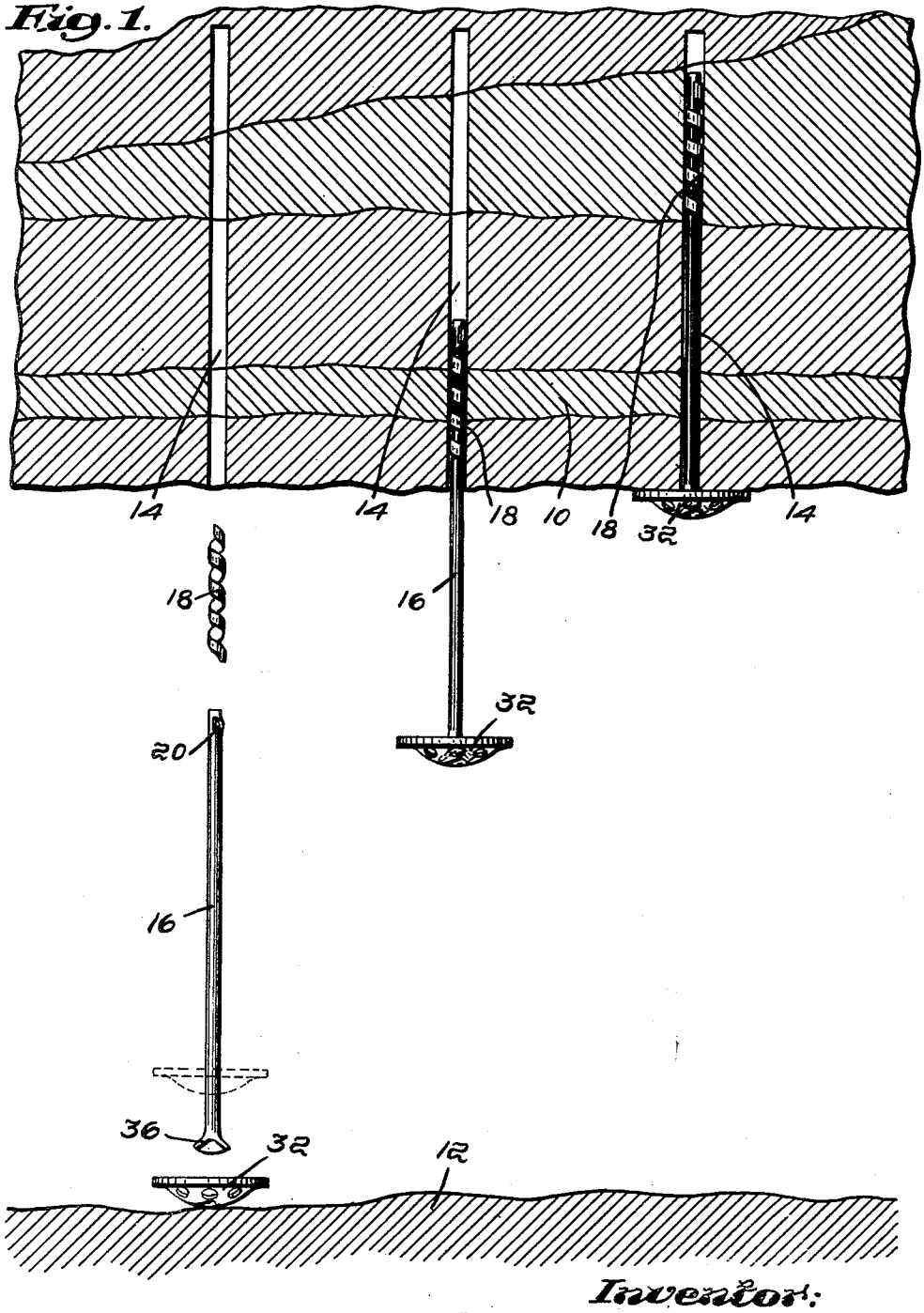
Oct. 5, 1954 M. S. CAMPBELL 2,690,693

FASTENER WITH EXPANDING SPRING GRIPPING MEANS

Filed Sept. 7, 1950 5 Sheets-Sheet 1

Fig. 1.



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FASTENER WITH EXPANDING SPRING GRIPPING MEANS

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Fig. 3.

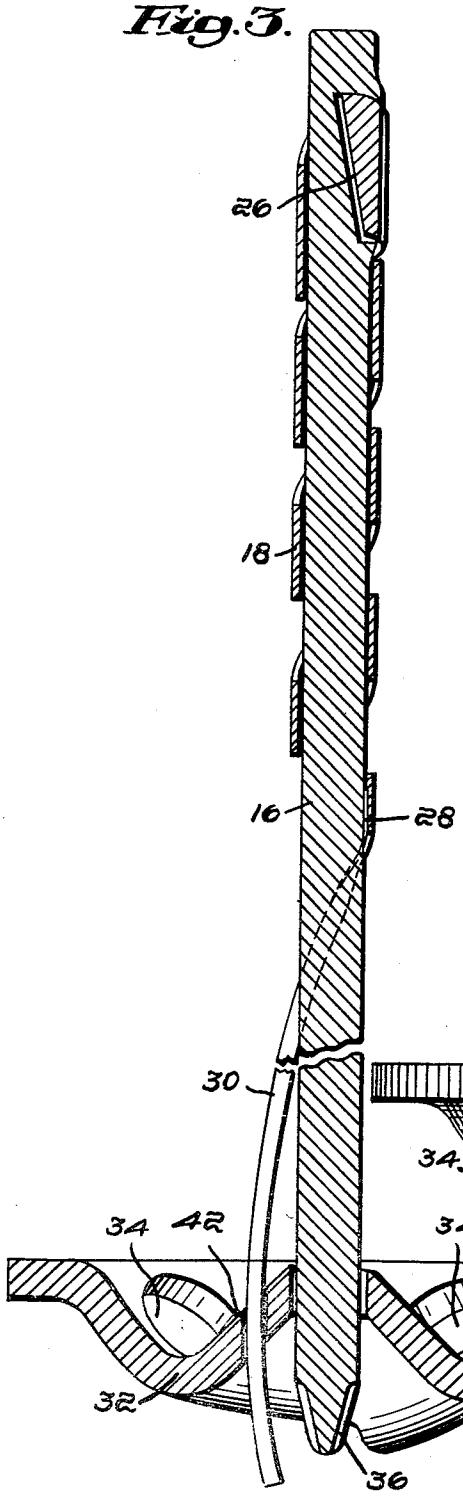
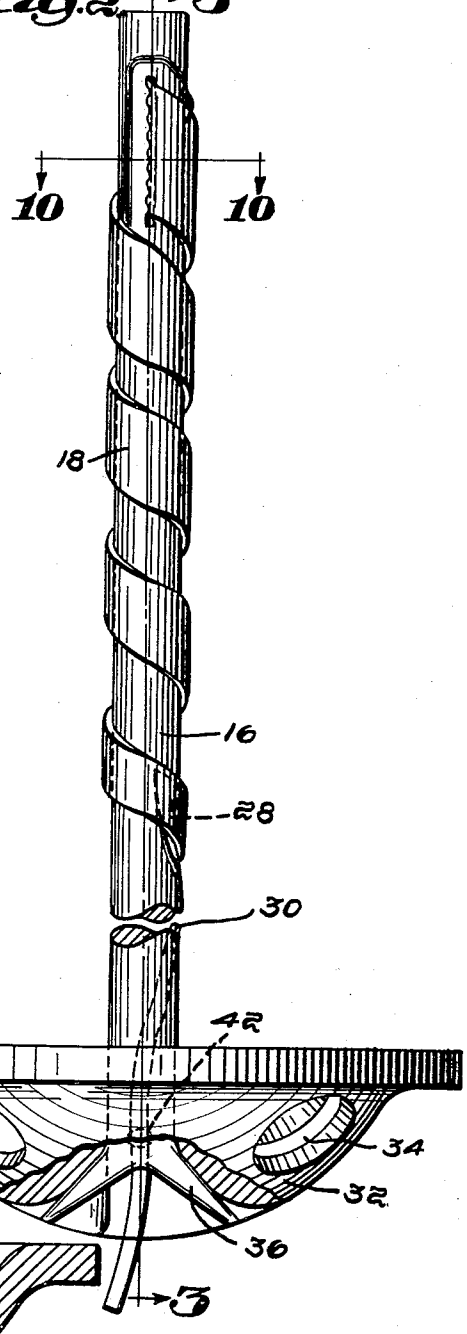


Fig. 2.



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FASTENER WITH EXPANDING SPRING GRIPPING MEANS

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Fig. 4.

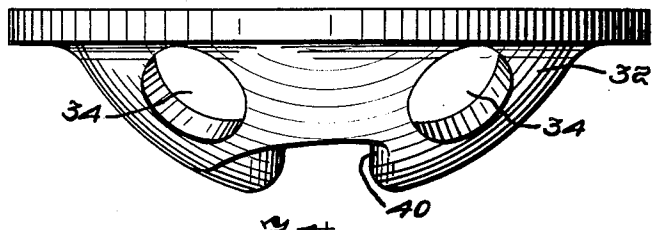


Fig. 5.

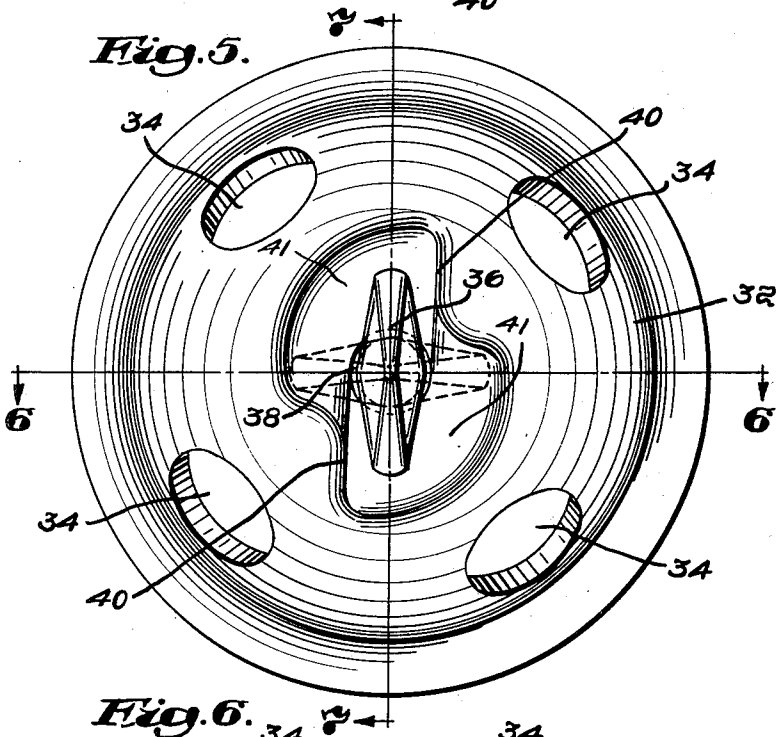


Fig. 6.

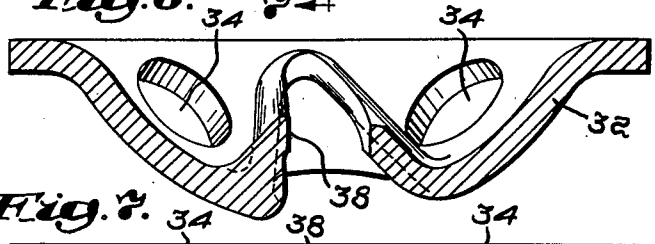
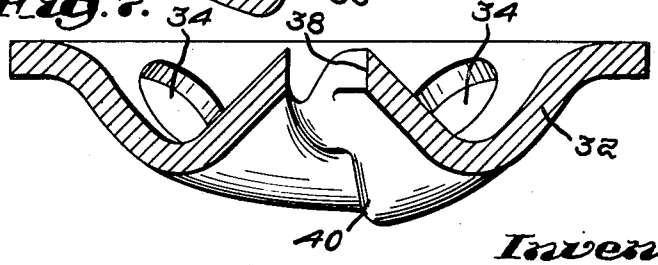


Fig. 7.



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FASTENER WITH EXPANDING SPRING GRIPPING MEANS

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Fig. 8.

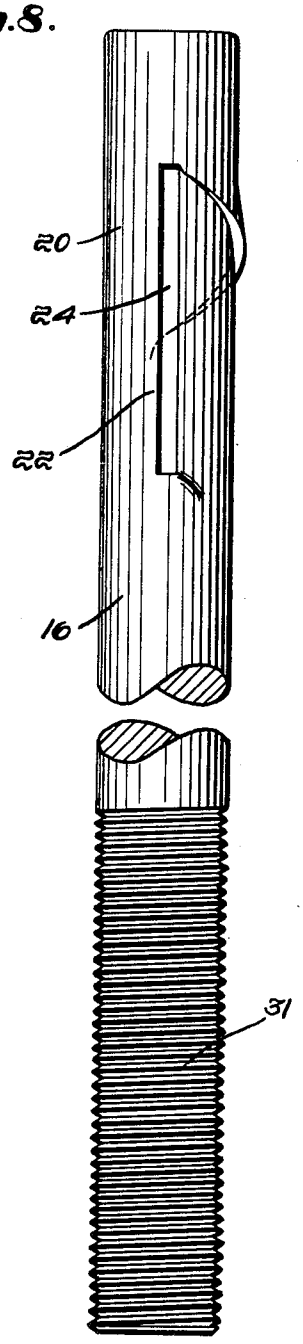


Fig. 9.

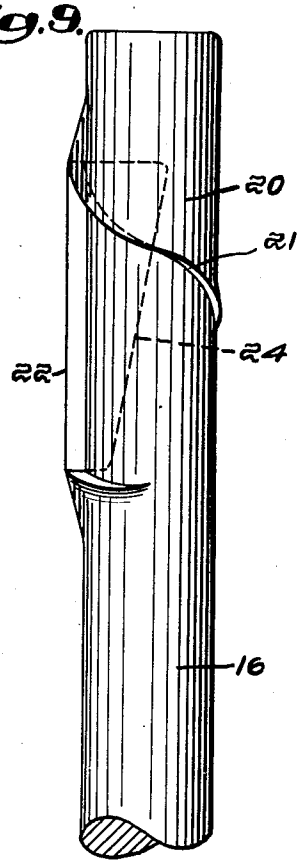
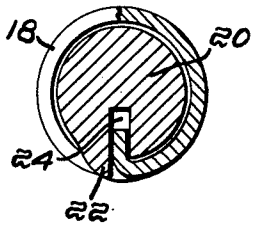


Fig. 10.



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FASTENER WITH EXPANDING SPRING GRIPPING MEANS

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Fig. 11.

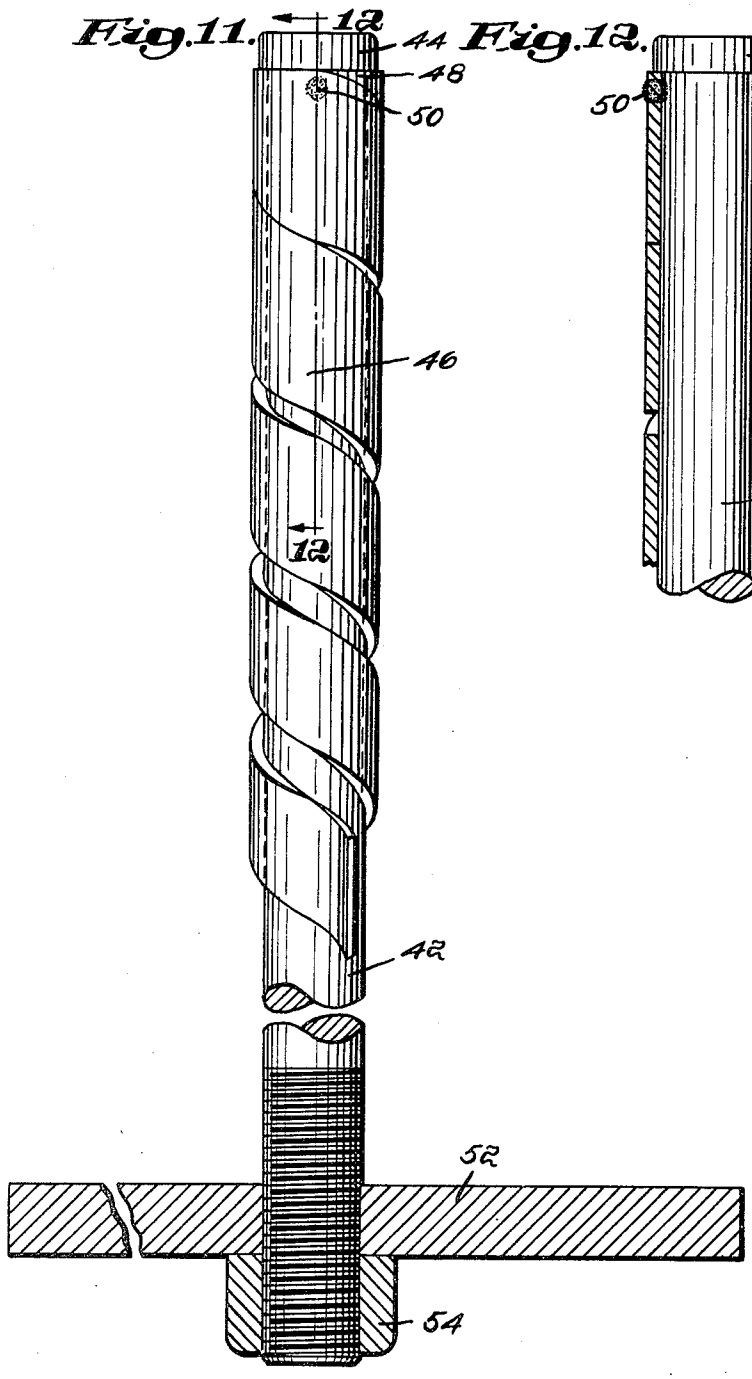


Fig. 12.

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2,690,693

UNITED STATES PATENT OFFICE

2,690,693

FASTENER WITH EXPANDING SPRING GRIPPING MEANS

Maxwell S. Campbell, Elkins, N. H.

Application September 7, 1950, Serial No. 183,596

17 Claims. (Cl. 85—2.4)

1

This invention relates to improvements in a roof pin lock for mines or for other purposes.

In mining operations, it is necessary to support the roof as the bore of the mine is extended. The old method consisted in placing posts or columns to brace the roof from the floor of the bore. Such a method is slow, insecure and a handicap to modern mining machinery.

The more modern method involves placing reinforcing beams across the roof of the mine and to hold such beams in place by bolts extending into the mine roof. The essential problem, therefore, consists of providing means to readily lock a bolt in a bore drilled into the roof of a mine.

It is an object of my invention to provide improvements for locking roof pins or bolts.

It is further an object of my invention to employ a roof pin and a helical leaf spring wrapped around the pin adapted to be inserted in a smooth bored hole with means for placing the pin under a tension load to expand the coil and lock it in the bore.

Another object of my invention resides in means for locking a pin in a smooth bored hole comprising a helical spring wrapped around the pin with means for connecting the upper end of the spring to the pin and to employ a cap lock attached to the outer end of the pin which may be turned in one direction to tighten the spring in the bore.

More particularly, it is an object of my invention to provide a roof pin which is locked in the bore by a helical spring.

Further objects and advantages of my improvements will be more readily apparent from the following description of a preferred embodiment thereof as illustrated in the accompanying drawings: in which,

Fig. 1 is a fragmentary vertical section taken through the bore of a mine and illustrating the manner of inserting my improved roof pin;

Fig. 2 is a side elevation partially in broken section and shown on an enlarged scale of the roof pin;

Fig. 3 is a vertical section taken through the roof pin shown in Fig. 2;

Fig. 4 is a side elevation of the lock plate;

Fig. 5 is a bottom view of the lock plate shown in Fig. 4;

Fig. 6 is a vertical section taken on the plane indicated 6—6 in Fig. 5;

Fig. 7 is a vertical section taken on the plane indicated 7—7 in Fig. 6;

Fig. 8 is a side elevation partially in broken

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section of a roof pin showing the stop portion to engage the end of the helical spring;

Fig. 9 is a partial side elevation of the roof pin taken at 90° with respect to the view of Fig. 8;

Fig. 10 is a cross section of the roof pin of Fig. 8 and the upper end of the helical spring;

Fig. 11 is a side elevation of a modified design of the roof pin and spring with the cap plate and nut shown in section; and

Fig. 12 is a fragmentary view of the upper end of the pin with the spring shown in vertical section.

In Fig. 1 the roof of a mine bore is indicated 10 and the floor of the bore at 12. Holes 14 are bored into the roof of the mine. These bores may be vertical or at an angle. The bores must be sufficiently deep to reach into the compression zone or self-supporting material of the roof. The portion of the roof below this zone must be held in place under tension. According to customary practice, the roof pins are driven in until they reach the inner end of the bore and then special wedge locks are set to hold the pins. According to my method, it is not necessary for the pin to be driven into the end of the drilled hole. The diameter of the springs in their unstressed condition, or at least some portion, preferably the lower ends, of the springs, is at least as large as that of the holes and preferably slightly larger so as to provide an initial frictional engagement between the springs and the walls of the holes. The friction between the spring and the wall tends to stretch the spring axially and reduce its diameter as the pin is driven in. After the pin is in place, however, any force applied in such a direction as to withdraw it will compress the spring axially causing it to tend to expand radially. This tendency gives rise to a radial pressure against the wall of the hole which locks the pin in place in the hole. The desired mechanical interference between the spring diameter and the hole diameter may be obtained, for example, by making the whole length of the spring, except perhaps for the coil immediately behind the point of attachment at the inner end of the pin, slightly larger in diameter than the hole, or by tapering the spring diameter toward the outer end so that the free end is larger in diameter than the hole. The interference required is not large. Adequate frictional engagement for locking purposes may be obtained by making the diameter of the spring exactly equal to the maximum diameter of the hole, and allowing only a plus tolerance in the spring diameter. For example, for a maximum hole size of $1\frac{5}{16}$ in.,

the maximum diameter of the spring may be made $1\frac{5}{16}$ in. with a plus tolerance of $\frac{1}{16}$ in.

Some means must be employed to transmit the load between the spring and the pin. I have shown in Fig. 1 that the upper end 20 of the pin 16 is specially formed to engage the upper end of the spring 18. As more clearly shown in Figs. 2, 3, 8 and 9, the pin 16 is up-set to form the helical shoulder 21 and the vertical shoulder 22. A vertical slot 24 is formed in the pin 16 adjacent the shoulder 22 and receives the bent end 26 of the helical spring 18. The upper end of the spring is thus secured to the pin in both the axial and the circumferential direction. The compressive load upon the spring is transferred to the pin 16 through the shoulder 21 and in part through the end 26 of the spring. The spring 18 may, as shown in Figs. 2 and 3, be tapered from its upper end towards its lower end 28 with the width of the coil decreasing towards the lower end. This results in an increase in the space betwen the coils from the upper and towards the lower end. The compression of the spring in the drill hole will first take effect at the lower end of the spring and as the load is increased the coils further up will be closed together.

One advantage of my improvement resides in the fact that the roof pin may be readily released from the drill hole if the tension load upon the pin is released. The compressive load upon the spring is also released and the pin with the spring may be slipped from the bored hole. In order to aid in releasing the spring, I may attach a strap member 30, as shown in Figs. 2 and 3 to the lower end 28 of the spring. By pulling on the strap member 30, the spring will be stretched thereby reducing its diameter and permitting its release from the drill hole.

Some means must be employed to place the pin under a tension load. It may merely be necessary to employ a threaded bolt, as shown in Fig. 8, in which the lower end of the pin 16 has the threads 31 and a suitable nut is threaded on to the lower end of the pin until a thrust is exerted against the roof of the mine bore around the drilled hole, thereby pulling the pin 16 downward in the hole. The downward pull on the pin 16 will place the helical spring under compression and the compression of the spring will expand the lower end of the spring as the coils are closed up, thereby locking the spring in the bore.

I may instead use a special locking cap or plate 32, as shown in Figs. 2 to 7. The cap or plate 32 may be assembled with the pin before the pin 16 is inserted in the bored hole. The cap 32 is a crown cap having the holes 34 adapted to receive tools for tightening the cap 32. The lower end of the pin 16 may be formed with a T-head 36, as shown in Fig. 1. The pin 16 passes through the central opening 38 of the cap 32.

As shown in Fig. 5, the T-shaped head 36 of the pin 16 fits into a pocket formed in the cap 32. The cap has the substantially vertical shoulders 40 which will engage the T-shaped head 36 in order to turn the rod 16 in a counter-clockwise direction. This may be required in setting the pin with the spring in the drill hole. The bottom of the pocket has the sloped cam surfaces 41, therefore, when the cap is turned in a clockwise direction a downward pull will be exerted on the pin 16 and the lock will be set. The cap 32 may have an opening 42, as shown in Figs. 2 and 3, to receive the strap release 30.

Figures 11 and 12 disclose a modified design of my roof pin lock in which all direct shear stresses on the connection between the pin and the spring are eliminated. The pin or bolt 42 is formed with a head 44 making a radial flange against which the helical spring 46 may seat. The spring 46 is specially made so that when coiled the upper end of the coil will be closed and seat flat against the radial flange of the head 44. Thus the end 48 of the coil is cut off at a sharp angle and, as shown in Figs. 11 and 12, the first turns of the coil are closed so as to be inactive. The coil stock is formed with parallel edges identical to the pitch of the coil for a distance sufficient to produce the closing of the coil, as shown. The load, therefore, will be evenly distributed around the seat of the coil against the head 44. The coil stock is cut so as to taper the stock towards its lower end; thus there is allowed compression of the lower coils and radial expansion sufficient to provide the locking action.

It may be desirable to spot-weld the upper end of the coil 46 to the pin 42, as indicated at 50. This weld is not intended to bear any load but only serves to hold the upper end of the coil against the head of the bolt as it is being driven into the bore. The lower end of the pin 42 may be fastened as previously described or I may use, as shown, a cap plate 52 and a nut 54. As the nut 54 is tightened to lock the pin in the bore, the downward thrust on the coil 46 from the head 44 will cause the lower coils to be compressed, thereby producing the radial expansion of the spring which will lock against the inner surface of the bore hole.

The pin or bolt 16 with the helical spring 18 thereon is driven vertically into the drill hole. It is not necessary to cause the end of the pin 16 to engage the bottom of the hole. The setting of the pin in the hole may be facilitated by turning the cap 32 in a counter-clockwise direction, thereby tending to screw the helical spring into the hole. When the cap 32 has engaged the seat around the drill hole or against a reinforcing beam, the cap may then be turned for a short distance in a clockwise direction. This movement will cause the T-shaped head 36 of the pin 16 to ride up on the cam surfaces 41 and the downward pull upon the pin 16 will compress the coils of the helical spring 18 near the lower end, thereby causing the spring to be expanded radially and lock in the drill hole. With the modification of Figs. 11 and 12, the nut 54 is merely tightened until the desired load is impressed upon the pin 42. In order to assist the gripping action of the spring on the bore of the drill hole, the spring as initially formed may have an outside diameter which is slightly increased from the fixed end towards the free end. This will tend to insure that the free end of the spring will be first to grip the side of the drill hole and further compression will build up the gripping action towards the fixed end of the spring.

I claim:

1. A load supporting device, adapted for insertion into a smooth-walled cylindrical hole of predetermined diameter, comprising: a rigid pin of a transverse dimension smaller than that of the hole, having an inner end designed for insertion into said hole and an outer end designed to project from said hole; a resilient coil spring, of external contour generally conforming to the shape of the hole, attached to the pin near said inner end, and freely encircling the pin from the point of attachment toward said outer end, said spring having spaced apart coils, and at least one of the

coils remote from said inner end having a diameter when unstressed somewhat larger than that of coils nearer said inner end and of the hole so as to frictionally engage the wall thereof upon insertion of the device; and means on said pin near the inner end thereof adapted to bear upon the adjacent coil of said spring and transmit an axial compressive force thereto, whereby a load applied to said pin in a direction tending to pull the pin out of the hole compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the device in the hole, the outer end of the pin being adapted to receive such a load.

2. A device as described in claim 1 having a member connected to the outer coil of the spring and adapted to project from the hole to provide a hand grip whereby said spring may be stretched axially for disengagement with the hole.

3. A load supporting device as described in claim 1, said spring being formed from a flat strip wound with its flat faces lying in the axial direction of the spring.

4. A load supporting device as described in claim 1, said spring being tapered in outside diameter from a diameter at its point of attachment smaller than that of the hole to a diameter at its outer end larger than that of the hole.

5. A load supporting device as described in claim 1, said spring being formed from a flat strip wound with its flat faces lying in the axial direction of the spring, said strip decreasing in width and the space between coils increasing from said point of attachment outward.

6. A load supporting device, adapted for insertion into a smooth-walled cylindrical hole of predetermined diameter, comprising: a rigid pin of a transverse dimension smaller than that of the hole, having an inner end designed for insertion into said hole and an outer end designed to project from said hole; an axial groove near the inner end of said pin; a resilient coil spring, of external contour generally conforming to the shape of the hole, having one end bent toward the pin and received in said groove for attachment to the pin, and freely encircling said pin from the point of attachment toward said outer end, said spring having spaced apart coils, and at least one of the coils remote from said inner end having a diameter when unstressed somewhat larger than that of coils nearer said inner end and of the hole so as to frictionally engage the wall thereof upon insertion of the device; and a shoulder on the inner end of said pin engaging the innermost coil of said spring so as to bear thereon and transmit an axial compressive force thereto, whereby a load applied to said pin in a direction tending to pull the pin out of the hole compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the device in the hole, the outer end of the pin being adapted to receive such a load.

7. A load supporting device, adapted for insertion into a smooth-walled cylindrical hole of predetermined diameter, comprising: a rigid pin of a transverse dimension smaller than that of the hole, having an inner end designed for insertion into said hole and an outer end designed to project from said hole; a resilient coil spring, of external contour generally conforming to the shape of the hole, having an innermost coil closed upon itself and attached to said pin near the inner end thereof, said spring having spaced apart coils freely encircling said pin from the point of attachment toward said outer end, and at least one of the coils remote from said inner end having a diameter when unstressed somewhat larger than that of coils nearer said inner end and of the hole so as to frictionally engage the wall thereof upon insertion of the device; and a flange on the inner end of said pin engaging said innermost coil so as to bear thereon and transmit an axial compressive force thereto, whereby a load applied to said pin in a direction tending to pull the pin out of the hole compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the device in the hole, the outer end of the pin being adapted to receive such a load.

8. In a structure for supporting a mine roof, or the like, employing roof bolts inserted into smooth bored holes which extend upward from the under surface of the roof into a self supporting stratum above said surface, a roof bolt comprising: a rigid pin of a transverse dimension smaller than that of the hole in which it is inserted, having an upper end disposed in said stratum and a lower end projecting below said surface; a resilient coil spring, of external contour generally conforming to the shape of the hole, attached to the pin near said upper end and freely encircling the pin from the point of attachment downward, said spring having spaced apart coils, and at least one of the lower coils having a diameter when unstressed somewhat larger than that of coils above it and of the hole so as to frictionally engage the wall thereof upon insertion of the bolt; and means on said pin near the upper end thereof adapted to bear upon the adjacent coil of said spring and transmit an axial compressive force thereto whereby a downward load applied to said pin compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the bolt in the hole, the lower end of the pin carrying means adapted to engage said surface and transmit a downward load to the pin.

9. A roof pin as described in claim 8, the means carried by the lower end of the pin being adapted to be tightened against said roof surface by rotation in a direction tending to expand said spring radially.

10. A roof pin as described in claim 8, having a member attached to the lower end of said spring and extending below said roof surface to provide a hand grip whereby said spring may be stretched axially for disengagement from the hole.

11. A roof pin as described in claim 8, said spring being formed from a flat strip wound with its flat faces lying in the axial direction of the spring.

12. In a structure for supporting a mine roof employing roof pins inserted into smooth bored holes which extend upward from the under surface of the roof into a self supporting stratum above said surface; a roof bolt comprising: a rigid pin of a transverse dimension smaller than that of the hole in which it is inserted, having an upper end disposed in said stratum and a lower end projecting below said surface; an axial groove on said pin near its upper end; a resilient coil spring, of external contour generally conforming to the shape of the hole, having a bent in lip at its upper end received in said groove for attachment to the pin, said spring having spaced apart coils freely encircling the pin from the point of attachment downward, and at least one of the lower coils of said spring having a diameter when unstressed somewhat larger than that of coils above it and of the hole so as to

frictionally engage the wall thereof upon insertion of the bolt; and a shoulder on the upper end of said pin engaging the uppermost coil of said spring so as to bear thereon and transmit an axial compressive force thereto, whereby a downward load applied to said pin compresses the spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the bolt in the hole, the lower end of the pin carrying means adapted to engage said surface and transmit a downward load to the pin.

13. In a structure for supporting a mine roof employing roof pins inserted into smooth bored holes which extend upward from the under surface of the roof into a self supporting stratum above said surface; a roof bolt comprising: a rigid pin of a transverse dimension smaller than that of the hole in which it is inserted, having an upper end disposed in said stratum and a lower end projecting below said surface; a resilient coil spring of external contour generally conforming to the shape of the hole, having an uppermost coil closed upon itself and attached to the pin near said upper end, said spring having spaced apart coils freely encircling said pin from the point of attachment downward, and at least one of the lower coils having a diameter when unstressed somewhat larger than that of coils above it and of the hole so as to frictionally engage the wall thereof upon insertion of the bolts; and a flange on the upper end of said pin engaging said uppermost coil so as to bear thereon and transmit an axial compressive force thereto, whereby a downward load applied to said pin compresses the spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the bolt in the hole, the lower end of the pin carrying means adapted to engage said surface and transmit a downward load to the pin.

14. A load supporting device, adapted for insertion into a smooth-walled cylindrical hole of predetermined diameter, comprising: a rigid pin of a transverse dimension smaller than that of the hole, having an inner end designed for insertion into said hole and an outer end designed to project from said hole; a resilient coil spring, of external contour generally conforming to the shape of the hole, attached to the pin near said inner end, and freely encircling the pin from the point of attachment toward said outer end, said spring having spaced apart coils, and at least one of the coils remote from said inner end having a diameter when unstressed somewhat larger than that of coils nearer said inner end and of the hole so as to frictionally engage the wall thereof upon insertion of the device, the remaining coils being closely wrapped about the pin; and means on said pin near the inner end thereof adapted to bear upon the adjacent coil of said spring and transmit an axial compressive force thereto, whereby a load applied to said pin in a direction tending to pull the pin out of the hole compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the device in the hole, the outer end of the pin being adapted to receive such a load.

15. In a structure for supporting a mine roof, or the like, employing roof bolts inserted into smooth bored holes which extend upward from the under surface of the roof into a self supporting stratum above said surface, a roof bolt comprising: a rigid pin of a transverse dimension smaller than that of the hole in which it is inserted, having an upper end disposed in said stratum and a lower end projecting below said surface; a resilient coil spring, of external contour generally conforming to the shape of the hole, attached to the pin near said upper end and freely encircling the pin from the point of attachment downward, said spring having spaced apart coils, and at least one of the lower coils having a diameter when unstressed somewhat larger than that of coils above it and of the hole so as to frictionally engage the wall thereof upon insertion of the bolt, the remaining coils being closely wrapped about the pin; and means on said pin near the upper end thereof adapted to bear upon the adjacent coil of said spring and transmit an axial compressive force thereto whereby a downward load applied to said pin compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the bolt in the hole, the lower end of the pin carrying means adapted to engage said surface and transmit a downward load to the pin.

16. A load supporting device, adapted for insertion into a smooth-walled cylindrical hole of predetermined diameter comprising: a rigid pin of a transverse dimension smaller than that of the hole, having an inner end designed for insertion into said hole and an outer end designed to project from said hole; a resilient coil spring, of external contour generally conforming to the shape of the hole, attached to the pin near said inner end, and freely encircling the pin from the point of attachment toward said outer end, said spring having spaced apart coils, and at least one of the coils remote from said inner end having a diameter when unstressed somewhat larger than that of coils nearer said inner end and of the hole so as to frictionally engage the wall thereof upon insertion of the device, the remaining coils being spaced from the pin by less than the thickness of the stock from which the spring is formed; and means on said pin near the inner end thereof adapted to bear upon the adjacent coil of said spring and transmit an axial compressive force thereto, whereby a load applied to said pin in a direction tending to pull the pin out of the hole compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the device in the hole, the outer end of the pin being adapted to receive such a load.

17. In a structure for supporting a mine roof, or the like, employing roof bolts inserted into smooth bored holes which extend upward from the under surface of the roof into a self supporting stratum above said surface, a roof bolt comprising: a rigid pin of a transverse dimension smaller than that of the hole in which it is inserted, having an upper end disposed in said stratum and a lower end projecting below said surface; a resilient coil spring, of external contour generally conforming to the shape of the hole, attached to the pin near said upper end and freely encircling the pin from the point of attachment downward, said spring having spaced apart coils, and at least one of the lower coils having a diameter when unstressed somewhat larger than that of coils above it and of the hole so as to frictionally engage the wall thereof upon insertion of the bolt, the remaining coils being spaced from the pin by less than the thickness of the stock from which the spring is formed; and means on said pin near the upper end thereof adapted to bear upon the adjacent coil of said spring and transmit an axial compressive force

thereto whereby a downward load applied to said pin compresses said spring axially, causing it to exert radial pressure on the wall of the hole and thus lock the bolt in the hole, the lower end of the pin carrying means adapted to engage said surface and transmit a downward load to the pin.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
860,430	Zeller	July 16, 1907
900,318	Smith	Oct. 6, 1908
1,212,298	Weston	Jan. 16, 1917
1,268,828	Flannery	June 11, 1918
1,631,044	Lytton	May 31, 1927
1,648,855	Lytton	Nov. 8, 1927
2,520,232	Bereza	Aug. 29, 1950
2,542,579	Sanders	Feb. 20, 1951

FOREIGN PATENTS

Number	Country	Date
408,608	Great Britain	Apr. 11, 1934
608,233	Great Britain	Sept. 13, 1948