

12 **EUROPEAN PATENT APPLICATION**

21 Application number: 83105803.7

51 Int. Cl.³: E 21 D 15/02

22 Date of filing: 14.06.83

43 Date of publication of application:
27.12.84 Bulletin 84/52

84 Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

71 Applicant: **STOPE INTERNATIONAL INC.**
80 Broad Street
Monrovia Montserrat(LR)

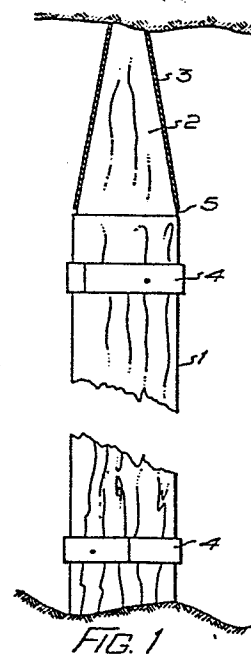
72 Inventor: **Cohen, Ronald Raymond**
26 Cleveland Road Sandhurst
Sandton Transvaal(ZA)

72 Inventor: **Pretorius, Willem Johannes**
48 Lower Main Reef Road
Princess Roodepoort Transvaal Province(ZA)

74 Representative: **Denmark, James**
c/o Bailey Walsh & Co. 5 York Place
Leeds LS1 2SD Yorkshire(GB)

54 **Mine props.**

57 A prop of the type used to support the hanging wall in underground mining operations includes a substantially cylindrical timber pole, one end of which is tapered in a frusto-conical manner and is located within a complementary shaped metal sleeve.



Mine_Props.

This invention relates to mine support posts, referred to herein as "props" of the type utilized for the support of overhead surfaces such as hanging walls in underground mines.

05

Such props are often designed so that they resist a predetermined loading, but thereafter, collapse to allow the hanging wall to approach the foot wall in a controlled manner, as the hanging walls cannot be
10 stopped from slowly closing into the foot walls.

Numerous different designs have been proposed for props. Costly, reusable hydraulic props are extremely efficient in that such props can be controllably
15 contracted in sympathy with the closing of the hanging walls on the foot walls, but their expense prevent them from being used exclusively. Rather, they are used in conjunction with props which are crushed in use, and are left in the mine, and hence are not reusable.

20

An old and extremely popular design of reusable prop consists of a wooden pole fitted neatly inside a metal sleeve of constant circular cross-section. Also, such poles (without the sleeve) have been encased in glass
25 fibre reinforced resins and the like.

While such props operate effectively for the most part, the manner in which they collapse when subjected to excessive axial loads is not always desirable and also
30 they do not exhibit the required resilience when rapidly subjected to high loads.

Furhtermore, such props are expensive, the cost arising mainly from the use of the metal sleeve or glass fibre
35 casing.

It is an object of the invention to provide a collapsible prop with improved load bearing characteristics.

05 According to one aspect of the invention, there is provided a non-reusable, collapsible prop, comprising an elongated timber pole of the required cross sectional configuration and having at one end thereof, a region in which the timber decreases in cross-
10 sectional area at least partly within a complementary shaped reinforcing sleeve encasing the timber.

Preferably, the timber pole and the zone of decreasing cross-sectional area are of substantially circular
15 cross section, and the end region of the log is formed in a frusto-conical configuration with the complementary sleeve being frusto-conical. Additionally, the sleeve may be made of mild steel, and the largest portion of said zone of decreasing
20 cross-sectional area may be less than the cross-sectional area of the remainder of the timber pole immediately adjacent thereto.

According to another aspect of the invention, there may
25 be provided along that portion of the prop's length which is not encircled in the sleeve, a series of spaced bands encircling the pole; the cone angle of the portion of decreasing cross section may be of the order of between 6° and 12° and preferably of the order of
30 about 8° .

It will be understood that the prop may be made of any suitable timber and may be composed of a plurality of longitudinally arranged lengths of timber as may be
35 required.

The frusto-conical end of the prop may have one or more

slots therein and extending axially and lying diametrically of the prop to control the collapsing of the prop. Alternatively, the frusto-conical end may have a series of grooves cut therein, said grooves
05 being of increasing depth in a direction from the smaller to the larger end of the frusto-conical portion.

The sleeve preferably has one or more elongated regions
10 of weakening, to ensure the collapse of the sleeve in predetermined fashion. To this end the regions of weakening may be slots which lie centrally of the sleeve, and extend axially thereof, the slots being of a length no greater than one third of the length of the
15 sleeve.

In order that the invention may be more fully understood, embodiments thereof will now be described with reference to the accompanying drawings, wherein;
20

Fig. 1 is an elevation of a prop according to a first embodiment of this invention and wherein the sleeve is shown in section;

25 Fig. 2 is a part cross-sectional elevation through a prop having a modified sleeve;

Fig. 3 is a cross-section elevation of a sleeve of a further modified form;
30

Fig. 4 is a part cross-sectional elevation of a sleeve of a third form;

Fig. 5 is an elevation of an end of another embodiment
35 of a prop according to the invention;

Fig. 6 is an elevation of an end of another embodiment

of the invention;

Fig. 7 is a part sectional elevation of a prop of another embodiment of the invention;

05

Fig. 8 is a part sectional elevation of the prop shown in Fig. 7 during compression;

Fig. 9 shows the prop of Fig. 7 at a further stage of
10 compression.

Figs 10 and 11 show in side elevation and plan a log of a prop according to another embodiment of the invention; and

15

Fig. 12 shows in elevation how the parameters of the log of the prop are determined.

In the embodiment of the invention shown in Fig. 1, a
20 timber pole or prop 1 of a nominal outside diameter of about 200 mm. has one end region turned to provide a frusto-conical zone 2. The frusto-conical zone, in this case, measures of about 500 mm. in length and has its larger diameter end of the order of about 170 mm.
25 in diameter. The narrow end, or in other words the free end of the prop, is made to a diameter of about 100 mm. These dimensions provide a cone angle of approximately 8° .

30 A complementarily shaped sleeve 3 is manufactured by cutting and welding a metal sheet, which can conveniently be mild steel of about 2.5 mm. in thickness. The longitudinally extending joint can simply be welded in the usual way. It is not necessary
35 that the sleeve be welded.

The sleeve 3 fits neatly over the frusto-conical end 2

and there is of course, no setting problem which is experienced in the conventional prop of constant diameter encased in a steel sleeve. Also, if the timber shrinks in the present invention the sleeve will
05 automatically accommodate such shrinkage as the prop is placed under compression or axial loading.

In order to ensure that the length of prop not located in the sleeve does not split prior to use and thereby
10 decrease the effectiveness of the prop, a plurality of steel bands 4 are made to encircle the pole or prop at spaced positions along the length thereof. These bands can be cut from the same 2.5 mm. thick metal plate and each is, in this particular embodiment, made to a width
15 of about 50 mm.

Each of the bands is simply bent to encircle the pole, and while it is held in a tightly closed condition, the ends, which are overlapped, are welded. One or more
20 nails are then passed through holes in the band and into the timber pole or prop simply to locate the band axially in its required position. The spacing of these bands can be chosen as required and usually as dictated by the nature of the timber employed for the particular
25 pole or prop which is generally saligua or a similar timber.

It will be understood that the length of pole or prop which is not encased in the frusto-conical sleeve will
30 be of appreciably greater diameter than the maximum diameter of the frusto-conical portion. This gives rise to a shoulder 5 as shown in Figure.

It has been found that a prop as described above is
35 highly effective in use and provides excellent characteristics when the axial loading thereof exceeds the required value and the prop starts to yield.

Yielding takes place smoothly and evenly from the thin end of the tapered zone to the thick end thereof.

It will also be understood that a prop as described above can be made relatively inexpensively as only part
05 of the length thereof has to be turned or otherwise machined. Thus, on a 1 m. prop only half of its length has to be turned and on a 2.5 m. prop only 20% of its length must be turned. This represents an appreciable saving when compared to the manufacture of the
10 conventional prop of constant cross-section which required to be turned along its entire length.

A highly effective prop or elongate support which can be easily manufactured at a reasonable cost and which
15 exhibits highly desirable yielding characteristics when subjected to excessive axial loading is therefore provided.

In the embodiment of the invention as shown in Figure
20 2, a prop for use in the support of the hanging wall in underground mining operations comprises a substantially cylindrical timber element 6 one end region 7 of which has been turned into a substantially frusto-conical configuration with a shallow shoulder 8 at its base.

25

The approximate dimensions of the frusto-conical region are as follows:

Height	350 mm.
30 Base Diameter:	205 mm.
Top Diameter:	95 mm.

Although not shown in the drawings the frusto-conical region may include one or more annular grooves in the
35 conical surface as shown in Fig. 7. These grooves will aid in the controlled collapsing of the prop in use.

The frusto-conical region 7 of the timber element 6 is provided with a co-operating frusto-conical sleeve 9 which is manufactured from 2 mm. thick mild steel. This sleeve 9 includes in its length four equally spaced slots 10 which are approximately 25 mm. long and 5 mm. wide. These slots also aid in the controlled collapsing of the sleeve and frusto-conical region during loading.

10 Near the base 11 of the sleeve is a reinforced area which is provided by a reinforcing ring 12 which is manufactured from steel of circular cross-section and welded to the sleeve 9.

15 In order to ensure that the length of the prop or timber element not located in the steel sleeve 9 does not split prior to use and thereby decrease the effectiveness of the prop, a plurality of steel bands 13 are located to encircle the prop at spaced positions along the length thereof.

In use, the prop is located as shown in Figure 2 between the hanging and foot walls, numbered 14 and 15 respectively, in an underground mine.

25

During loading of the prop, the frusto-conical region 7 together with the steel sleeve collapse in a more or less controlled manner. The reinforced area provided by the steel rings 12 prevents the base of the sleeve from splitting or in any event prevents any splits which do occur from progressing any appreciable distance up the length of the sleeve. This in turn prevents a decrease in the loading characteristics at any particular position about the axis of the prop with a resultant decrease in the tendency of the sleeve and frusto-conical region 7 to either bend over or to "goose-neck".

In Figure 3 another embodiment of the sleeve is shown. This embodiment is substantially identical to the first embodiment except that the reinforced region of the sleeve 9 is provided during manufacture by folding the material of the sleeve back on itself twice as shown by numeral 16 in order to provide a region in which the material is three times as thick as the normal material of the sleeve.

The embodiment as shown in Figure 4 is also substantially the same as the Fig. 1 embodiment except that the reinforced area is provided by a groove 17 formed in the material of the sleeve during manufacture.

Still further embodiments are envisaged within the scope of the invention and include other methods of providing the reinforced area as well as the position of more than one reinforced area either adjacent or spaced apart from each other.

In the embodiment of Fig. 5 a prop indicated generally by numeral 18, of the type used to support the hanging wall in underground mining operations comprises an outer steel sleeve 19. This steel sleeve 19 is frusto-conical and open at both ends 20 and 21. In this particular instance, the sleeve is approximately 500 mm. long and the diameter of the narrower end 20 is about 110 mm. while the diameter of the wider end 21 is about 185 mm.

Six slots 22 equally spaced from each other are located in the sleeve. The slots run along the length of the sleeve for about 100 mm. and are spaced about 100 mm. from the wide end 24, but in another embodiment, it is preferred that the slots 22 be in the middle of the sleeve 19 and be no more than one third of the length

thereof. The width of the slots is about 6 mm.

A frusto-conical timber insert 23 which is slightly longer than the sleeve but of the same cone angle passes through the sleeve to extend a small amount from
05 each end 20 and 21 thereof.

Preferably, the timber insert 23 includes a plurality of spaced annular grooves along its length as described in relation to Fig. 7.

10

It has been found in use that the inclusion of the slots 22 in the steel sleeve provide for more controlled collapsing of the prop 18 in use. Where the slots are not present and the sleeve is of uniform
15 strength the prop tends not to collapse uniformly during advance stages of collapsing and instead tends to form a "goose-neck" in its length.

It will readily be appreciated that the slots enable
20 the sleeve to collapse outwardly in a manner similar to the shape of a Chinese Lantern, during advanced stages of compression.

In the embodiment of Figure 6, a timber prop 24 has an
25 end 25 formed to a frusto-conical shape by means of a suitable turning operation. This frusto-conical part of the prop can assume any length and the cone angle can be any that may be required.

30 The frusto-conical section is covered by means of a complementary sleeve 26 which is formed to have plurality of folded regions 27 capable of allowing for circumferential expansion of the sleeve in the regions in which it has a smaller internal diameter.

35

During manufacture, the sleeve is urged axially into a complementary die and a mandrel, or alternatively the

formed end of a prop is located on the interior thereof whilst it is being formed to ensure that the sleeve contacts the outer surface of the frusto-conical section about at least the major portion of its
05 circumference.

It has been found that early shearing of the sleeve does not take place and only after substantial axial compression does shearing occur.

10

Other embodiments are envisaged within the scope of the invention and include other shapes and configurations of the prop and its component parts and more particularly provide that the regions of weakness need
15 not be slots but could, for example, be lines of perforations or simply lines of decreased thickness in the sleeve.

In the embodiment shown in Fig. 7, a prop, indicated
20 generally by numeral 28, comprises an elongated cylindrical timber member 29, one end region 30 of which has been turned to form an elongated frusto-conical timber insert 31.

25 Nearer the free end 32 of the frusto-conical insert 31 are three spaced annular grooves 33 of substantially trapezoidal cross-section. These grooves 33 are co-axial with each other and with the axis of the prop 28 as a whole.

30

Located over a major portion of the frusto-conical insert 31 is a sleeve 34 in the form of an open-ended frusto-conical member or cone. This cone 34 is made from mild steel plate bent to the required
35 configuration and welded along a seam.

Figure 8 depicts the prop described in relation to

Fig. 7 during initial stages of compression between the hanging and foot walls of an underground mine.

From this figure, it will be noted that the axial load
05 on the prop has pushed the cone 34 further onto the
frusto-conical insert 31 and has started collapsing
both insert and cone. As the insert is compressed,
some of the timber moves in to fill the void originally
created by the groove 33 thus providing some measure of
10 control to the collapse of the insert.

Similarly, the collapse of the cone is controlled by
the regular spaced nature of the grooves so that it
collapses in a series of concentric rings as indicated
by the numeral 35.

15

During the final stages of compression, and in a
substantially ideal situation, the prop takes on the
configuration shown in Figure 9. It will be noted from
this drawing that the lower portion of the cone 34 has
20 split to accommodate the majority of the timber of the
insert 31 while the concentric rings 35 of the cone
have been compressed together at the upper end. In
this way, the compressed prop has a substantially
linear axis.

25

What we have described above is an ideal situation in
that depending on the degree of accuracy of location of
the prop as well as the nature of the foot and hanging
walls, there may well be a certain tendency to goose-
30 neck. However, it is envisaged that this tendency will
be substantially decreased over props not having the
grooves described.

Other embodiments are envisaged within the scope of the
35 invention and include particularly other groove
configurations, spacings and numbers as well as other
methods of providing sections of decreased cross-

sectional area.

Thus instead of the grooves 33, there may be one or more axial slots cut through the conical insert 31 as shown in Figs 10 and 11. The cross slots 36 and 38 lie at right angles and extend for the majority of the length of the frusto-conical end and more material is removed by providing the central hole 39.

10 The support of the invention behaves well, but refinements can be effected to control of fracture of the support as well as "brushing" (see below).

It is well known in the art that where elongated timber members having a substantially constant cross-section are used as props they tend to bend and fracture about their mid-points, particularly under rapid, or "shock", loading conditions. Assuming that the nature of the timber and the length of the member are substantially constant, it will readily be appreciated that the characteristics of the tapered portion of the support largely determines not only the load characteristics of the support but also the manner in which it finally fractures.

25 Generally where the degree of taper is great and the tapered portion is short the support will fracture about its mid-point relatively early; while if the degree of taper is small and the tapered section is relatively long the support will only fracture about its mid-point at a late stage. However in the latter case extensive "brushing" may occur; "brushing" is the bending over and separation of the timber fibres at the tapered end.

35 According to a preferred arrangement of the invention the tapered end portion of the support has a transverse

flat end, the included angle of the taper being between 12° and 26° and the ratio of the area of the flat end of the tapered portion to the cross-sectional area of the non-tapered portion of the support being between
05 the ratios of 1:3 and 1:5.

The tapered end portion and metal sleeve are right circular frusto-conical with their cone angles being between 12° and 26° and preferably about 16° and the
10 ratio of the surface areas is about 1:4.

The metal sleeve is mild steel and has a thickness of about 2 mm; the metal sleeve has spaced elongated regions of weakness running along the length thereof
15 and equally spaced from each end thereof; and the regions of weakness are slots.

In this embodiment of the invention shown in Fig. 12 an elongated support in the form of a prop 40 for use in
20 supporting the hanging wall in underground mining operations comprises a timber element 41 which is conveniently a de-barked cylindrical pole of about 200 mm diameter. The timber element 41 is thus substantially circular in cross-section at all points
25 along its length.

The one end portion 42, which accounts for about one third of the length of the timber member 41, is machined to have a right circular frusto-conical shape.
30 This frusto-conical portion 42 has a base diameter of about 200 mm which is equal to the diameter "Y" of the major portion of the timber member 41; a length "Z" of 310 mm and a diameter "X" at its end 43 of 100 mm. These dimensions provide a cone angle of
35 approximately 90.

The frusto-conical end portion 42 of the prop is

provided with a co-operating sleeve 44 in the form of a hollow open ended right circular frusto-conical member made from 2 mm mild steel sheeting the ends of which have been welded together to form a single sleeve.

05

The sleeve 44 has six equally spaced elongated slots 45 running along the length thereof. These slots 45 are located equi-distant from each end of the sleeve 44.

10 As may be seen from figure 12 the sleeve 44 co-operates with the end portion 42 of the prop in such a manner that the end 43 of the prop protrudes a small amount through the sleeve 44 and the sleeve 44 does not quite reach the base of the frusto-conical portion.

15

Experimental work carried both in situ as well as on a suitable compression test rig indicates that a prop of this type having approximately the parameters described above provide the best load and yield and fracture characteristics. It has thus been found that with increasing values of the cone angle and of the ratio of the dimensions of "X" to those of "Y", so the tendency of the prop to break or snap about its mid-point "W", also increases. Furthermore as the ratio of the dimensions of "X" to "Y" decreases so does the tendency of the frusto-conical portion 3 to "brush" i.e. for the timber fibres to separate and bend over.

These same test results have indicated that the positioning of the slots 45 is also very important. Thus where the slots are displaced too much towards the narrow end of the sleeve 44 they do not provide for a sufficient build up of timber in the sleeve during initial stages of compression. Where the slots are too far towards the base of the sleeve, however, it has been found that the loads are too high before distortion takes place and consequently the incidence

of "brushing" increases.

It is intended that all matter contained herein with respect to the described embodiments be interpreted as
05 illustrative of the invention and not in a limiting sense. For example, instead of only an end of the log being tapered, the log can be tapered substantially throughout its length, and a long steel cone of similar length applied thereto.

CLAIMS

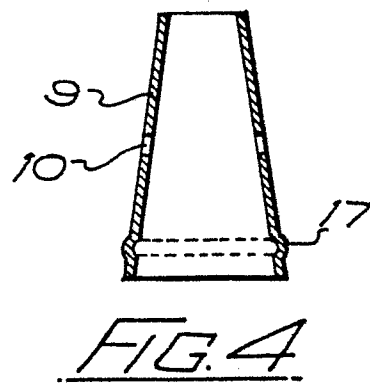
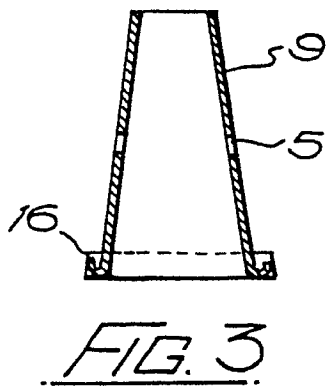
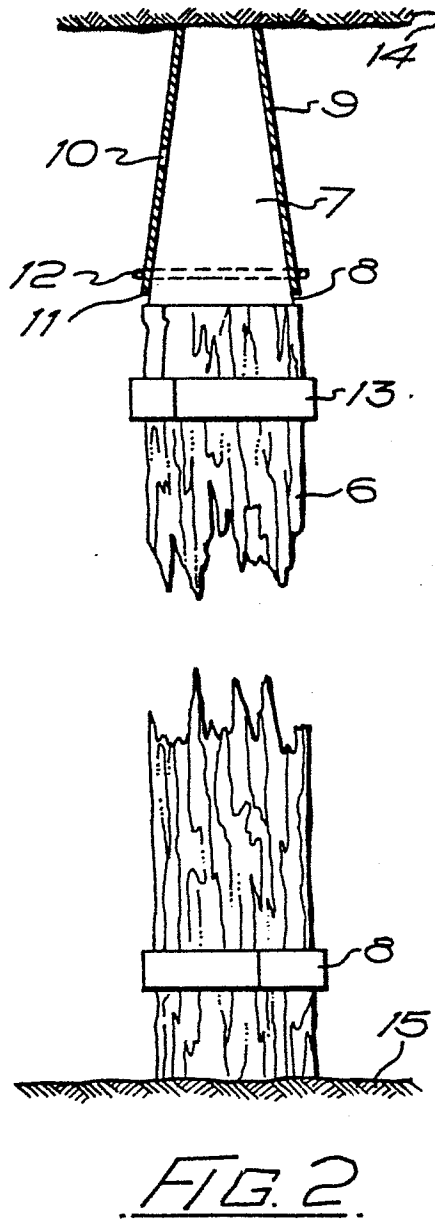
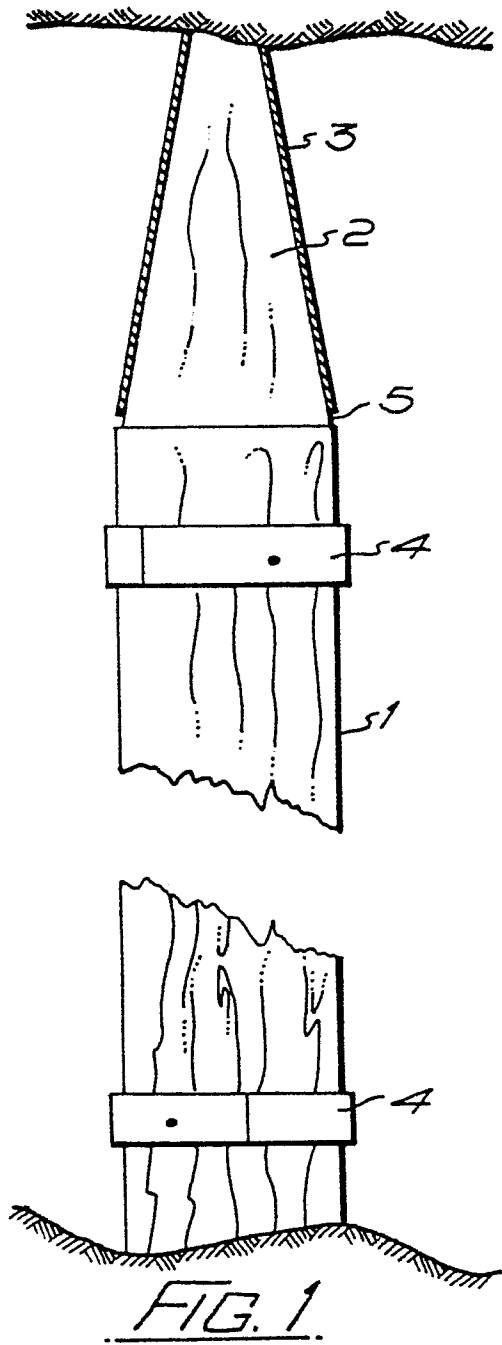
1. A prop comprising an elongated timber pole of the required cross-sectional configuration and having, at least at one end thereof, a region in which the timber decreases in cross-sectional area towards its free end,
05 with the zone of decreasing cross-sectional area at least partly located within a complementarily shaped sleeve encasing the timber.
2. The prop as claimed in Claim 1, in which the sleeve
10 is made of mild steel.
3. The prop as claimed in Claim 1 or 2 in which the largest portion of said zone of decreasing cross-sectional area is less than the cross-sectional area of
15 the remainder of the timber pole immediately adjacent thereto.
4. The prop as claimed in Claim 1, 2 or 3, in which the prop is provided along that portion of its length
20 which is not encircled in the sleeve, with a series of spaced bands encircling the pole.
5. The prop as claimed in any of Claims 1 to 4, in which the timber pole and the zone of decreasing cross-sectional area are of substantially circular cross-section and the end region of the log is formed to a
25 frusto-conical configuration with the complementary sleeve being frusto-conical.
- 30 6. The prop as claimed in Claim 5, in which the cone angle of the portion of decreasing cross-section is of the order of between 60° and 120°.
7. The prop as claimed in Claim 5 or 6, in which the
35 cone angle is about 80°.

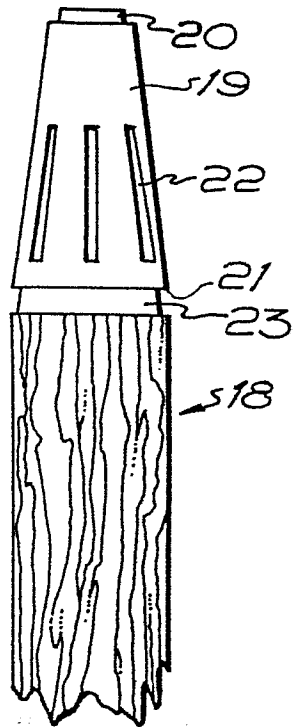
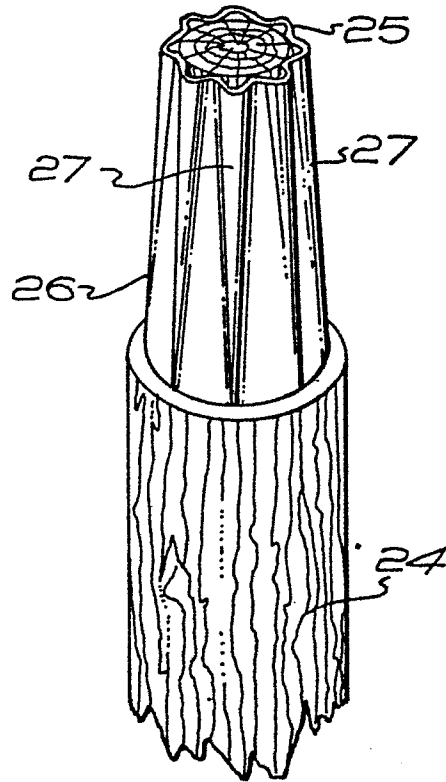
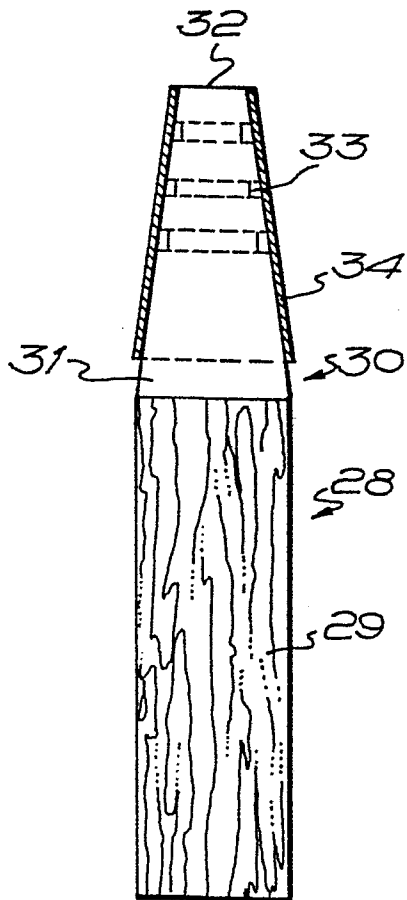
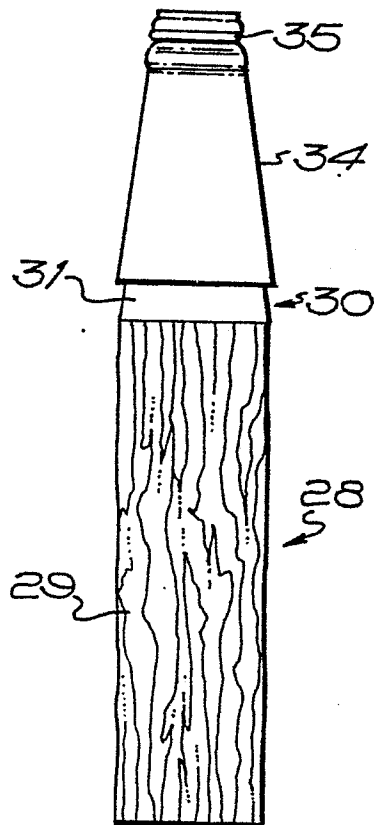
8. The prop as claimed in any preceding claim 7, wherein the zone of decreasing cross-section has peripheral grooves therein in the region surrounded by the sleeve.

05

9. The prop as claimed in any preceding claim, wherein the sleeve has elongated regions of weakness therein.

10. The prop as claimed in any preceding claim,
10 wherein at the larger end of the sleeve there is sleeve reinforcement.



FIG. 5FIG. 6FIG. 7FIG. 8

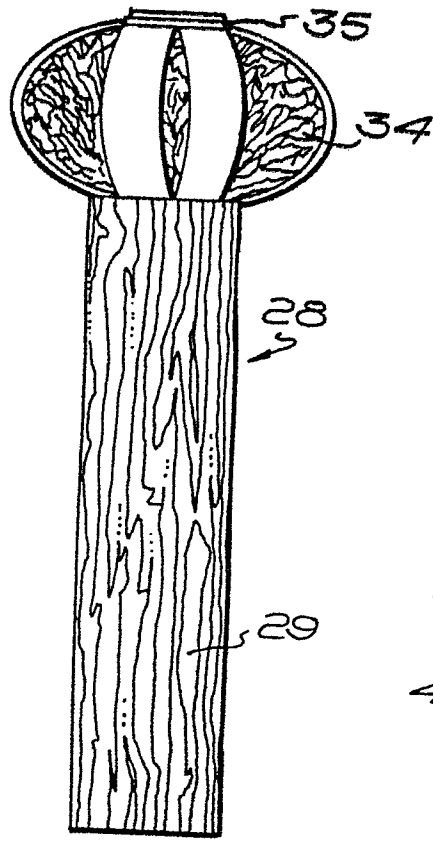


FIG. 9

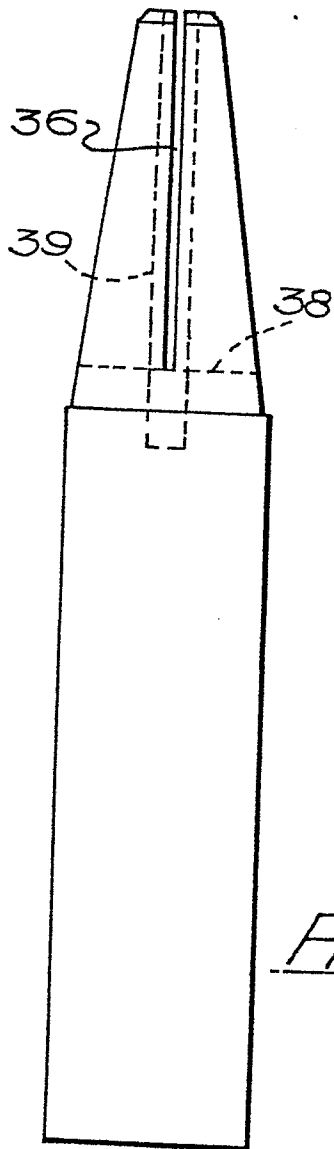


FIG. 10

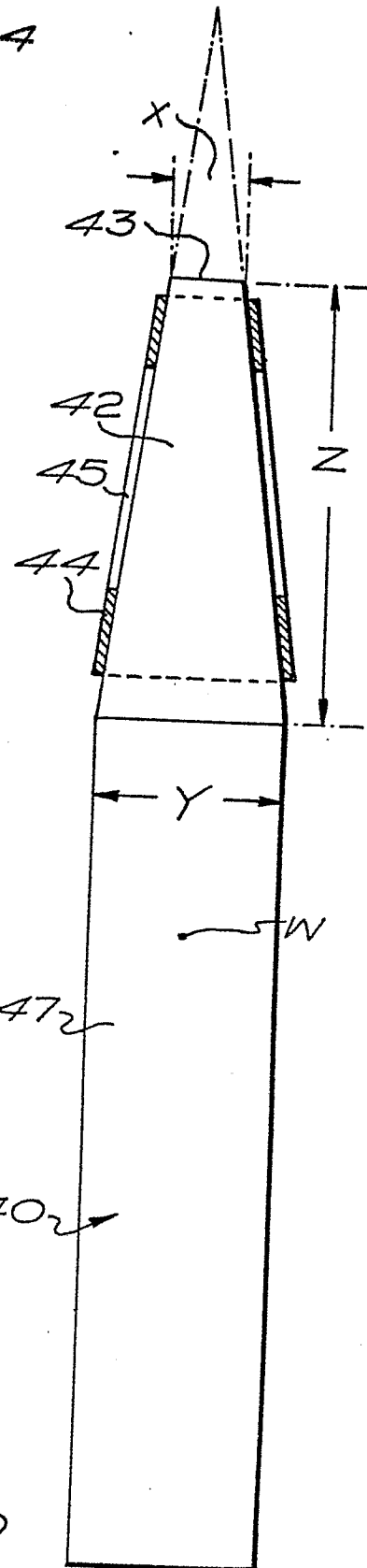


FIG. 12

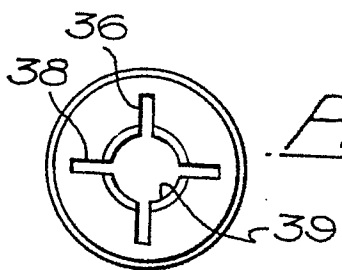


FIG. 11



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	GB-A-2 081 340 (ALLAN HENRY GEORGE) * page 1, lines 15-20, 32-38; claims 1-6; figures 1-17 *	1, 2, 4, 5	E 21 D 15/02
X	GB-A-2 096 203 (LONGWALL MINING EQUIPMENT) * page 1, lines 59-67; claim 1; figures 1,2 *	1, 5-7	
A	GB-A- 721 647 (LUKA) * claim 1; figures 2-5 *	1	
A	GB-A- 244 654 (WILKE) * claim 1; figures 1,2 *	1	
A	EP-A-0 028 496 (MINE SUPPORT SYSTEMS)		TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			E 21 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17-02-1984	Examiner HAKIN R.E.M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			