Dec. 7, 1954 E. M. THOMAS ET AL 2,696,137

MULTICONTACT ROOF REINFORCER OR ANCHOR

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Fig. 1.

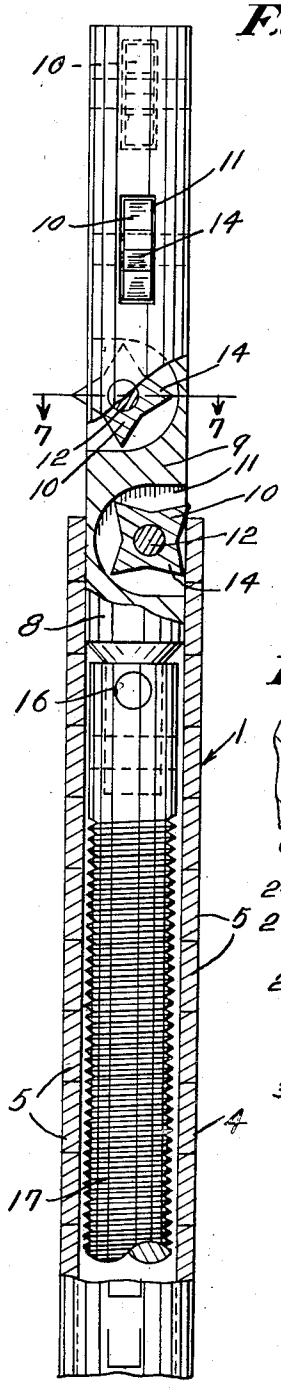


Fig. 2.

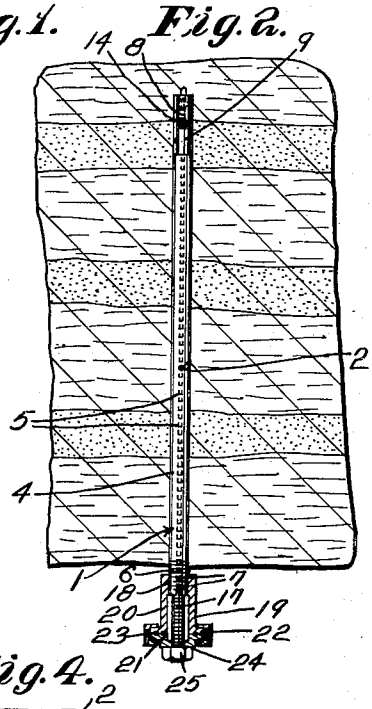


Fig. 3.

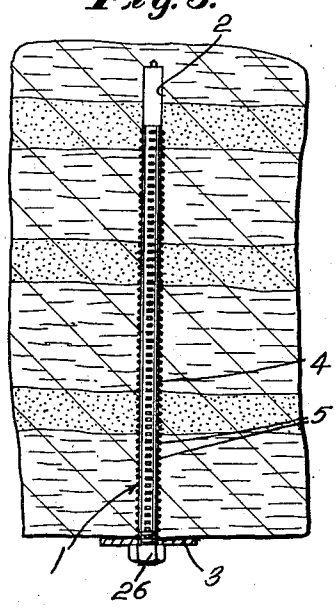


Fig. 4.

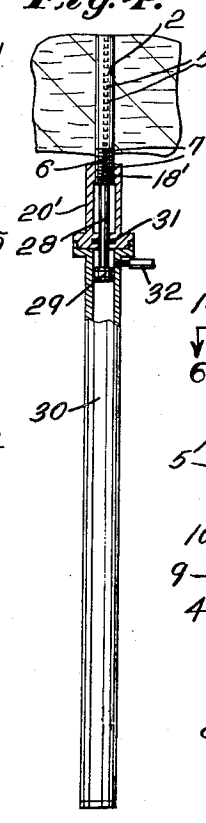


Fig. 5.

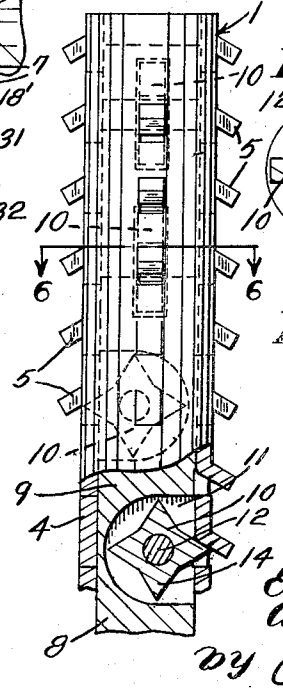


Fig. 6.

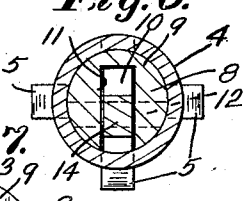


Fig. 7.

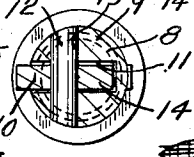
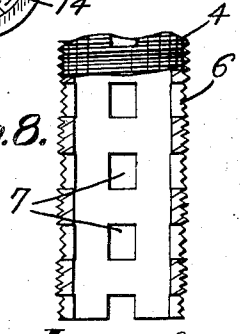


Fig. 8.



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Fig. 9.

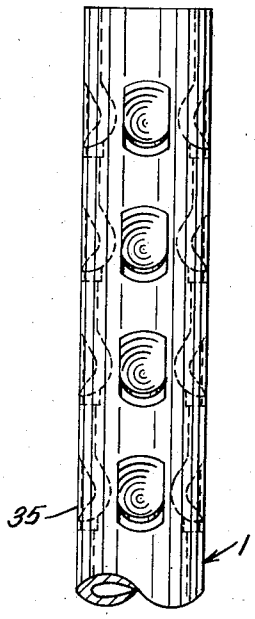


Fig. 10.

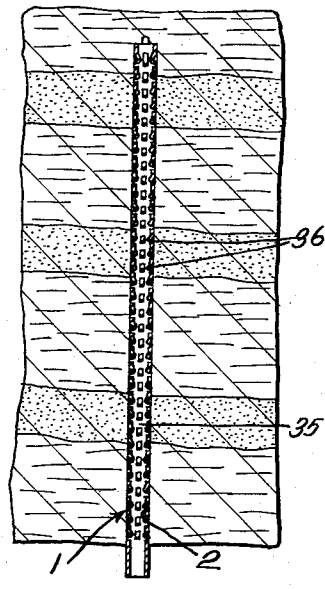


Fig. 11.

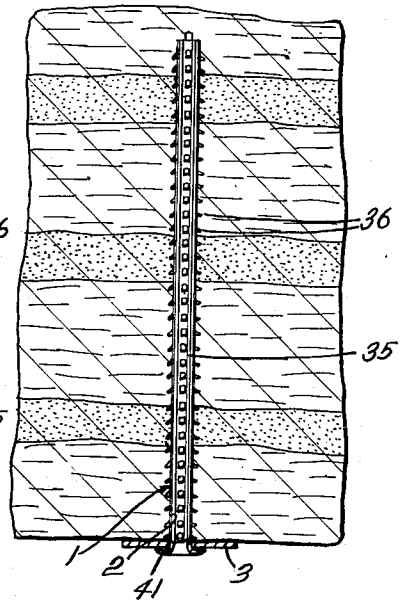


Fig. 12.

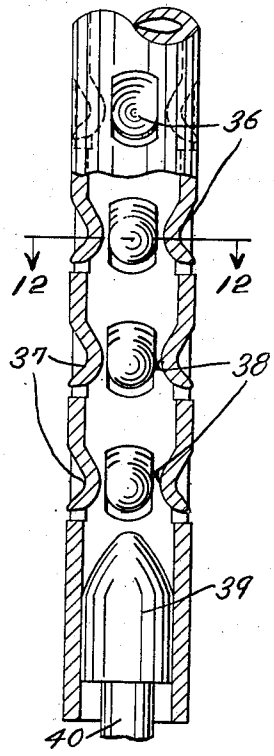


Fig. 12a.

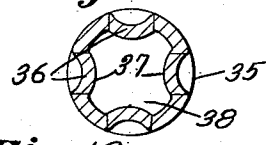


Fig. 13.

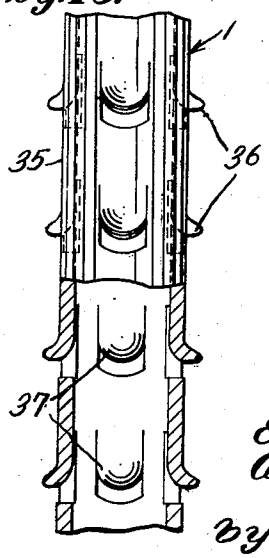


Fig. 14.

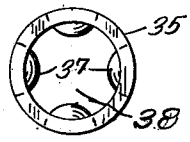
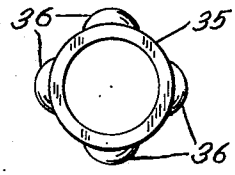


Fig. 15.



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MULTICONTACT ROOF REINFORCER OR ANCHOR

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Application October 15, 1949, Serial No. 121,611

3 Claims. (Cl. 85—2)

This invention relates to suspension type roof supports and particularly to roof anchors insertable in holes drilled in the roof strata for binding the strata together to minimize flexure and thus prevent rock failure, thereby eliminating the necessity of conventional external timbering.

In internally supporting the roof of a mine passageway or other underground working, expansible anchor bolts are usually set in holes drilled in the roof strata and engage cross beams or bearing plates for holding the latter in supporting position against the roof, thereby to bind the strata together to prevent rock failure. In known types of roof anchors there is a possibility of slippage of the anchors in the holes due to the comparatively small surface contact of the expansible anchor heads with the walls of the holes so that the supports are sometimes torn loose presenting the danger of roof-falls or cave-ins. The present invention contemplates improvements over such known types of roof anchors in that an improved anchor structure is provided which engages the walls of the hole in the roof strata at numerous points substantially along the entire length of the anchor so that slippage or tearing loose of the anchor is substantially avoided. The anchor bolt of the present invention is of tubular form substantially fitting the hole drilled in the roof strata and has numerous laterally bendable or expansible portions along substantially its entire length, and such portions are bendable outwardly by expander means movable axially within the tube, into firm gripping engagement with the hole walls. The expander means of the present invention comprises a spreader tool which may be moved axially through the tube to distend the bendable portions in an easy and expeditious manner. The anchor bolt of the present invention not only firmly grips the hole walls along substantially the entire length of the hole but is also comparatively simple and rugged in design, well adapted for the purpose for which it is intended.

It is accordingly a primary object of the present invention to provide an improved suspension type roof support for mine passages or other subterranean excavations whereby the roof strata is rigidly supported with little possibility of the supports slipping or becoming torn loose. Another object is to provide an improved anchor bolt structure which may be inserted in a hole drilled in the roof strata and which is provided with expansible portions spaced along its length for firmly engaging the walls of the hole whereby the possibility of slippage of the anchor in the hole is substantially avoided. Yet another object is to provide an improved anchor bolt of tubular form having series of laterally bendable portions or fingers spaced circumferentially along substantially its entire length whereby the hole walls may be firmly gripped at numerous points. A further object is to provide an improved expander or spreader means movable axially within the tubular bolt for bending or spreading the bendable portions or fingers laterally into firm engagement with the walls of the hole. A still further object is to provide an improved anchor bolt structure insertable in a hole drilled in the roof strata for firmly binding the strata together to minimize flexure thereby to prevent rock failure and resultant roof-falls. Yet another object is to provide an improved multicontact roof reinforcing member or anchor. A still further object is to provide an improved tubular roof reinforcing element comprising a tubular body having series of gripping teeth integral with its walls and which are laterally bendable into gripping engagement with the hole walls substantially along its entire length. Another object is to provide an improved spreader means

comprising a series of toothed spreader wheels so arranged and mounted that when the spreader is moved axially within the anchor tube the gripping teeth are forced outwardly into firm gripping engagement with the walls of the hole. A still further object is to provide an improved tubular roof reinforcing member having a series of laterally bendable portions along substantially its entire length and which are shaped to provide a series of restrictions spaced longitudinally within the tube and which are bendable outwardly when an expander tool is moved axially within the tube into engagement with the restrictions. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration several forms and modifications which the invention may assume in practice.

In these drawings:

Fig. 1 is a central longitudinal sectional view taken through an illustrative form of the improved roof anchor and showing the associated spreader tool.

Fig. 2 shows a section of roof strata with the anchor of Fig. 1 inserted in a hole drilled in the strata, with the actuator for the spreading tool attached to the lower end of the anchor.

Fig. 3 is a view similar to Fig. 2 showing the anchor in its expanded roof supporting position, in engagement with a bearing plate.

Fig. 4 is a sectional view showing a modified form of spreader-actuator attached to the anchor tube.

Fig. 5 is a sectional view taken on the plane of Fig. 1 showing the upper portion of the anchor tube with some of its gripping teeth in distended position, with the spreader tool shown passing through the tube.

Fig. 6 is a cross sectional view taken on line **6—6** of Fig. 5.

Fig. 7 is a cross sectional view, taken on line **7—7** of Fig. 1, illustrating one of the spreader wheels.

Fig. 8 is a detail view of the threaded lower end portion of the anchor tube.

Fig. 9 is a view similar to Fig. 1 showing a modified form of anchor tube and spreading tool.

Fig. 10 shows a section through the roof strata showing the anchor tube of Fig. 9 inserted in a hole in the strata, prior to anchoring of the tube.

Fig. 11 is a view similar to Fig. 10 showing the anchor tube in anchored roof supporting position, in engagement with a bearing plate.

Fig. 12 is a cross sectional view, taken on line **12—12** of Fig. 9, showing the anchor-teeth in contracted position.

Fig. 13 is a fragmentary side view of the tube shown in Fig. 9 with the gripping teeth in distended anchoring position.

Fig. 14 is an end view of the tube shown in Fig. 9 with the gripping teeth in contracted position.

Fig. 15 is an end view of the tube shown in Fig. 13 with the gripping teeth in distended position.

In both illustrative embodiments of the suspension type supports for the roof of a mine passageway or tunnel, the roof reinforcers or anchors, which are of the multi-contact type, are generally designated **1** and are inserted in upright holes **2** drilled in the roof strata, and the anchors when in expanded anchored position in the holes may engage bearing plates **3** to hold the latter firmly in supporting position against the roof. The expansible anchors function to bind the roof strata together to minimize flexure and thus prevent rock failure. Under certain conditions the bearing plates may be omitted and the lower ends of the anchors may directly engage the roof and also, instead of the individual bearing plates, the anchors may engage continuous plates or cross beams at points along the length of the latter. The holes drilled in the roof strata may be vertically disposed as shown or may be relatively inclined or located in any desired manner to suit the particular conditions encountered.

Now referring to the embodiment shown in Figs. 1 to 8 inclusive it will be noted that the improved roof reinforcer or anchor bolt is in the form of an elongated cylindrical sleeve or hollow tube **4** of substantially uniform bore which is shaped to fit closely the walls of the hole. The tubular body of the anchor bolt may be

formed as by rolling, pressing, forging or otherwise so that numerous laterally bendable fingers or gripping teeth 5, arranged in separated relation in vertical rows along substantially the full length of the tube, are provided. The gripping teeth are desirably arranged in four equally spaced longitudinal rows and normally lie flush with the exterior walls of the tube but when expanded move outwardly from the tube walls to embed themselves in the walls of the hole as later explained. The lower end portion of the tube is externally threaded at 6 and at this threaded portion some of the gripping teeth are omitted to provide apertures 7 (Fig. 8).

A spreader tool 8 may be used in conjunction with the anchor tube for distending the finger-like portions or teeth 5, and, in this instance, this tool comprises an elongated cylindrical body 9 having toothed spreader wheels 10 which are arranged in staggered relation on the body and project outwardly from the body walls at a plurality herein desirably four equally spaced points so that they may assume alignment with the four rows of distendable teeth of the anchor tube. The body 9 is recessed at 11 to receive the wheels and short shafts or supporting pins 12 are secured in transverse bores 13 in the body and provide journals for the toothed wheels. Each wheel is desirably formed with a plurality herein desirably four equally spaced teeth 14 which may project outwardly from the body as the wheels are rotated and the teeth are so arranged on the body and are so proportioned that all of the wheel teeth cannot be passed through the bore of the anchor tube without some distortion of the tube. Attached at 16 to the lower end of the spreader tool is a screw threaded shaft or rod 17 which may extend axially within the anchor tube as shown in Fig. 1. Attachable at 18 to the lower threaded end 6 of the anchor tube is an actuator or puller device 19 for the spreader tool. This device has a casing 20 threaded on the anchor tube and a rotatable bottom plate 21 held in position by a retaining collar 22 and mounted to turn on bearings 23. The rod 17 extends axially through the casing 20 and downwardly through a hole 24 in the rotatable plate 21 and a nut 25 threaded on the lower end of the rod bears against this rotatable plate so that when the nut is rotated the rod 17 is drawn downwardly to pull the spreader tool axially through the anchor tube. As the spreader tool is moved downwardly the teeth of the spreader wheels engage and punch out the finger-like portions 5 into anchoring relation with the walls of the hole, as later explained.

The hole 2 is drilled vertically in the roof strata to a depth of somewhat greater length than the effective one length of the anchor and the spreader tool is inserted in the upper end of the tubular body 4 of the anchor and moved upwardly in the hole by the anchor tube to the position shown in Fig. 2 with the upper end of the tool body 9 engaging the hole bottom in the manner shown. The threaded rod 17 extends from the anchor tube downwardly from the bottom thereof and the casing 20 of the puller device is threaded on the lower end of the anchor tube. The nut 25 is then threaded on the lower end of the rod 17 and when rotated the rod is drawn downwardly to pull the spreader device axially through the anchor tube. The teeth of the wheels 10 bear against the bendable fingers or teeth 5 of the anchor tube to press the teeth outwardly into firm gripping engagement with the walls of the hole thereby to anchor the tube in intimate contact with the strata along substantially the full length of the hole. As above mentioned, the last few teeth at the bottom of the tube are omitted to provide the apertures 7 so that the teeth of the spreader wheels may freely pass through the lower threaded end of the tube to which the puller device is attached. The puller device may then be detached from the anchor and the spreader tool removed. Evidently, the spreader tool may be pushed upwardly within the anchor tube instead of being drawn downwardly through the tube, if desired. When the puller device is detached the bearing plate 3 may be placed over the lower end of the anchor tube and a nut 26 may be threaded on the tube and when the nut is tightened the plate is firmly clamped in supporting position against the roof as shown in Fig. 3.

In Fig. 4 a modified form of puller device is shown which is actuated by pressure fluid, as for example liquid under pressure or a gaseous fluid such as compressed air. In this construction a casing 20' is threadedly attached at 18' to the lower end of the anchor tube and a rod 28 attached to the spreader tool extends downwardly through this casing and has secured to its lower end a piston 29 contained in a cylinder 30. This casing carries a packing 31 sealingly engaging the rod periphery to prevent fluid leakage and a supply pipe 32 is attached to the upper end of the cylinder. When fluid under pressure is supplied to the upper end of the cylinder bore above the piston 29 the latter is forced downwardly in the cylinder thereby drawing the spreader tool downwardly through the anchor tube to effect spreading of the anchoring tooth into contact with the hole walls. Suitable pressure release vents may be provided at appropriate locations in the cylinder to limit the travel of the piston 29 in a well-known manner. Under certain conditions the piston of the puller device may be actuated by an explosive charge released in the upper end of the cylinder 30 above the piston 29.

In Figs. 9 to 15 inclusive a modified form of roof anchor bolt is shown. In this embodiment the anchor comprises an elongated cylindrical sleeve or hollow tube 35 which is of substantially uniform bore and adapted to fit closely the hole, and this tube is formed as by rolling, pressing, forging or otherwise so as to provide laterally bendable finger-like portions or gripping teeth 36. These gripping teeth are formed within the walls of the tube and are arranged in separate rows along substantially the entire length of the tube and when contracted desirably lie flush with the exterior periphery of the tube-body as shown in Fig. 9. The teeth are arcuately bent inwardly at 37 within the tube bore to provide a series of axially spaced constrictions 38 within the tube.

The anchor tube, in use, may be inserted in the hole 2 drilled in the roof strata with its body tightly fitting the hole walls as shown in Fig. 10. A snub-nosed tool 39 which may be in the form of a projectile, slug, or rod may be inserted in the lower end of the anchor tube and shoved upwardly through the constrictions of the tube to distend the gripping teeth laterally into firm engagement with the walls of the hole. The tool 39 may be actuated mechanically as by a rod 40 (Fig. 9) or by a power device such as disclosed in Fig. 4 of the embodiment above described. The tool 39 instead of being pushed upwardly through the tube may be pulled downwardly through the tube, if desired. When the anchor tube is firmly anchored in the hole the tool 39 may be removed and the bearing plate 3 may be placed over the projecting lower end of the tube and the bottom of the tube may be crimped or headed-over at 41 against the plate as shown in Fig. 11 to secure the plate firmly in supporting position against the roof.

As a result of this invention an improved suspension type roof support is provided for mine passageways or other underground workings whereby the roof strata may be rigidly supported without the use of conventional external timbering. By the provision of the expansible gripping teeth arranged along substantially the entire length of the anchor the latter may grip the hole walls at a multiplicity of points substantially along the entire length of the hole so that the possibility of slippage or tearing loose of the anchor is substantially avoided. By the provision of a multi-contact reinforcer or anchor of the character disclosed the roof strata may be firmly bound together thereby minimizing flexure and thus preventing rock failure. By the provision of the improved spreader tool the anchor tube may be quickly and easily anchored in place and the spreader tool may be removed and reused at other locations. The anchor is of a rugged and durable structure and is inexpensive in design, thereby not only providing an effective roof support but also maintaining the cost of roof control at a minimum. These and other uses and advantages of the invention will be clearly apparent to those skilled in the art.

While there are in this application specifically described several forms and modifications which the invention may assume in practice, it will be understood that these forms and modifications of the same are shown for purposes of illustration, and that the invention may be further modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent is:

1. A reinforcing member insertable in a hole drilled in

rock strata for binding the rock strata together to minimize flexure, relative slipping and failure thereof comprising an elongated cylindrical hollow metal tube of substantially uniform wall thickness and having a substantially uniform external diameter, said tube being adapted to be inserted in a hole drilled in rock strata of substantially the same diameter as that of the said tube whereby the outer surface of said tube is in close fit and in substantial face contact with the walls of said hole, said tube being provided with a plurality of gripping teeth portions spaced circumferentially along substantially the entire length of said tube integral with said tube and normally not extending beyond the outer periphery of said tube, said gripping teeth being connected to the tube at one end thereof on a line transverse to the axis of the tube and free at the sides and at the other end and being of the same substantially uniform thickness as that of the tube wall, whereby they may be bent laterally along a line transverse to the axis of the tube after the tube is inserted in said hole to extend outwardly of the exterior periphery of the tube to grip and embed into the adjacent walls of the hole into permanent locking relation therewith, whereby the rock strata are supported at their contacting regions with the interlocked tube portions and slippage or tearing loose of said tube from said hole is substantially avoided.

2. An anchor as defined in claim 1 wherein the gripping teeth are normally formed to extend internally within the walls of the tube and are adapted to be bent outwardly of the exterior periphery of the tube to grip and embed into the walls of the hole.

3. An anchor as defined in claim 1 wherein the gripping teeth are arranged in separate rows along substantially the entire length of the tube.

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