool may pass through said shell member inwardly toward the bottom of the hole for discharge about inner portions of the shell member and outward discharge about the outside of the shell member, and said plug having flat end faces with the face at the increased taper end provided with a transverse slot.

7. In an anchoring device, a tubular shell member having a bore formed therein, a tapered expansion plug, an adapter insertable in the shell for driving the shell and having first and second annular shoulders, said shell member having a thrust bearing surface at one end complementary to said first annular shoulder and an annular centering seat within the shell bore complementary to said second annular shoulder, said shell member having a toothed drilling end, lugs within the bore of the shell member, internal threads in the shell bore between said lugs and said centering seat, said adapter having a shank with slots therein at the end extended beyond said second annular shoulder for engaging said lugs and removably coupling the shell to the adapter, said shank being insertable in the shell bore and being of less diameter than the threaded portion of the shell member, said tapered expansion plug member being adapted to be disposed in a previously drilled hole ahead of the shell member to expand the shell upon inward driving of the shell member, and said plug member having a gradual taper extending from its outer end for a substantial distance and having an increased taper adjacent the other end.

8. An anchoring device according to claim 7 wherein the diameter of the shell bore adjacent said lugs is less than the diameter of said threaded portion, and wherein the portion of the adapter shank having said slots is of such diameter as to be in bearing engagement therewith.

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