

Nov. 27, 1962

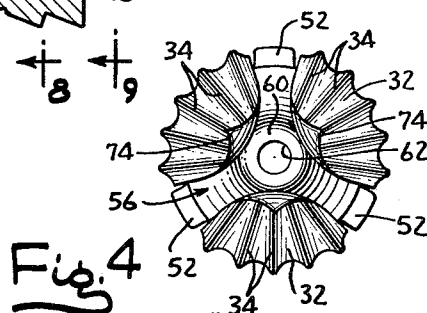
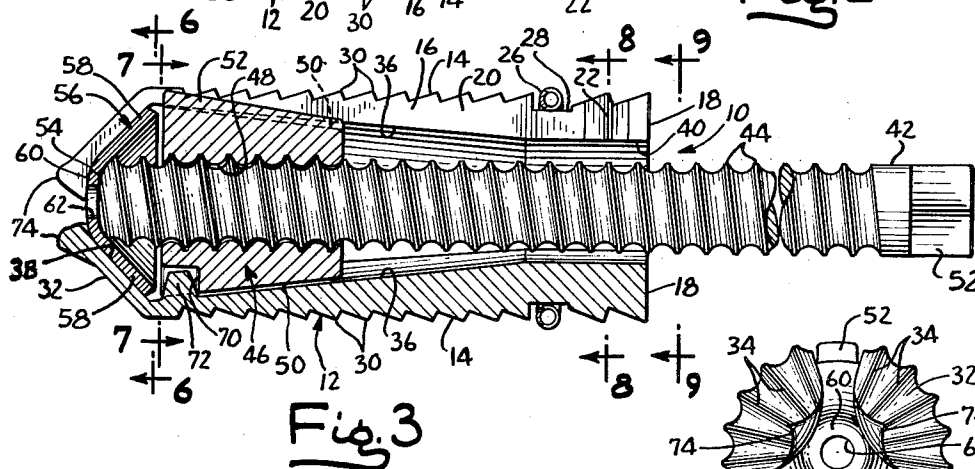
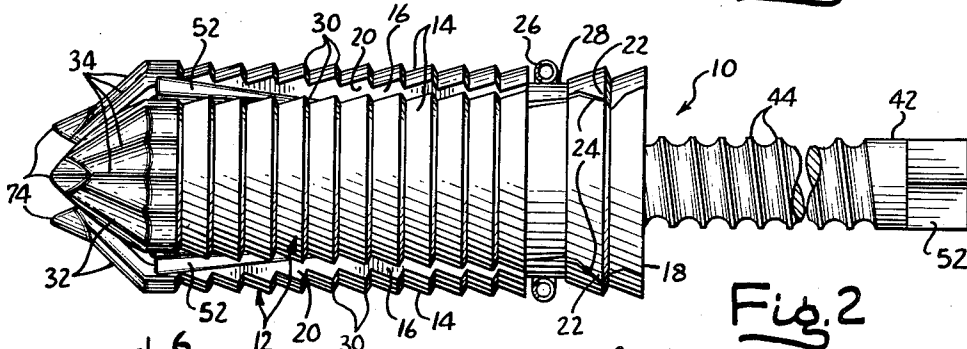
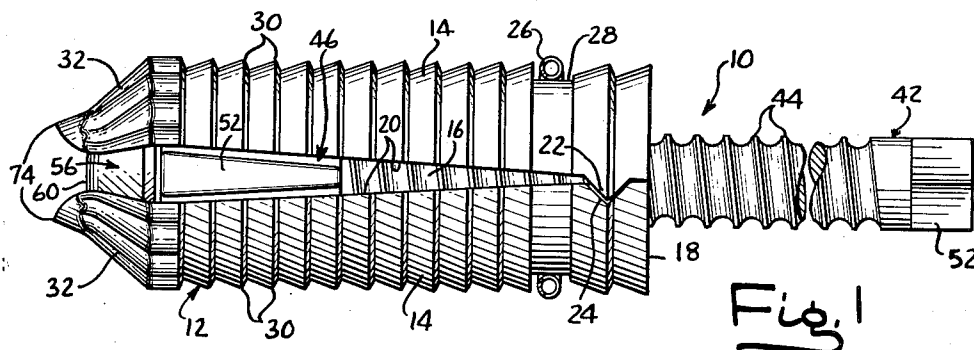
G. J. ERIKSSON ET AL

3,065,659

EXPANSION BOLT

Filed Sept. 28, 1959

2 Sheets-Sheet 1



INVENTORS
GEORGE J. ERIKSSON
BROR HILLBERG

by: *Norman Gedach*
ATTY.

Nov. 27, 1962

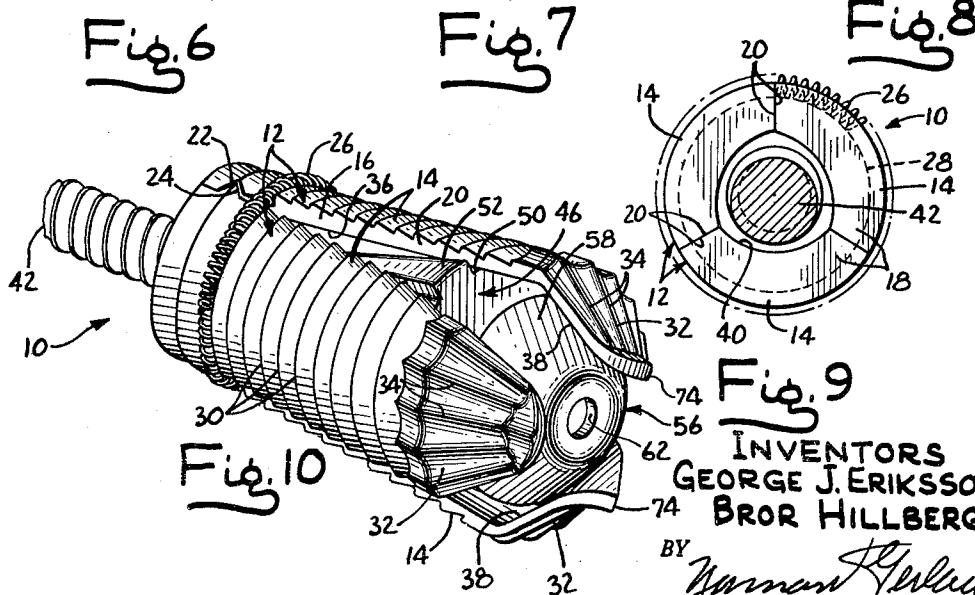
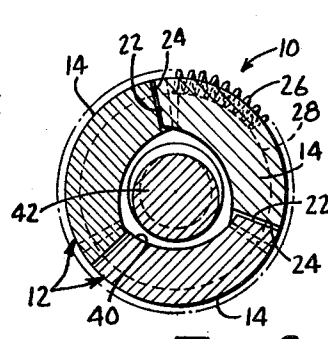
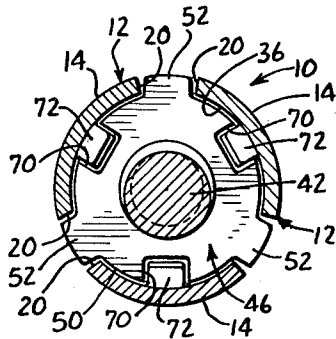
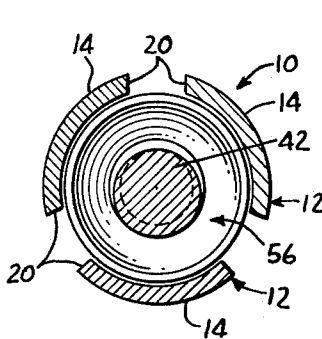
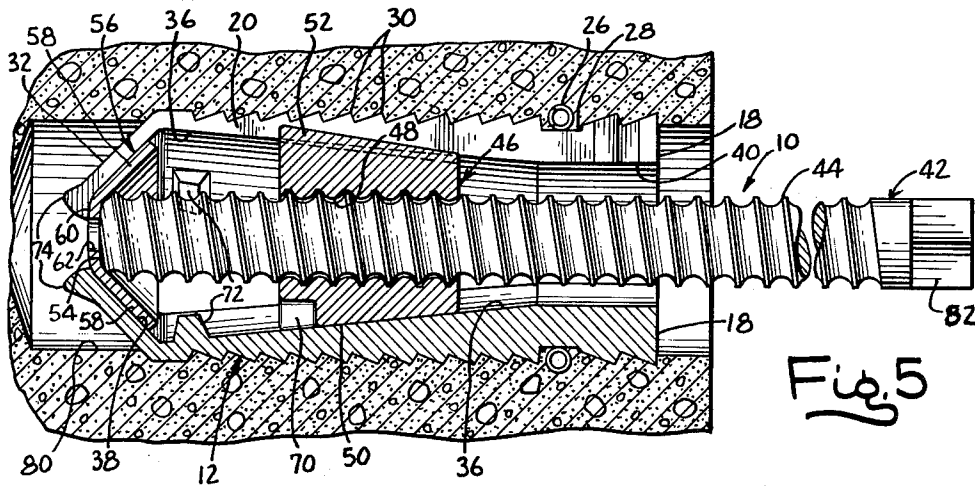
G. J. ERIKSSON ET AL

3,065,659

EXPANSION BOLT

Filed Sept. 28, 1959

2 Sheets-Sheet 2



INVENTORS
GEORGE J. ERIKSSON
BROR HILLBERG
BY *Norman H. Erickson*
ATTY.

1

3,065,659

EXPANSION BOLT

George J. Eriksson, Morton Grove, and Bror Hillberg, Franklin Park, Ill., assignors, by mesne assignments, to Superior Concrete Accessories, Inc., a corporation of Delaware

Filed Sept. 28, 1959, Ser. No. 842,743

1 Claim. (Cl. 85—2.8)

The present invention relates to expansion bolts and has particular reference to an expansion bolt assembly of the type commonly known as a concrete or rock anchor and having general utility as an article of concrete hardware. Rock or concrete anchor devices constructed in accordance with the principles of the present invention will find utility in connection with various concrete installations wherein it is desired to provide an anchor on an exposed section of rock or where it is desired to provide an anchor on an exposed section of hardened concrete, in which cases a hole will be drilled in the rock or concrete for reception therein of the expansion bolt assembly of the present invention. Expansion bolts constructed in accordance with the principles of the present invention may also find use as mine roof anchor designed for retaining engagement with the cylindrical walls of holes drilled in a mine roof. Irrespective however of the particular use to which the present expansion bolt may be put, the essential features of the invention are at all times preserved.

One form of conventional expansion bolt commonly in use has a split or divided tubular outer casing or shell provided with a tapered inner wall. Within the shell there is axially slidable an expander nut which is in the form of a frustum of a cone. A stud is threaded through the expander and by means of the stud the expander is shifted axially of the casing so that by drawing the expander in one direction and into engagement with the interior wall surfaces of the divided shell, the shell is expanded into engagement with the wall of the drilled opening in which the device is installed.

The improved expansion bolt herein disclosed includes the various elements described above but the parts are shaped in such a manner and an additional functional element has been added to the combination so that the expandable assembly as a whole operates upon a substantially different principle and with various improved results compared with the functioning of conventional conical wedged shaped expansion bolt assemblies.

It is among the principal objects of the present invention to provide an expansion bolt assembly which, when compared with the conventional bolt, is capable of more efficiently meeting the varying conditions of installation encountered in everyday use, as for example the drilling of holes of varying diameters in materials such as rock which may be relatively hard and present unyielding walls or which may be of soft material presenting walls which are fragile or deformable.

Another and general object of the invention is to provide an expansion bolt of this character which, although it relies for the expansion of its parts upon the use of a suitable torque-applying tool, is capable of being manipulated without the use of a tool upon initial insertion thereof in a drilled hole so that the device as a whole may temporarily be retained in place until such time as the expanding tool is applied thereto. By such an arrangement the expansion bolt may be inserted into a substantially vertical hole in a ceiling or roof, for example, and held therein against gravitational dislodgment thereof until such time as the expanding tool is brought into play.

Yet another general object of the invention is to provide a multi-part expansion bolt in which the various parts thereof may be initially assembled to provide a

2

package-type unit wherein the parts are unlikely to become disassembled before installation, such disassembly being a problem with conventional multi-part expansion bolts and frequently involving the loss of a part.

It is a specific object of the invention to provide an expansion bolt assembly of the general character set forth above having associated therewith a sectional outer shell which is substantially circular in transverse cross section throughout, and which, when the shell is fully collapsed, has overall dimensions which are less than those of a drilled hole in a rock or concrete foundation with which the bolt assembly is to be associated. Furthermore, according to this object of the invention, novel expansion means are provided whereby, upon initial turning movement of the bolt proper or stud, the forward end of the shell will be expanded to increase the radial dimension thereof while the rear end of the shell will remain contracted until such time as the forward end coextensively engages the wall of the drilled hole, at which time the rear end of the shell will commence to expand and expansion thereof will continue until such time as the outer face of the shell uniformly and coextensively engages the wall of the drilled hole, whereupon, further turning movement of the stud will effect binding or locking of the expansion bolt assembly in the drilled hole. Stated in other words, it is an object of the invention to provide an expansion bolt assembly having an outer shell or shield which is divided into sections, together with expansion means for spreading the sections apart radially while at the same time allowing the sections a degree of unrestrained floating freedom to follow the shape of the internal wall of the drilled hole within which the assembly is installed.

By such an arrangement the expansion bolt as a whole may, during expansion thereof, follow the contour of a hole which is not truly cylindrical, as for example a hole which has been improperly drilled or which has been created by shipping or other impact means resulting in a hole having an out-of-round contour or one which is not uniformly circular.

A still further object of the invention is to provide an expansion bolt having associated therewith novel means for preventing relative rotation between the shell and the wedge nut associated with the same during threading of the bolt proper through the wedge nut.

Another object of the invention is to provide such an expansion bolt which is adapted to be manipulated into its expanded condition within a drilled hole entirely by the application of torque to the bolt proper, thereby eliminating the use of percussive or other power tools for its installation in a drilled hole.

A still further object of the invention is to provide an expansion bolt assembly in which the bolt proper may be continuously threaded in one direction only, yet which, in a manner of speaking, exerts a turnbuckle action on a pair of wedge members so as to force the wedge members axially in opposite directions whereby the latter may exert respective wedging actions against both the ends of the sectional frusto-conical outer shell or casing whereby the uniform expansion of the shell without alteration of its slant angle, as briefly outlined above, may be attained.

The provision of an expansion bolt assembly which is relatively simple in its construction, consisting as it does of but five principal parts exclusive of the threaded bolt proper; one in which the component parts thereof may be in the form of relatively small simple castings, thereby contributing toward economy of manufacture; one which is rugged and durable and which will withstand extremely high internal and external forces; one which may be easily manipulated and does not require any particular degree of skill in its application; and one

which otherwise is well adapted to perform the services required of it are further desirable features which have been borne in mind in the production and development of the present invention.

Numerous other objects and advantages of the invention, not at this time enumerated, will become more readily apparent as the nature of the invention is better understood.

In the accompanying two sheets of drawings forming a part of this specification one illustrative embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a side elevational view of an expansion bolt assembly constructed in accordance with the principles of the present invention;

FIG. 2 is another side elevational view of the expansion bolt assembly shown in FIG. 1, the direction of viewing being at an angle of 30° relative to the direction of viewing in FIG. 1;

FIG. 3 is a sectional view taken substantially centrally and longitudinally through the expansion bolt assembly of FIGS. 1 and 2;

FIG. 4 is an end elevational view of the expansion bolt assembly;

FIG. 5 is an enlarged fragmentary sectional view taken substantially centrally and longitudinally through the expansion bolt assembly and showing the same in its fully expanded position within a drilled hole provided in a rock, concrete or other foundation support;

FIG. 6 is a sectional view taken substantially along the line 6—6 of FIG. 3;

FIG. 7 is a sectional view taken substantially along the line 7—7 of FIG. 3;

FIG. 8 is a sectional view taken substantially along the line 8—8 of FIG. 3;

FIG. 9 is a sectional view taken substantially along the line 9—9 of FIG. 3; and

FIG. 10 is a perspective view of the expansion bolt assembly showing the same in a partially expanded condition.

Referring now to the drawings in detail, in the embodiment of the invention illustrated herein, the expansion bolt assembly has been designated in its entirety at 10. This assembly involves in its general organization a composite outer shell or shield 12, this shield being of a sectional nature and being comprised of three identical shell sections 14. Inasmuch as the three sections 14 are identical, a description of one will suffice for them all.

Each of the three shell sections 14 is in the form of an elongated member which is generally of arcuate configuration in transverse cross section as best seen in FIGS. 6, 7, 8 and 9. As shown in FIG. 5, each section 14 is of tapering configuration, which is to say that it decreases in thickness from its rear to its forward end. When the three shell sections 14 are assembled upon one another in concentric relationship about the longitudinal axis of the expansion bolt assembly, and when they are collapsed upon one another as shown in FIGS. 1 to 3 inclusive, they constitute in effect an outer longitudinally split sectional shell or casing assembly having three longitudinal splits or separations 16 therealong.

Each section 14 is provided with a relatively thick rear end face 18 and longitudinal side faces 20 which are of elongated generally triangular design in that they decrease in width from the rear end of the section to the front end thereof. The side faces 20 of each shell section 14 are planar and they extend at an angle of approximately 120° to each other so that the planes of these side faces extend substantially radially of the expansion bolt assembly. Adjacent the rear end of the member 14 one of the planar side faces 20 is interrupted by the provision of a V-shaped tongue 22 while the opposite side is similarly interrupted adjacent the rear end thereof by a notch 24 which is conformable

in configuration to the configuration of the tongue 22. These tongue and notch arrangements are best seen in FIG. 1 and they form an interlocking structure at the rear end of the shell assembly when the sections are assembled upon one another and in their collapsed condition.

An endless garter spring 26 encircles the rear end of the composite shell or shield 12, fits within three arcuate recesses 28 and serves to contract the rear end region of the composite assembly so that the tongues 22 and notches 24 fit within one another as shown in FIGS. 1 and 8.

The outer curved faces of the various sections 14 are provided with a series of teeth or ridges 30 which present relatively sharp tooth edges which, except for the interruptions or splits 16, extend in parallel circumferential relationship around the shell assembly. These teeth are provided for the purpose of enhancing the frictional characteristics of the shell when the same is expanded against the cylindrical wall of the drilled hole in the rock, concrete or other foundation with which the expansion bolt assembly is employed.

The major portion of the composite shell 12, when the latter is in its collapsed condition as shown in FIGS. 1 to 3, is substantially cylindrical, except for the slight irregularities afforded by the teeth 30. In other words the diameter of the composite collapsed shell at the rear end region thereof is substantially the same as the diameter of the shell in the forward regions thereof where the last of the series of teeth 30 is formed. Forwardly of this cylindrical region the outer face of the composite shell extends forwardly and inwardly on an incline as shown at 32, thus affording a generally frusto-conical region of steep slant angle in the neighborhood of 45° and of short slant height, the cone being interrupted by the three longitudinally extending splits 16. In the collapsed condition of the shell 12, the frusto-conical fragments 32 of the various shell sections 14 assume positions which are fairly close to one another but in the expanded condition of the shell these frusto-conical portions or fragments assume fairly widely separated positions as shown in FIG. 5. The outer face of the frusto-conical portion 32 of each shell section 14 is formed with a series of diverging ribs 34 which, in certain installations function to frictionally engage the bottom wall of the drilled hole or socket and prevent turning movement of the shell within this socket during initial expanding operations before the outer shell wall engages the inner wall of the socket.

In a sense, each of the shell sections 14 is of shallow elongated cup-shape design in that it is formed with a shallow internal depression affording surfaces which, when the shallow sections are assembled as shown in FIG. 5, provide an inner frusto-conical wall surface 36 of relatively long slant height and small slant angle, a second frusto-conical surface 38 of short slant height and large slant angle, and a cylindrical wall surface 40. The frusto-conical surface 36 is in the medial region of the shell assembly while the frusto-conical surface 38 and cylindrical wall surface 40 are on opposite sides of the surface 36 with the cylindrical surface 40 being adjacent the rear end of the assembly. It will be understood of course that the aforementioned surfaces 36, 38 and 40 of the composite assembled shell 12 are all interrupted by the longitudinal splits 16.

From the above description it will be seen that the composite longitudinally split outer shell or shield 12 is generally of open-ended tubular configuration. A threaded anchoring stud or bolt 42 having contour threads 44 which are integrally cast therewith extends into the open-ended tubular structure from the rear end thereof and threadedly receives thereon a wedge nut, ring or collar 46 having an internal threaded bore 48 designed for threaded reception over the threads 44. The wedge ring 46 presents an outer frusto-conical face 50, the smooth continuity of which is interrupted by the provision of a series of three longi-

tudinally extending ribs 52 (see particularly FIGS. 1 and 7), the three ribs 52 extending into the longitudinal splits 16 of the composite shell 12 between the adjacent shell sections. The ribs 52 are tapered inwardly in a forward direction to accommodate the taper of the longitudinal splits 16, thus affording close nesting of the parts of the assembly when they are in their collapsed condition as shown in FIG. 1. The function of the ribs 52 is to prevent relative turning movement between the wedge ring or collar 46 and the shell during initial application of torque to the stud 42 as will be described presently.

The extreme forward end of the threaded stud 42 may be rounded as at 54 and is designed to seat within the concave side of a cup shaped seat member 56 having a frusto-conical wall 58 and a generally rounded bottom 60 through which there extends a relief hole 62. The seat member 56 not only serves as a reaction seat for the forward end 54 of the stud 42, but it also functions as a second wedge member in cooperation with the frusto-conical inside wall 38 of the shell for spreading the rear end regions of the sectional shell outwardly during initial turning movement of the stud 42 after the expansion bolt assembly has been positioned in a given drilled hole for subsequent tightening of the assembly within the hole.

The rear rim of the frusto-conical wedge ring 46, i.e. the end thereof adjacent the large base of the cone frustum, is formed with a series of three outwardly and rearwardly facing notches or recesses 70 (FIGS. 3, 5 and 7) adapted to receive therein a series of three alignment posts 72 integrally formed on the inside faces of the shell sections 14 near the forward end thereof. The posts 72 and notches 70 constitute interengaging means for preventing the expander ring 46 from pushing the seat member 56 from the assembly in the free state of the expansion bolt.

Reference to FIGS. 4 and 10 will show that the three frusto-conical sections of the wall 58 hug the convex face of the cup-shaped member 56, so to speak, and retain the latter member within the longitudinal confines of the shell. The extreme forward ends of the sections of the wall 58 terminate in outwardly flared tip regions 74 which may also assist the tapered ribs 34 in maintaining the composite shell 12 from turning when torque is initially applied to the stud 42.

The expansion bolt assembly described above may be manufactured, assembled and sold as a package unit for immediate use in the field. For sales purposes and to encourage use of articles such as have been described herein it is essential that the cost of the assembly be maintained reasonably low. According to the present invention the number of parts required is relatively few and each of the principal parts employed may be castings of malleable iron which require only simple and inexpensive molds. Additionally, the assembly process involves no special skill, it being necessary merely to thread the stud 42 through the wedge ring 46 to the extent illustrated in FIG. 3, after which the reaction cup or seat member 56 may be applied to the extreme forward end 54 of the stud 42. Thereafter the three shell sections 14 are assembled about the stud, wedge ring and cup and the garter spring 26 is spread over the assembly and released into the slot or groove 28. During such assembly, care must be taken to cause the notches 70 and alignment posts 72 to register, and also to cause the V-shaped protuberances 22 and notches 24 to register. The alignment posts 72, in combination with the frusto-conical inner wall surfaces 73 of the inclined portions 32 of the shell sections 14 afford a confining space or chamber for retention of the cup or seat member 56.

In the use of the present expansion bolt assembly, for any given installation, whether the drilled hole in the rock, concrete or other material be horizontal as indicated at 80 in FIG. 5, or whether the hole be drilled vertically or on an incline in a ceiling, wall, floor or rock formation at any angle, the assembled and collapsed expansion

bolt device is inserted, with its forward end leading, endwise into the drilled hole or socket 80. The depth of the socket is preferably slightly greater than the axial extent of the three-piece sectional shell 12 so that the entire shell may be encompassed by the socket. If the socket 80 is not of exceptional depth, the pointed or tapered ends 74 may be driven solidly against the bottom of the socket and, thereafter, a suitable tool such as a wrench (not shown) may be applied to the end of the stud or bolt 42 which may be squared as at 82 to receive the wrench. Upon initial turning of the threaded stud 42, the end 54 thereof will seat against the bottom wall of the cup-shaped seat member 56 while the threads 44 will progressively force the seat member and wedge ring 46 apart. Under the influence of the encircling garter spring 26, the rear end regions of the various shell sections 14 will remain in positions of close proximity, while the seat member 56 will tend to ride forwardly on the inner frusto-conical surfaces 38 of the shell sections 14 and thus effect a spreading of the front end regions of the various shell section. This spreading action will continue until such time as the teeth 30 at the forward region of the shell engage the inner cylindrical wall of the drilled hole 80.

As soon as such engagement between the wall of the drilled hole 80 and the teeth 30 in the forward region of the assembly takes place, further expansion of the forward regions of the shell 12 is prevented and the seat member 58 is prevented from further forward movement. As the stud 42 continues to be rotated, the seat member 58 acts as a reaction member for the end of the stud 42 and the wedge ring 46 is caused to travel rearwardly on the stud so as to progressively spread the forward regions of the sectional shell 12 into intimate contact with the wall of the hole 80. The sectional shell 12 thus assumes a generally cylindrical configuration. After it has assumed this shape, further turning of the stud 42 serves merely to apply outward spreading movement to both the rear and front end regions of the shell and cause the teeth 30 to bite into the wall of the drilled hole with substantially uniform radial pressure.

Prior to engagement of the shell with any portion of the inside wall of the drilled hole 80, a certain amount of anti-torque reaction force may be obtained by the frictional engagement between the pointed ends 74 of the shell sections 14 and the bottom wall of the drilled hole so that as the stud 42 is rotated, the remainder of the assembly will be held against rotation with the stud. The interlocking studs 72 on the inner faces of the sections 14 and the external notches 70 in the rear rim region of the wedge ring 46 prevent relative turning movement between the wedge ring and shell. The ribs 52 which interlock with the side surfaces 20 of the shell section 14 also prevent such relative turning movement between the wedge ring and shell. These ribs 52 further confine the three shell sections in their respective 120° sectors for proper radial expansion.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, while the composite shell 12 has been illustrated herein as being comprised of three identical sections 14, each occupying a position within one 120° sector of the assembly, it is to be understood that, if desired, four or more sections may comprise the shell and that, in such instances, the character of the wedge ring 46 will be modified accordingly to provide the necessary number of ribs 52 and notches 70. Only insofar as the invention has particularly been pointed out in the accompanying claim is the same to be limited.

Having thus described the invention what we claim as new and desire to secure by Letters Patent is:

An expansion bolt assembly adapted to hold the end

of a threaded stud in a recess with a generally cylindrical inner wall, and comprising a longitudinally split composite expandable outer shell including three circumferentially arranged shell segments, each shaped as a longitudinally tapering fragment of a hollow cylinder and having oppositely facing longitudinally extending planar side edges disposed in respective approximately radial planes, each side edge being opposed to a side edge of the adjacent segment and defining therewith a longitudinal split, one side edge of each segment being formed with a V-shaped tongue near the rear end of the segment, the other side edge being formed with a V-shaped notch conformable to the shape of said V-shaped tongue, the tongues and notches on adjacent segments being adapted to interfit when the shell segments are assembled, a garter spring surrounding said shell adjacent said tongues and notches, the outer surface of said shell segments having protuberances thereon for gripping the wall of the recess, an expander ring nested within said outer shell and having a threaded longitudinal bore for receiving the stud, ribs on said ring adapted to extend into said splits to prevent relative rotation, the inner surfaces of said shell segments being formed with two longitudinally displaced zones including a forward end zone presenting a frusto-conical surface of short slant height and steep slant angle facing the rear of said shell, and a rear zone presenting an oppositely facing frusto-conical surface of long slant height and small slant angle, said expander ring being disposed within the longitudinal confines of said rear zone and movable axially in said zone for camming engagement with the frusto-conical surface of long slant height, a cup-shaped frusto-

conical combined stud seat and expander member disposed within the longitudinal confines of said forward zone and movable axially in said latter zone for camming engagement with the frusto-conical surface of short slant height, the rear concave face of said stud seat and expander member being designed for engagement with the forward end of said stud whereby, upon turning of the stud in one direction, said expander ring and expander member will be progressively moved away from each other in an axial direction, and interengaging means on said expander ring and shell for limiting the extent of forward movement of the expander ring within the shell while maintaining the position of said stud seat and expander member, said interengaging means comprising an inwardly extending post on each shell segment forwardly of the expander ring and adjacent the juncture of said oppositely facing surfaces, and a series of cooperating forwardly facing recesses on the expander ring adapted to receive said posts.

References Cited in the file of this patent

UNITED STATES PATENTS

710,534	Steward	Oct. 7, 1902
1,025,275	Kennedy	May 7, 1912
1,100,185	Kennedy	June 16, 1914
2,353,851	Rosan	July 18, 1944

FOREIGN PATENTS

62,549	Norway	June 10, 1940
538,709	Great Britain	Aug. 13, 1941
408,617	Italy	Jan. 4, 1945