

Feb. 27, 1951

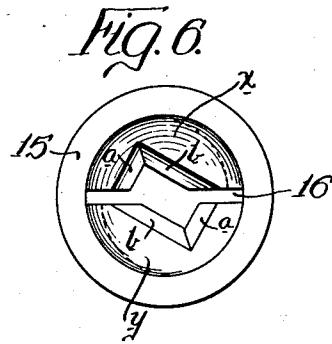
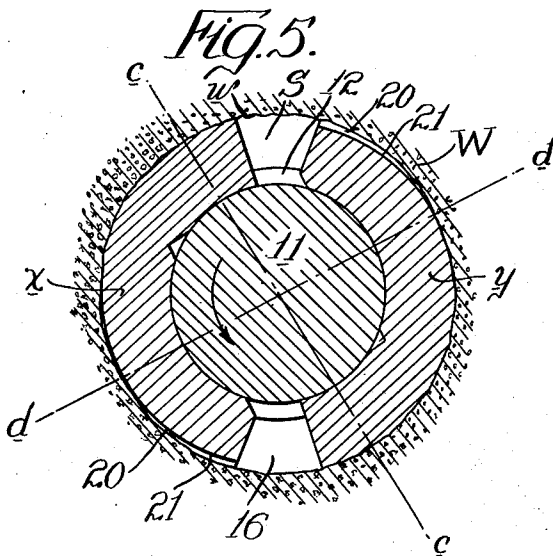
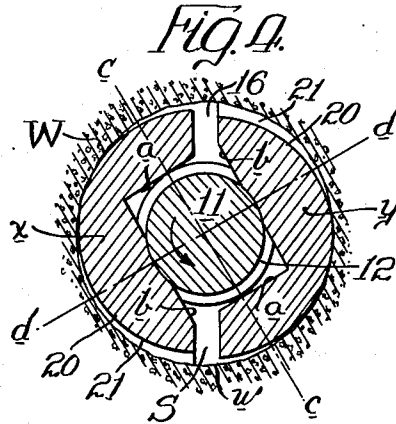
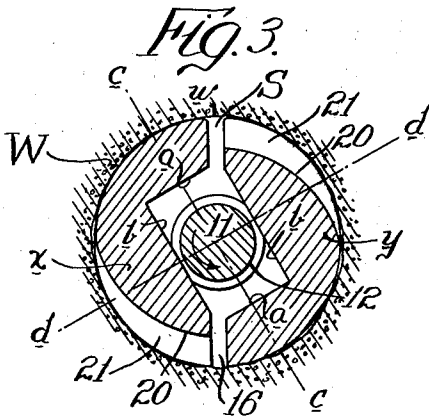
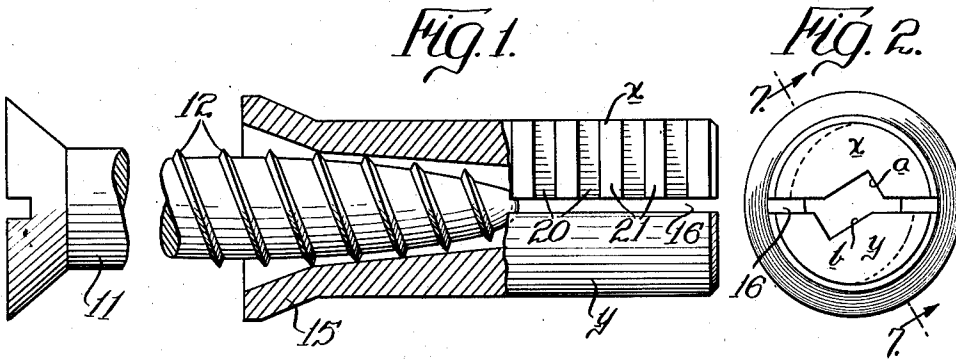
G. M. ARISMAN, JR

2,543,683

EXPANSION SHIELD

Filed June 7, 1949

2 Sheets-Sheet 1



INVENTOR.
George M. Arisman Jr.
BY *Wm. & Wm. C. C. Co.*
ATTY.

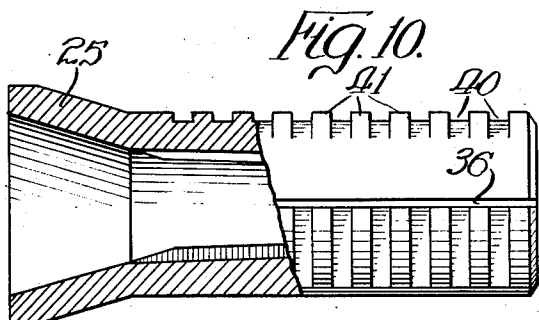
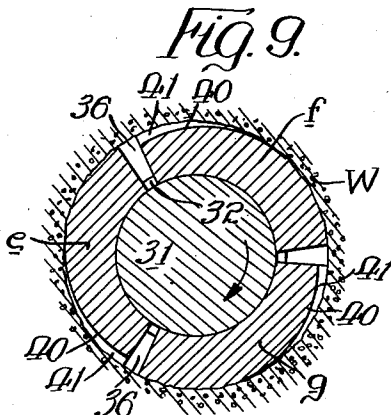
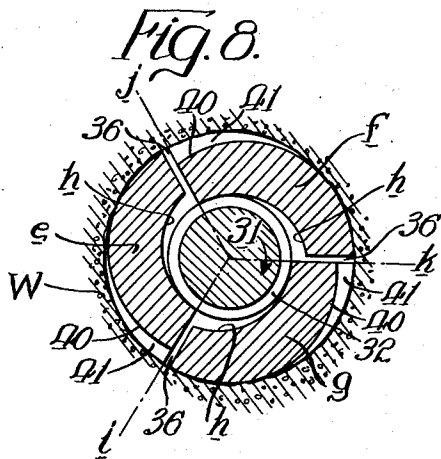
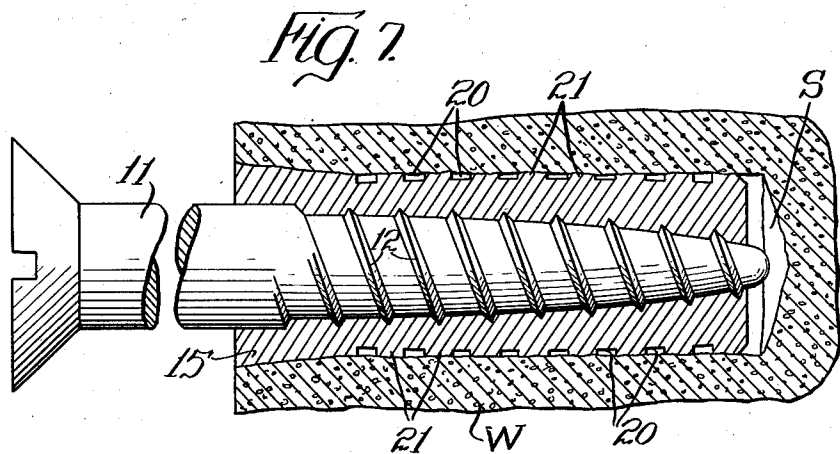
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EXPANSION SHIELD

2,543,683

Filed June 7, 1949

2 Sheets-Sheet 2



INVENTOR.
George M. Arisman Jr.
BY *Edmund & Edmund*
Attys:

UNITED STATES PATENT OFFICE

2,543,683

EXPANSION SHIELD

George M. Arisman, Jr., York, Pa., assignor to
U. S. Expansion Bolt Co., York, Pa., a corpora-
tion of Pennsylvania

Application June 7, 1949, Serial No. 97,620

10 Claims. (Cl. 85—2.4)

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This invention relates to an expansion shield of the type which employs separable segmental sections adapted to be pressed outwardly into tight engagement with the surrounding walls of a socket prepared for its reception in a structure of masonry or the like. To expand such a shield, a screw or bolt is commonly used, and the present device is particularly advantageous when operated by a so-called wood screw which at its forward end tapers toward a point, and which in the process of its axial advance within the shield cuts complementary threads in the interior surfaces of the separable segmental sections of the shield so as to engage firmly therewith.

The conventional anchoring means for applying wood screws to brick and masonry walls is to drill a socket into the masonry with a so-called star drill of the proper size and depth. A shield or sleeve of generally cylindrical configuration is then loosely fitted into this socket. The material commonly used for these shields is lead, plastic, fiber, wood, etc. Such a shield is formed with an inclined axial passageway through which a wood screw may be rotatively advanced while cutting coacting screw threads interiorly of the shield. As the screw continues to advance, the shield is expanded outwardly against the inside walls of the socket in the masonry, and this expansion or outward flowing of the material anchors the screw into the masonry wall.

It has been a common practice to use specific diameter shields for each size of wood screw and also to have various lengths in these specific diameters for the various combinations of wood screw lengths. This calls for a wide variation in both diameters and lengths, making it unduly expensive to manufacture and carry stock sizes for the many combinations.

It is, therefore, desirable to have a universal type of design which will be suitable for several diameters of wood screws of varying lengths. According to my invention this is accomplished by having the shield conform to the various size screws through the provision of external ribs or grooves which are distorted a small amount for the small screws and a greater amount for the larger screws. Of course, the greater distortion of the shield, the greater bearing pressure that is exerted on the sides of the socket in the masonry wall and the greater the holding pressure. The present anchoring shield, as hereinafter described, has several unique features, and test applications have proven it to be much more effective from the standpoint of holding strength

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than is offered by comparable devices now available.

Certain suggestive embodiments of this invention are set forth in the accompanying drawings wherein—

Figure 1 is a view in elevation, and partly in longitudinal section, showing one form of the shield, together with an associated wood screw, as they appear when assembled before use;

Fig. 2 is an elevation of the inner end of the shield;

Figs. 3, 4, and 5 are diagrammatic cross sectional views through the shield and its expanding wood screw shown in relation to a surrounding circular reference line indicating the socket walls against which the shield is expanded, the sections being taken in the same plane medially of the length of the shield and illustrating, respectively, an initial, an intermediate, and a substantially final stage in the advance of the wood screw and of the shield sections expanded thereby;

Fig. 6 is an elevation of the outer end of the shield;

Fig. 7 is a longitudinal sectional view through the shield as it appears when expanded within a socket prepared for its reception, the view being taken in the plane of line 7—7 of Fig. 2;

Fig. 8 which is a diagrammatic view similar to Fig. 3 illustrates a shield of modified form as it appears at an initial stage of its expansion;

Fig. 9 which is a view similar to Fig. 8, shows the shield segments expanded in response to axial advance of the screw; and

Fig. 10 is a view in elevation and partly in longitudinal section of the shield of Figs. 8 and 9.

As herein shown, the present shield is of one piece, being made of a material which is displaceable or deformable under pressure, such as lead, plastic, fiber, wood, etc. The shield is cylindrical in form, as is common, with a tapered axial passageway for reception of a so-called wood screw 11 which is convexly tapered to or toward a point and provided with threads 12 outstanding from its shank, these threads having capacity for cutting like complementary threads in the confronting interior faces of the shield walls, i. e. within the axial passageway where engagement therewith of the screw takes place. Whether the shield be of one piece or of two or more pieces secured together at the outer end, it is desirable that radially expansible segments be provided. This may be accomplished by slitting the shield longitudinally from its inner end to or toward its outer end, thereby to define two

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or more segments which are radially separable from each other in response to an outwardly exerted pressure originating from within the shield. This general description applies to many of the expansion shields heretofore known, but from this point on the several features of construction to be discussed in their relation to each other are novel, unique, and operative to produce greatly improved results.

The shield of one piece herein shown in two forms, by way of example, is provided with an outwardly flaring head 15 at its outer end, and from this point on to its inner end is slit diametrically at 16 to provide a pair of separable segmental sections *x* and *y* which at their outer ends are joined integrally to the head. The exterior surface of each segmental section is specially configured, each being grooved circumferentially and recurrently throughout the major portion of its length. Each groove 20 starts at one of the two slits 16, the depth of the groove decreasing progressively to zero which is reached at or about 90° distant from the starting point. The two quadrants thus grooved are disposed oppositely of each other. Approximately 180° of the shield surface is configured with recurrent grooves which define between them circumferential ribs 21 about 90° in length having outer faces which are curved substantially concentrically with the axis of the shield; the bases of these ribs, i. e. the grooves 20, are of increased depth toward the slits 16 so that the body of the shield is changed from a cylindrical configuration to one which approaches ellipticity (see Fig. 4). The two remaining quadrants exteriorly of the shield are non-grooved, i. e. smooth.

The axial passageway within the shield is also of novel configuration and specially related to the ellipticity of its body. Each segmental section *x* and *y* is formed interiorly with a transversely concave surface here shown as an angled groove having a throat at the outer end from which point it tapers inwardly toward the inner end of the shield. This groove comprises walls *a* and *b*, the former desirably shorter (transversely) than the latter, and each in substantially right angular relation to the other. The disposition of these groove walls is such that a diametric line *c—c* normal to the walls *a* will emerge upon the shield exterior in a quadrant thereof which is non-grooved and of full diameter, whereas a diametric line *d—d* normal to the walls *b* will emerge upon the shield exterior in a different quadrant thereof, i. e. one which is grooved and of lesser diameter. Because of the special interrelated configurations of the axial passageway and body ellipticity, it will be obvious that outward movement of the shield sections will proceed in a novel manner whenever expansion takes place.

In Figs. 3-5 there are presented certain diagrammatic views in which a circular reference line *w* represents the inside of a cylindrical socket *S* prepared in a wall *W* of masonry or the like for reception of the shield. As indicated in Fig. 3, the exterior contour of the shield is generally cylindrical, if the ribs 21 be considered in this connection, so as to conform to the usual cross sectional form of the socket *S*. But the quadrants wherein the ribs 21 are located are thereby rendered weaker than the remaining quadrants where the full diameter of the shield body has been preserved. It follows therefore that when an expander, such as a conventional wood screw 11, is rotatively advanced axially of the shield the segmental sections *x* and *y* will be out-

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wardly expanded from the initial position of Fig. 3 through the stage of Fig. 4 and then arrive at about the condition which is shown in Fig. 5. When expansion first starts, the primary force operating upon the segmental sections will be directed oppositely substantially along the line *d—d* against the walls *b* which are the closer (see Fig. 4). As resistance increases, the advancing screw, whose direction of rotation is shown by the arcuate arrows in Figs. 3-5, will move radially toward the further walls *a* and eventually exert a secondary expanding force in the direction of the line *c—c* as well. A tendency to shift one shield section into offset relation with the other (see Fig. 5) is thereby set up as the result of the component of the primary and secondary forces just referred to.

The displaceable material of which the shield is made will flow most readily in radial directions which intercept the ribs 21; in other words it is these ribs with intervening grooves 20 which will deform first, the shield body being pushed outwardly between the ribs, or the latter being flattened inwardly, or both, the effect being to somewhat smooth the exterior surface of the shield in these two quadrants, as represented in Fig. 7. It will be noted that these quadrants wherein maximum displacement takes place are radially opposite the walls *b* of the axial passageway, that these walls are disposed closer to the shield axis than the remaining walls *a*, and that the outwardly directed pressure originating from a screw advancing axially within the shield will accordingly be greatest against the walls *b*. This is the primary expansion force, and it operates in the direction of the quadrants which are weakest.

In the operation of expansion while the shield is confined within the socket *S* prepared for its reception, the advancing screw not only spreads the segmental sections radially apart, but also shifts them laterally of each other in the plane of the separating slits 16. This is due in part to (1) the advancing rotating screw exerting against each wall *b* a frictional force in the direction of the wall *a* of the other shield segment, and (2) the resultant expansive forces that are exerted against two adjacent sides of each shield segment *x* and *y* forming the four sides of the angled passageway which extends axially of the shield. The ribbed quadrants are, in consequence, crushed into the masonry wall; also the larger the screw used, the greater is this lateral crushing action of the ribs which are required to give way in order that space may be provided for the advancing screw. This lateral shifting movement is distributed evenly between the segmental sections whereby to produce a semi-rigid interlock of the ribs against the sides of the socket. As a result the shield becomes anchored very firmly whether a larger or a smaller screw be used, and is highly resistant to outward axial movement from the socket.

The construction thus far described is concerned with an expansion shield having but two segmental sections, but as shown in Figs. 8-10 it is feasible to modify the construction to provide three separable segmental sections *e*, *f* and *g* which may be joined to each other at or adjacent a flaring head 25. The exterior surface of each segment is grooved at 40 circumferentially and recurrently throughout the major portion of its length, each groove starting at one of the three longitudinal slits 36 separating two of the adjacent segments and decreasing progressively in depth to zero at a point which is at

or about 60° distant therefrom. Approximately 180° of the shield surface is configured with these recurring grooves which define between them circumferential ribs 41 about 60° in length having outer faces which are curved substantially concentrically with the axis of the shield. As a result of such a pattern of exterior configurations, three alternate sextants are grooved (and ribbed), the other three sextants being non-grooved, i. e. plain.

The axial passageway within the shield is also of novel configuration. Each segmental section *e*, *f*, and *g* is transversely concave on its interior face, the form here shown being an arcuate surface *h* tapering inwardly (and to a shorter arcuate length) toward the inner end of the shield. These arcuate surfaces are eccentric with respect to each other and to the shield axis, the several arcuate centers being located equidistantly from each other and from the shield axis as well. Each arcuate surface approaches the shield axis most closely at a point which lies proximate to a radial line *i*, *j*, or *k*, as the case may be, these three lines being spaced approximately 120° apart and in substantial coincidence with the sides of the slits 36 which are adjacent the deep end of the grooves 40.

An axial passageway answering to this description is adapted to receive an expander, such as a wood screw 31, and when advanced axially within the shield the threads 32 of such a screw will initially engage the arcuate surfaces at the close-in points which are adjacent the radial lines *i*, *j*, and *k*. Continued advance of the screw will result in its threads cutting complementary threads of constantly increasing length in the arcuate surfaces *h* against which the expanding forces are radially exerted. It will be noted that at the start these forces proceed only in the direction of the lines *i*, *j*, and *k*, but, with increase in the area of contact between the advancing screw and the opposing arcuate surfaces of the shield segments, there is a corresponding increase in the various directions wherein the expanding forces are operative until finally, as suggested in Fig. 9 where a final condition of expansion is indicated, the outward pressure is directed against substantially 100% of the interior arcuate surface of each shield segment.

In this operation of expansion, the outward thrust is greatest where the external configuration is weakest, i. e., where the grooves 40 are deepest and the ribs 41 are highest. As a result, the displaceable material of which the shield is made will flow most readily in these directions where the maximum deformation takes place. The ribs 41 with intervening grooves 40 will deform first, the shield body being pushed outwardly between the ribs, or the latter being flattened inwardly, or both, and the effect is to somewhat smooth the exterior of the shield in these three sextants, as suggested in Fig. 9.

It will be noted that the resultant forces which cause the present shield to be anchored in place are, in fact, a single component force which is much greater than the usual radial force that is operative in conventional shields of the present day. When a relatively small screw is used, the lateral movement or thrust against the ribs is less and the holding power of the anchored shield is also reduced, but with a relatively large screw the holding power is increased due to the lateral pressures exerted in the directions of the ribs and the enhanced flow of the shield material into the surface irregularities of the wall socket wherein

the shield is anchored. Stated otherwise, the present shield provides in its construction means having an enhanced displacement range wherein an effective anchorage is obtainable, whether or not such a displacement be within the capacity of a screw which is relatively large or small.

I claim:

1. An expansion shield of generally cylindrical form made of displaceable material and formed to provide a pair of opposed radially movable and laterally shiftable segmental sections separated from each other by a pair of aligned slits, each segmental section being recurrently grooved circumferentially through a quadrant which is opposite a like quadrant of the other section and adjacent one slit whereby to leave the adjacent quadrant non-grooved, the several grooves defining between them ribs which remain concentric with the shield axis, there being an axial passageway formed through the shield and tapering inwardly toward its inner end for reception of an operating screw therein, the interior face of each segmental section being formed with a longitudinally extending angle groove one side of which intercepts a radial line extending to its grooved quadrant exteriorly of the shield, the other side of the angle groove intercepting a radial line which extends to the non-grooved quadrant of the shield exterior, whereby in response to advance of a screw axially through the passageway an expansive force is exerted outwardly and in the direction of the grooved quadrants against each segmental section tending to press it outwardly with consequent displacement of the ribs thereof and also to shift each segment laterally with respect to the other section.

2. An expansion shield according to claim 1 in which the grooves progressively decrease in depth to the zero point at or adjacent the non-grooved quadrant.

3. An expansion shield according to claim 1 in which the longitudinally extending angle groove has its two sides of unequal cross sectional width, the wider one being the side which is intercepted by a radial line which extends to the grooved quadrant.

4. An expansion shield of generally cylindrical form made of displaceable material and formed to provide a pair of opposed radially movable and laterally shiftable segmental sections separated from each other by a pair of aligned slits, each segmental section being characterized by two quadrants upon its exterior face one of which is of full diameter and the other of which is of variable but less than full diameter and provided with spaced elements projecting therefrom for the full diameter distance, the full diameter quadrants being opposite each other, there being an axial passageway formed through the shield and tapering toward its inner end for reception of an operating screw therein, the interior face of each segmental section being formed with a longitudinally extending angle groove one side of which intercepts a radial line extending to its full diameter quadrant exteriorly of the shield, the other side of the angle groove intercepting a radial line which extends to the quadrant of variable diameter upon the shield exterior whereby, in response to advance of a screw axially through the passageway an expansive force is exerted outwardly and in the direction of the variable diameter quadrants, against each segmental section tending to press it outwardly and

also to shift it laterally with respect to the other section.

5 An expansion shield of generally cylindrical form made of displaceable material and formed to provide a plurality of radially movable segmental sections, each separated from those adjacent by a longitudinally extending slit, each segmental section being recurrently grooved eccentrically and circumferentially for a limited distance to one side of one adjacent slit to provide therebetween ribs of limited circumferential length which remain concentric with the shield axis, and there being an axial passageway formed through the shield for reception of an operating screw therein, the interior face of each segmental section being formed with a longitudinally extending angle groove one side of which intercepts a radial line extending to the ribbed area exteriorly of the shield, the other side of the angle groove intercepting a radial line which extends to a non-ribbed area of the shield exterior, whereby in response to advance of a screw axially through the passageway an expansive force is exerted outwardly and in the direction of the ribbed areas against each segmental section tending to press it outwardly with consequent displacement of the ribs thereof and also to shift each segment laterally with respect to the adjacent section.

6 An expansion shield of generally cylindrical form made of displaceable material and formed to provide a pair of opposed radially movable segmental sections separated from each other by intervening slits, each segmental section being characterized by two quadrants upon its exterior face one of which is of full diameter and the other of which is less than full diameter and provided with spaced elements projecting therefrom for the full diameter distance, the full diameter quadrants being opposite each other, there being an axial passageway formed through the shield and tapering toward its inner end for reception of an operating screw therein, the interior face of each segmental section being formed with a longitudinally extending transversely concave surface one side of which substantially intercepts a radial line extending to its full diameter quadrant exteriorly of the shield and the other side of which substantially intercepts a radial line extending to its quadrant of variable diameter upon the shield exterior whereby, in response to advance of a screw axially through the passageway, a primary expansive force is exerted outwardly in the direction of the variable diameter quadrants against each segmental section, tending to press it outwardly against the surrounding wall of a socket wherein the shield is placed.

7 An expansion shield of generally cylindrical form made of displaceable material and formed to provide three opposed radially movable segmental sections separated from each other by a like number of slits, each segmental section being characterized by two sextants upon its exterior face one of which is of full diameter and the other of which is less than full diameter and provided with spaced elements projecting therefrom for the full diameter distance, the full diameter sextants being opposite each other, there being an axial passageway formed through the shield and tapering toward its inner end for reception of an operating screw therein, the interior face of each segmental section being formed with a longitudinally extending transversely concave surface one side of which substantially in-

tercepts a radial line extending to the full diameter sextant exteriorly of the shield and the other side of which substantially intercepts a radial line extending to the sextant of variable diameter upon the shield exterior whereby, in response to advance of a screw axially through the passageway, a primary expansive force is exerted outwardly in the direction of the variable diameter sextants against each segmental section, tending to press it outwardly against the surrounding wall of a socket wherein the shield is placed.

8 An expansion shield of generally cylindrical form made of displaceable material and formed to provide a plurality of radially movable segmental sections separated from each other by intervening slits, each segmental section being characterized upon its exterior face by two circumferential areas one of which is of full diameter and the other of which is less than full diameter and provided with spaced elements projecting therefrom for the full diameter distance, the full diameter areas being opposite each other, there being an axial passageway formed through the shield and tapering toward its inner end for reception of an operating screw therein, the interior face of each segmental section being formed with a longitudinally extending transversely concave surface one side of which substantially intercepts a radial line extending to the full diameter area exteriorly of the shield and the other side of which substantially intercepts a radial line extending to the area of variable diameter upon the shield exterior whereby, in response to advance of a screw axially through the passageway, a primary expansive force is exerted outwardly in the direction of the variable diameter areas against each segmental section, tending to press it outwardly against the surrounding wall of a socket wherein the shield is placed.

9 An expansion shield of generally cylindrical form made of displaceable material and formed to provide a plurality of radially movable segmental sections separated from each by intervening slits, each segmental section being characterized upon its exterior face by two circumferential areas one of which is of full diameter and the other of which is of less than full diameter and provided with spaced elements projecting therefrom for the full diameter distance, the full diameter areas being opposite each other, there being an axial passageway formed through the shield and tapering inwardly toward its inner end for reception therein of an operating screw, the interior of each segmental section being formed with longitudinally extending plural faces confronting the shield axis and at unequal distances therefrom, the nearer faces lying opposite the areas of projecting elements exteriorly of the shield whereby, in response to advance of a screw axially through the passageway, an expansive force is exerted sequentially upon the nearer and then the remoter interior shield faces to press the segmental sections outwardly with maximum displacement thereof in the areas of projecting elements exteriorly of the shield.

10 An expansion shield of generally cylindrical form made of displaceable material and provided therethrough with an axial passageway tapering inwardly toward its inner end for reception therein of an operating screw, the interior of the axial passageway being formed with lengthwise faces which are disposed alternately at distances closer to and further from the axis

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of the shield, and the body of the shield at separated lengthwise points opposite the closer-in faces being radially discontinuous transversely of the shield exteriorly thereof and at separated lengthwise points opposite the further-out faces being radially continuous transversely of the shield exteriorly thereof whereby to provide in alternation lengthwise displaceable areas which are relatively weak and strong, the arrangement being such that a screw advancing axially within the passageway toward the inner end of the shield will exert an outwardly radial expansive force initially in the directions of the weak areas thereof and sequentially in the directions of the strong areas thereof.

GEORGE M. ARISMAN, JR.

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