United States Patent [19]

Scott

[11] **3,922,867**

[45] **Dec. 2, 1975**

[54] **FRICTION ROCK STABILIZERS**

[76] Inventor: **James J. Scott,** Lecoma Star Rte., Rolla, Mo. 65401

[22] Filed: **Nov. 4, 1974**

[21] Appl. No.: **520,310**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 430,695, Jan. 4, 1974, which is a continuation-in-part of Ser. No. 330,954, Feb. 9, 1973, abandoned.

[52] **U.S. Cl.** .... **61/45 B;** 61/63

[51] **Int. Cl.²** **E21D 21/00;** E21D 20/00

[58] **Field of Search** .... 61/45 B, 45 R, 63; 85/84, 85/32.1, 80, 8.3

[56] **References Cited**

UNITED STATES PATENTS

2,006,813	7/1935	Norwood	85/84 X
2,240,425	4/1941	Sternbergh	85/84 X
2,246,888	6/1941	Messenger	85/84
2,430,543	11/1947	Tinnerman	85/84 X
2,448,351	8/1948	Brush	85/84
2,648,247	8/1953	Schmuziger	85/8.3
2,754,716	7/1956	Bourns	85/8.3
3,157,417	11/1964	Ruskin	85/84 UX
3,187,620	6/1965	Fischer	85/84 X
3,349,567	10/1967	Munn	61/45 B
3,630,261	12/1971	Gley	85/8.3 X

FOREIGN PATENTS OR APPLICATIONS

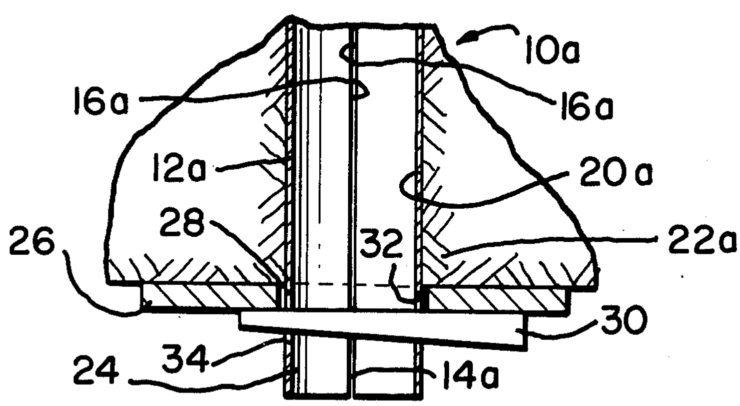
1,443,392	5/1966	France	61/45 B
825,003	12/1959	United Kingdom	61/45 B
1,028,664	5/1966	United Kingdom	85/84

Primary Examiner—Dennis L. Taylor
Attorney, Agent, or Firm—Robert R. Paquin

[57] **ABSTRACT**

Friction rock stabilizers such as for example roof anchors, comprising a generally annular body which from end-to-end has a slot through its thickness and is circumferentially compressible for installation into a bore of diameter substantially smaller than the normal outer diameter of the body whereby, after such installation, the resilience of the body causes the body outer periphery to anchor by frictional engagement with the surrounding wall of the bore. Also, an anchoring method employing a stabilizer of this type.

7 Claims, 5 Drawing Figures



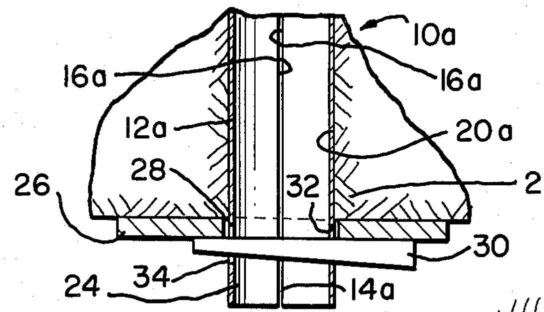


FIG. 5

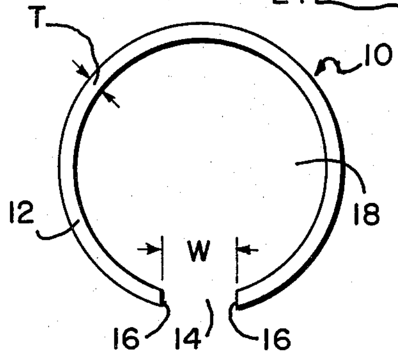


FIG. 2

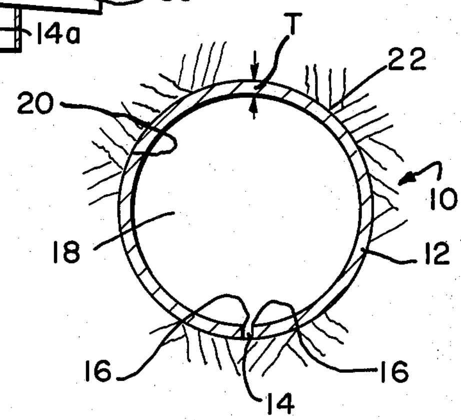


FIG. 4

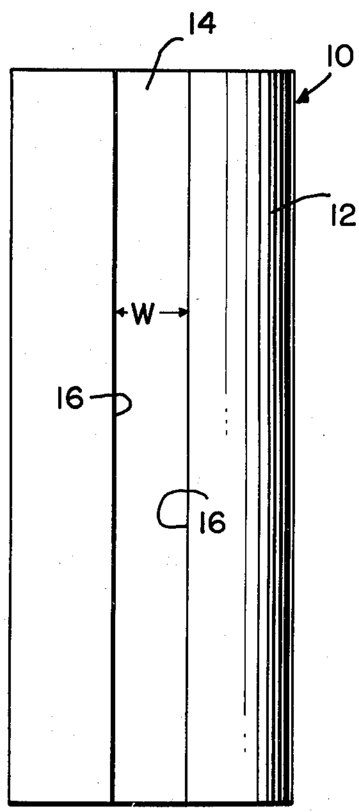


FIG. 1

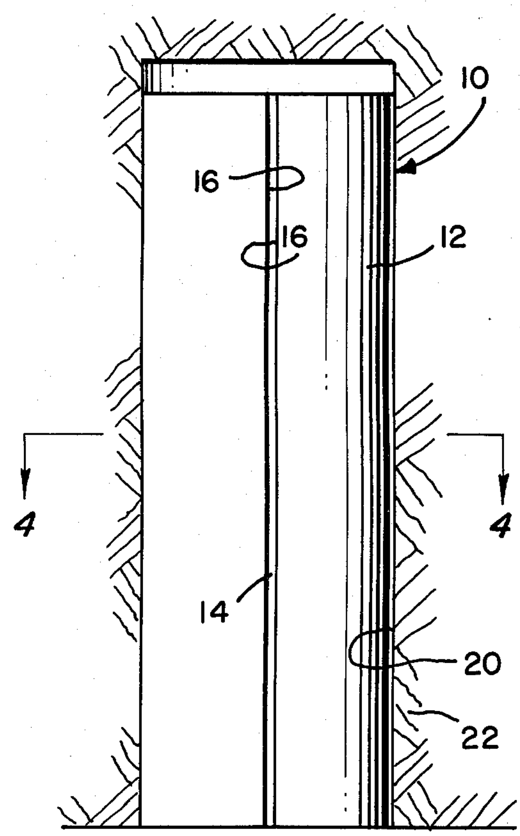


FIG. 3

FRICTION ROCK STABILIZERS

This is a Continuation-in-Part of my U.S. Pat. Application Ser. No. 430,695 filed Jan. 4, 1974 which is a Continuation-in-Part of my U.S. Pat. Application Ser. No. 330,954 filed Feb. 9, 1973, now abandoned.

The present invention relates to the anchoring of a structure such as a roof or side wall of a mine shaft or other underground opening, and more specifically to the provision of new and improved friction rock stabilizers and stabilizing methods particularly adapted for such anchoring.

An object of the present invention is to provide new and improved friction rock stabilizers which are highly efficient in operation while relatively simple and economical in construction.

Another object of the invention is to provide new and improved stabilizing methods particularly adapted to provide highly efficient anchoring through the employment of a stabilizer which is relatively simple and economical in construction.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein, as will be understood, the preferred forms of the invention have been given by way of illustration only.

In accordance with the invention, a friction rock stabilizer may comprise a generally annular body from end-to-end having a slot through its thickness, the body including edge portions extending along opposite sides of such slot and the width of the slot being sufficiently great to space apart such edge portions a distance permitting substantial circumferential compression of the body for insertion thereof in a bore of diameter smaller than the outer diameter of the body in uncompressed condition, the anchor being free of structure precluding such substantial circumferential compression of the body, and the body being of material permitting its said substantial circumferential compression for insertion in such a bore and, after such insertion, causing the body outer periphery to frictionally engage the surrounding wall of the bore for anchoring a roof.

Also, in accordance with the invention, a structure such as a roof or side wall of a mine shaft or other underground tunnel may be anchored by a method which may comprise the steps of forming a bore in the structure to be anchored, providing a circumferentially compressible stabilizer having an outer periphery of a diameter larger than that of the formed bore, and inserting the stabilizer into the bore whereby the stabilizer is circumferentially compressed and the outer periphery of the circumferentially compressed stabilizer frictionally engages the wall of the bore.

Referring to the drawings:

FIG. **1** is an elevational side view of one stabilizer constructed in accordance with the present invention;

FIG. **2** is a top or plan view of the stabilizer illustrated in FIG. **1;**

FIG. **3** is an elevational side view showing the stabilizer of FIG. **1** in operative position in a bore formed in the roof of a mine shaft or other underground opening;

FIG. **4** is a sectional view of the stabilizer as shown in FIG. **3,** taken on Line **4—4** of FIG. **3** looking in the direction of the arrows; and

FIG. **5** is a fragmentary, elevational sectional view of a second stabilizer constructed in accordance with the invention showing such in a bore in the roof of a mine shaft or other underground opening.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, FIGS. **1** and **2** illustrate a friction rock stabilizer, designated generally as **10,** which, although relatively simple and economical in construction, is highly efficient in anchoring a structure such as a roof or side wall of a mine shaft or other underground opening. As shown in such Figs., the stabilizer **10** consists of an elongated, generally annular, open-ended body **12** having a single, longitudinally extending, straight-slot **14** formed through its radial thickness T from end-to-end, or throughout the length, of the body **12.** The body **12** is imperforate, cylindrical and of constant outer diameter from end-to-end, the ratio of the length of the body **12** to the outer diameter thereof being at least a minimum of about **16** to **1** and preferably of about **32** to **1** or **48** to **1** although such longer stabilizers could be formed of interconnected sections each of **16** to **1** ratio or greater. The opposite longitudinal sides of the slot **14** are defined by opposed longitudinally extending edge portions **16** of the body **12;** and the circumferential dimension or width W of the slot **14,** with the body **12** in uncompressed condition, is sufficiently great to space apart the edge portions **16** a circumferential distance permitting substantial circumferential compression of the body **12** for insertion thereof in a bore of diameter substantially smaller than the outer diameter of the body **12.** The outer circumferential dimension of the body **12,** not including the width W of the slot **14,** is greater than about 2 inches; and the width W of the slot **14** is no greater than a maximum of about 25 percent of the overall outer circumferential dimension of the stabilizer **10**—that is, no greater than about 25 percent of the complete annulus formed by the body **12** and slot **14.**

The body **12** is constructed of steel, thus permitting its substantial circumferential compression for insertion in such a substantially smaller diameter bore and, after such insertion, causing the body outer circumference to frictionally engage the surrounding wall of the bore for anchoring a structure such as the roof of a mine shaft. Also, as will be noted, the anchor **10** is entirely free of structure precluding such substantial circumferential compression of the body **12,** the interior **18** of the body **12** being open or empty. The outer diameter of the body **12** of the stabilizer **10** for any given size bore is pre-determined to be substantially larger than the diameter of the bore, but such that the edge portions **16** of the body **12** will be abutting, or spaced apart by only a relatively small gap, with the stabilizer **10** installed in the bore. The ratio of the radial thickness T of the body **12** to the body outer diameter is no greater than a maximum of about **1** to **5** and no less than a minimum of about **1** to **50,** thereby permitting plastic deformation of the body **12** during its insertion in the bore; and, although the body **12** has been shown as being of constant outer diameter from end-to-end, the outer diameter of the body forward or leading end could be of lesser outer diameter than the remainder of the body **12** to facilitate said insertion.

FIGS. **3** and **4** illustrate the stabilizer **10** of FIGS. **1** and **2** in installed condition in a pre-drilled bore **20** in a roof **22** to be anchored thereby. During such insertion, the body **12** of the stabilizer **10** is deformed plastically (that is, deformed in the plastic range) to a condition whereby

$$\frac{\Delta}{D} \times \frac{t}{D} > .84 \frac{\sigma y}{E}$$

Δ— being the difference between the outer diameter of the body **12** before insertion and the outer diameter of the body **12** after insertion,

D — being the outer diameter of the body **12** before insertion,

t — being the radial thickness of the body **12**,

E — being Young's Modulus, and

σy — being the yield stress of the material. As shown, the outer circumference of the body **12** of the installed stabilizer **10** frictionally engages the surrounding wall of the bore **20** throughout the length of the body **12**; and the stabilizer **10** anchors by this frictional engagement of the outer circumference of the body **12** with the wall of the bore **20**. The body outer circumference may, of course, be epoxy coated, roughened or otherwise constructed to enhance its frictional engagement with the bore wall; and, as illustrated, the body **12** of the stabilizer **10** is of a length to extend substantially the entire length of the bore **20**. The pull-out force of the installed stabilizer **10** is somewhat greater than the installation or push-in force applied to the stabilizer, thereby enabling such pull-out force to be predetermined by knowledge of the applied push-in force.

FIG. **5**, wherein parts similar to those shown in FIGS. **1** through **4** are designated by the corresponding reference numerals followed by the suffix *a*, fragmentarially illustrates a friction rock stabilizer **10*a*** which is different from the stabilizer **10** only in that it further includes means for tensioning the body **12*a*** after its insertion into the bore **20*a***. More particularly, as shown in FIG. **5**, the body **12*a*** of the stabilizer **10*a*** is inserted into the bore **20*a*** such that a minor portion **24** (for example, a few inches) of the length of the body **12*a*** is external to the bore **20*a***. The stabilizer **10*a*** includes a plate **26** having a central opening **28** receiving the body **12*a***, the plate **26** being mounted along the lower surface of the roof **22*a***; and the stabilizer **10** further includes a wedge pin **30** inserted through aligned openings **32, 34** in the body **12*a*** immediately beneath the plate **26** to tension the body **12*a*** after its insertion into the bore **20*a***.

If desired, either of the stabilizers **10, 10*a*** could be provided with a wedge, per se of any suitable configuration, which is inserted into the innermost or leading end of its body **12, 12*a*** after the body **12, 12*a*** has been installed in its bore **20, 20*a*** in the beforedescribed manner. Neither of the stabilizers **10, 10*a***, however, requires such a wedge; and both of the stabilizers **10, 10*a*** will provide highly efficient and safe anchoring without a wedge. Moreover, in the event that a wedge is employed with either of the stabilizers **10** or **10*a***, it must be disposed during the insertion of the stabilizer body **12** or **12*a*** into its bore **20** or **20*a*** to preclude it from interference with the beforedescribed substantial circumferential compression of the body **12** or **12*a*** occurring during such insertion.

The methods of the invention may, generally considered, comprise the steps of forming a bore **20** in the structure to be anchored, providing a circumferentially compressible stabilizer **10** having an outer circumference of a diameter larger than that of the formed bore **20**, and inserting the stabilizer **10** into the bore **20** whereby the body of the stabilizer **10** is circumferentially compressed during such insertion, thereby at least substantially closing the slot **14**, and the outer circumference of the circumferentially compressed body **12** frictionally engages the wall of the bore **20** for anchoring the structure.

From the preceding description, it will be seen that the invention provides new and improved stabilizers and methods, for attaining all of the aforestated objects and advantages. It will be understood, however, that although only two embodiments of the invention have been illustrated and hereinbefore described, the invention is not limited merely to these two embodiments, but rather contemplates other embodiments and variations within the scope of the following claims.

I claim:

1. A friction stabilizer for insertion in a bore in a structure such as a roof or side wall of a mine shaft or other underground opening for anchoring the structure, said stabilizer comprising a generally annular body from end-to-end having a slot through its thickness, said body including edge portions extending along opposite sides of said slot and relatively arranged to permit substantial circumferential compression of said body, said body being of outer diameter predetermined to be substantially larger than the diameter of the bore in which it is to be inserted such that insertion of said body in such bore causes substantial circumferential compression of said body, said body being dimensioned to be plastically deformed during its insertion in such bore, the stabilizer being free of structure precluding said substantial compression and plastic deformation of said body during its said insertion, said body being of material permitting its said substantial compression and plastic deformation during its said insertion and, after such insertion, causing the body outer periphery to frictionally engage the surrounding wall of the bore for frictionally anchoring the structure, the ratio of the length of said body to the outer diameter thereof being at least about 16 to 1, the ratio of the radial thickness of said body to the outer diameter thereof being at a maximum about 1 to 5 and at a minimum about 1 to 50, and the outer circumferential dimension of said body being at least two inches.

2. A friction stabilizer according to claim **1**, wherein the circumferential width of said slot is at a maximum about 25 percent of the outer circumferential dimension of said body.

3. A friction stabilizer according to claim **1**, wherein the outer periphery of said body is at least substantially imperforate.

4. A friction stabilizer according to claim **1**, wherein said slot is straight from end-to-end of said body.

5. A friction stabilizer according to claim **1**, wherein the interior of said body is open.

6. A friction stabilizer according to claim **1**, further comprising means for tensioning said body after its insertion in a bore.

7. A friction stabilizer according to claim **1**, further comprising wedge means movable internally of an end of said body.

* * * * *