

CONVENTION

AUSTRALIA

Patents Act 1990

NOTICE OF ENTITLEMENT

We, HEINRICH QUANTE BERG- UND INGENIEURTECHNIK GmbH & CO. KG of
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state the following in connection with Australian Application No. 55535/90:

1. The nominated person is the assignee of the actual inventor.
2. The nominated person is the applicant of the basic applications.
3. The basic applications are the applications first made in a
Convention country in respect of the invention.

Dated: 14 November 1991

By PHILLIPS ORMONDE & FITZPATRICK
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By:

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To: The Commissioner of Patents

Our Ref: 234227

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03/11/91 15/11/91



AU9055535

(12) PATENT ABRIDGMENT **(11) Document No. AU-B-55535/90**
(19) AUSTRALIAN PATENT OFFICE **(10) Acceptance No. 638249**

- (54) Title
FLEXIBLE TELESCOPIC PROP FOR BUILDING MATERIALS
- International Patent Classification(s)
(51)⁵ **E21D 015/18**
- (21) Application No. : **55535/90** (22) Application Date : **10.05.90**
- (87) PCT Publication Number : **WO90/14499**
- (30) Priority Data
- | (31) Number | (32) Date | (33) Country |
|----------------|-----------------|-------------------|
| 3915837 | 16.05.89 | DE GERMANY |
| 4000310 | 08.01.90 | DE GERMANY |
- (43) Publication Date : **18.12.90**
- (44) Publication Date of Accepted Application : **24.06.93**
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- (56) Prior Art Documents
DE 2847906
GB 2100318
US 3891184
- (57) Claim

1. A support element for use in underground mining and tunnel construction, particularly to secure mining cavities at a longwall face and headway, comprising an outer tube and an inner tube which are telescopically movable relative to each other, in which the outer ends of the tubes are closed off and the inner ends of the tubes open into each other, said inner and outer tubes being adapted to receive a settable material which on setting and hardening is operative to keep the tubes spaced from each other such that the tubes can absorb loading and form a prop, said inner and outer tubes having mechanical bracing means for mechanically bracing the tubes at a plurality of extension lengths prior to the introduction of the settable material thereto and said inner and outer tubes further including a plurality of drainage bore holes formed in each of the tubes for permitting the drainage of liquid out of the inner and outer tubes.

55535/90



PCT
ANNOUNCEMENT OF THE LATER PUBLICATION
OF INTERNATIONAL SEARCH REPORTS
 INTERNATIONALE ANMELDUNG VERÖFFENTLICHT NACH DEM VERTRAG ÜBER DIE
 INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT)

(51) Internationale Patentklassifikation ⁵ : E21D 15/18,	A3	(11) Internationale Veröffentlichungsnummer: WO 90/14499 (43) Internationales Veröffentlichungsdatum: 29. November 1990 (29.11.90)		
<table style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> (21) Internationales Aktenzeichen: PCT/DE90/00330 (22) Internationales Anmeldedatum: 10. Mai 1990 (10.05.90) (30) Prioritätsdaten: P 39 15 837.3 16. Mai 1989 (16.05.89) DE P 40 00 310.8 8. Januar 1990 (08.01.90) DE (71) Anmelder (für alle Bestimmungsstaaten ausser US): HEINRICH QUANTE BERG- UND INGENIEURTECHNIK GMBH & CO. KG [DE/DE]; Reitzensteinstraße 20, D-4350 Recklinghausen (DE). (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): QUANTE, Heinrich [DE/DE]; Behringstraße 23, D-4350 Recklinghausen (DE). </td> <td style="width: 50%; vertical-align: top;"> (74) Anwalt: SCHULTE, Jörg; Hauptstraße 2, D-4300 Essen-Kettwig (DE). (81) Bestimmungsstaaten: AT (europäisches Patent), AU, BE (europäisches Patent), CA, CH (europäisches Patent), DE (europäisches Patent)*, DK (europäisches Patent), ES (europäisches Patent), FR (europäisches Patent), GB (europäisches Patent), HU, IT (europäisches Patent), KR, LU (europäisches Patent), NL (europäisches Patent), SE (europäisches Patent), SU, US. Veröffentlicht Mit internationalem Recherchenbericht. Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist. Veröffentlichung wird wiederholt falls Änderungen eintreffen. (88) Veröffentlichungsdatum des internationalen Recherchenberichts: 21. Februar 1991 (21.02.91) </td> </tr> </table>			(21) Internationales Aktenzeichen: PCT/DE90/00330 (22) Internationales Anmeldedatum: 10. Mai 1990 (10.05.90) (30) Prioritätsdaten: P 39 15 837.3 16. Mai 1989 (16.05.89) DE P 40 00 310.8 8. Januar 1990 (08.01.90) DE (71) Anmelder (für alle Bestimmungsstaaten ausser US): HEINRICH QUANTE BERG- UND INGENIEURTECHNIK GMBH & CO. KG [DE/DE]; Reitzensteinstraße 20, D-4350 Recklinghausen (DE). (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): QUANTE, Heinrich [DE/DE]; Behringstraße 23, D-4350 Recklinghausen (DE).	(74) Anwalt: SCHULTE, Jörg; Hauptstraße 2, D-4300 Essen-Kettwig (DE). (81) Bestimmungsstaaten: AT (europäisches Patent), AU, BE (europäisches Patent), CA, CH (europäisches Patent), DE (europäisches Patent)*, DK (europäisches Patent), ES (europäisches Patent), FR (europäisches Patent), GB (europäisches Patent), HU, IT (europäisches Patent), KR, LU (europäisches Patent), NL (europäisches Patent), SE (europäisches Patent), SU, US. Veröffentlicht Mit internationalem Recherchenbericht. Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist. Veröffentlichung wird wiederholt falls Änderungen eintreffen. (88) Veröffentlichungsdatum des internationalen Recherchenberichts: 21. Februar 1991 (21.02.91)
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(54) Title: FLEXIBLE TELESCOPIC PROP FOR BUILDING MATERIALS

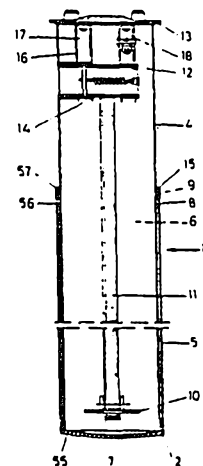
(54) Bezeichnung: NACHGIEBIGER BAUSTOFF-TELESKOPSTEMPEL

(57) Abstract

A structure for supporting mining cavities in underground mines and tunnels comprises props or elements (1) filled with building material (6). The elements (1) are composed of several telescopic inner and outer tubes (4, 5) which can be braced against each other and against the roofs and floors by means of a suitable mechanism. The telescopic prop is first braced in this manner and then filled with building material (6). The building material (6) can be rapidly and advantageously hardened by means of a drainage device, in particular drainage boreholes (49, 50), and therefore a structure of this type can absorb high supporting forces. The core of building material is secured by the outer and inner tubes (5, 4) which act as a sheath. A reinforcement (45) can also be inserted in order to further increase the supporting forces to be absorbed. This telescopic prop comprising individual inner and outer tubes (4, 5) can be used to obtain a multiple-section supporting arch (89). Each end face of the inner and outer tubes (4, 5) carries connecting butt straps (85, 86) with boreholes (88), so that a very simple articulated joint can be obtained.

(57) Zusammenfassung

Für die Sicherung bergmännischer Hohlräume im untertägigen Berg- und Tunnelbau ist ein Ausbau vorgesehen, der aus mit Baustoff (6) befüllten Stempeln bzw. Elementen (1) besteht. Die Elemente (1) sind dabei aus mehreren ineinanderverschiebbaren Innen- und Außenrohren (4, 5) zusammengesetzt, die durch eine geeignete Mechanik gegeneinander und gegen die Firste und Sohle verspannbar sind. Der Teleskopstempel wird auf diese Weise zunächst einmal verspannt und erst dann mit Baustoff (6) gefüllt. Durch eine Baustoffentwässerungseinrichtung, insbesondere durch Entwässerungsbohrungen (49, 50) kann der eingefüllte Baustoff (6) schnell und vorteilhaft aushärten, so daß ein derartiger Ausbau hohe Stützkkräfte aufnehmen kann. Der Baustoffkern ist durch das als Hülle dienende Außen- und Innenrohr (5, 4) gesichert, wobei auch eine Bewehrung (45) eingebracht werden kann, um so die aufzunehmenden Stützkkräfte noch zu erhöhen. Aus diesen einzelnen Innen- und Außenrohren (4, 5) aufweisenden Teleskopstempeln kann ein mehrgliedriger Ausbaubogen (89) erstellt werden, wobei jeweils die Endseiten von Innen- und Außenrohr (4, 5) Verbindungsglaschen (85, 86) mit Bohrungen (88) tragen, so daß eine sehr einfache Gelenkverbindung erreicht werden kann.



FLEXIBLE TELESCOPIC PROP FOR BUILDING MATERIALS

5 The invention relates to a support element for use in underground mining or tunnel construction, in particular for securing mining cavities at the longwall face and headway, comprising inner and outer tubes which move inside each other and a settable building material core which holds the two tubes at a desired distance from each other.

10 The so-called single use support is currently still being used in many areas of underground mining. It consists primarily of suitably sized wood props, trough profile supports, double-T supports, etc. Often individual hydraulic props are also used, either to
15 supplement the latter or by themselves. This results, however, in great expenditures because of the high production costs. The required support pressure in these hydraulic systems may be maintained advantageously by the pressure in the hydraulic system (300 to 600 bar) and
20 accurately operating pressure limit valves. All props in the system are characterized by identical characteristic or performance curves. Such hydraulic systems represent the optimum technical solution for rock support in a mobile application. But in a stationary design
25 application the above mentioned disadvantages occur. In headways where convergence is expected, so-called flexible trough profiles are used, whereby the friction coefficient is inaccurate and thus a safe and even support of the ceiling or the roof cannot be ensured. This also applies
30 to the two-part roadway or headway props known from German Patent 818332 where the outer prop is filled with a compressible fill mass. The intention there is to achieve a specific flexibility of the otherwise rigid
35 construction. But the disadvantage is that such elements are not tight enough for effective fill masses to be used. The used bitumen-like plastic fill masses do not provide the necessary and required support pressures. The same is true for the solution proposed by German Offenlegungsschrift 32 36 421.0 in which such a pasty mass



is arranged between two hollow tubes and is supposed to be displaced from there.

The invention thus has the object of creating a support element used as a single use prop which supports early on, absorbs high pressures, and is easy to handle.

According to this invention there is provided a support element for use in underground mining and tunnel construction, particularly to secure mining cavities at a longwall face and headway, comprising an outer tube and an inner tube which are telescopically movable relative to each other, in which the outer ends of the tubes are closed off and the inner ends of the tubes open into each other, said inner and outer tubes being adapted to receive a settable material which on setting and hardening is operative to keep the tubes spaced apart from each other such that the tubes can absorb loading and form a prop, said inner and outer tubes having mechanical bracing means for mechanically bracing the tubes at a plurality of extension lengths prior to the introduction of the settable material thereto and said inner and outer tubes further including a plurality of drainage bore holes formed in each of the tubes for permitting the drainage of liquid out of the inner and outer tubes.

With such a construction it is possible to brace the telescopic tube between roof and floor using simple mechanical bracing means. The single use prop or support element is thus able to introduce significant forces into the rock as soon as the building material or settable material has been introduced thereto and has hardened. In addition, the support element is anchored stably by the mechanical bracing means so that filling with concrete or settable building material may take place safely. Since the settable building material is only introduced to the element once the element has been braced in position by the mechanical bracing means, the single use prop is easy to use and has the advantage that the settable concrete or building material may be pumped in, in a more liquid form, the excess water being drained therefrom through drainage boreholes. Because of this draining, the filled-in

building material forms a supporting building material core which is significantly stabilised by the surrounding steel tube and is shaped so that it is able to absorb loads in excess of 100 tons. Since the building material core in both tube parts stands after hardening as a support column, the mechanical bracing means providing the preloading or prestressing is no longer required. As a result a simple and cheap mechanism may be used. The invented telescopic prop has a preload of ca. 47 kg/N.

The mechanical bracing means for mechanically bracing the tubes at a plurality of extension links may take any one of a variety of forms. For example according to one preferred embodiment, the mechanical bracing means comprises several bands running between the inner and outer tubes which are both fastened at the top end of the outer tube and passed through openings at the bottom and around the bottom end of the inner tube and attached at a collecting plate which is arranged within the inner tube. The collecting plate is connected by a center band to a rotatable spool located towards the opposite end of the inner tube. In this manner, the bands are able to fulfil their function without threat of tearing in order to achieve the extension of inner and outer tubes.

In order that the spool may also be used as a fill pipe, the invention preferably provides that the spool is mounted to a cap-like constructed head plate while being held by two U-sheets. The fill pipe is constructed as a hollow tube open at both ends and is equipped with either a flap valve which is located at the inner end, or a spring-loaded slide. Since the spool is located at the top end, that is in the area of the head plate, a complete filling of the telescopic tubes or prop with building material or settable material is facilitated, the flap valve or slide ensuring that after filling of the element, the still fluid building material or settable material cannot escape through the fill pipe.

In order to maintain the preload or pretension once it has been generated by the reeling in of the spool, the invention preferably provides that in the area of the

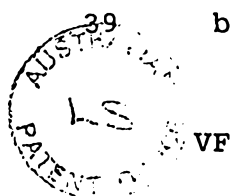


second U-sheet a return block or brake means is located. The return block or brake means preferably comprises a rope wound several times around the spool which is attached to a spring means, the spring means generating the necessary friction to prevent unravelling of the spool. Thus the return block or brake means functions according to the principle of rope friction. The rope is wound several times around the spool in such a way that its ends are fastened to one of the tubes through the spring means, the spring means generating the necessary friction to prevent unravelling of the spool. The spool is turned by means of a winding bolt which engages a tension bar which cuts through the spool.

As mentioned above, other optional mechanical bracing means for bracing the inner and outer tubes relative to each other may be used. For example, according to another embodiment, the mechanical bracing means comprises having the spool constructed as a gypsy spool and mounted on the outside of the outer tube towards the top edge thereof, and where on the outside wall of the inner tube, bands which correspond to the gypsy spool are arranged. The diameter tolerance between inner and outer tube is chosen so that two or three thin ropes or bands can be fastened on the inner tube in such a way that the inner tube may still be moved telescopically relative to the outer tube. The bands are also passed around the tabs at the lower end of the inner tube so that no damage can occur. The gypsy spool ensures a favourable winding moment and prevents unintentional unwinding.

According to yet another embodiment, the mechanical bracing means comprises the inner tube having one or more strips with semi-threads on the outside thereof and the spools being provided by endless screws with hexagon sockets at the free end which are mounted on the top edge of the outer tube. The entire arrangement turns easily this way, the inner tube being "unscrewed" from the outer tube via the endless screws.

According to yet another embodiment, the mechanical bracing means comprises assigning separate bands to



respectively the outer and inner tubes and then to move the bands relative to each other with the aid of a tightening or closing apparatus as is commonly used in the packaging industry so as to pull the inner tube
5 telescopically out of the outer tube. Of course any other suitable mechanical bracing means could just as easily be used, such as hydraulic cylinders or the like.

The necessary safety factors are achieved particularly if the bands and the center band consist of
10 plastic, e.g. a cord strap polyester.

In underground mining, two-component plastics are typically used for rock reinforcement. Such a material may also be used as the filler, settable material or building material for the support element. Thus the
15 filler or building material may be formed by a two-component plastic provided with a reinforcement, preferably in the overlap area between the outer and inner tubes. With the use of steel fibers or a similar reinforcement, a highly stable building material core of
20 high strength can be obtained enabling such a single use prop to perform a demanding support function.

In order to produce a single use prop which produces an approximately identical characteristic or performance curve in all applications and to provide a yielding support element, the filling or material includes a deformation element which prevents transverse expansion, preferably in the form of a cartridge containing breeze concrete which has edges which may be moved telescopically relative to each other. This deformation element or
25 cartridge may be prefabricated in such a way that an accurate response resistance to yielding is provided. Limited telescoping or yielding, in particular under unfavourable conditions, ensures long standing times of such a single use prop. If individual single use props
30 include the same deformation elements, the props advantageously exhibit the same characteristic or performance curve. The use of a prefabricated cartridge ensures that the pressure, in N/mm^2 , building up in the cartridge only allows compression when a predetermined
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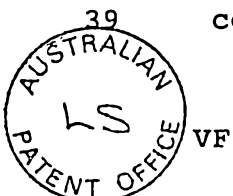


resistance to yielding has been overcome and a compression (measured in %) takes place, while a transverse expansion is resisted or is completely excluded.

Transverse expansions may advantageously be prevented in that the cartridge has two or more chambers one of which is filled with a pasty mass or grainy material, both being connected with each other and/or to atmosphere via a rupture disk or a valve. Instead one chamber may be filled with non-hardening cement or putty and the other chamber with steel balls or gravel. The displacement of the pasty material or pasty mass or overcoming of the resistance of the rupture disk or valve only occurs once a specific threshold force has been attained and thus the prop only demonstrates its yieldability once the threshold forces have been attained.

To ensure that the prop does not slide from its predetermined position, the head plate has associated therewith a building material-filled tissue cushion. Such a tissue cushion advantageously results in form fitting between support elements which are connected. A kind of circular arch support is achieved in that the head plate and base plate are equipped with corresponding connecting butt straps with bolt boreholes and are connected with other elements resulting in a multi-segmented support arch. Because of the tissue cushions here, additional forces may be absorbed, if the former are for example arranged in the joint areas.

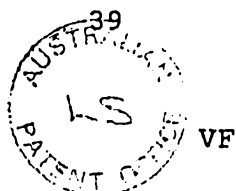
The advantage of a support element in accordance with the invention is that a versatile, preloadable single use prop is created which is also easy to handle and easy to transport. This single use prop significantly increases support safety since it is capable of adapting to specific installation site conditions and is equipped with a building material core which absorbs high supporting forces. The building material is introduced through the inner tube under pressure after the two tubes have been pulled out or pushed apart via the mechanical bracing means which simultaneously ensures an even and complete filling. After the hardening of the building



material core, the sheathing is designed in such a way that compressive forces may be absorbed. A premature destruction of the outer and inner tubes which form a type of sheath is thereby practically precluded. The choice or quality of the respective tubes also may significantly increase the standing time of the tubes, especially by the arrangement of deformation elements which provide a limited resilience.

Other details and advantages of the support element will become apparent from the following description in which various preferred embodiments are shown with the necessary details and individual parts.

- Fig. 1 shows a section of a single use prop;
Fig. 2 shows a cross-section of a headway with a single use support element;
Fig. 3 shows an enlarged drawing of the connection area between supporting arch and telescopic prop;
Fig. 4 shows the single use prop according to Fig. 1 in another longitudinal section;
Fig. 5 shows an enlargement of the head area of the single use prop with a longitudinal section of the spool;
Fig. 6 shows a cross-section of the head area of the single use prop with spool;
Fig. 7 shows a simplified drawing of a filling pipe installed in the inner tube;
Fig. 8 shows a top view of the slide correlated with the filling pipe;
Fig. 9 shows a dual-chambered construction of the deformation element;
Fig. 10 shows an insertable construction of the deformation element;
Fig. 11 shows a section through the telescopic prop with automatic bracing;
Fig. 12 shows another construction of the single use prop;
Fig. 13 shows an automatic bracing of the outer and inner tubes taken from the packaging



industry;

Fig. 14 shows a section of a single use prop with drainage boreholes and reinforcement; and

Fig. 15 shows a single use prop consisting of several support elements interconnected with joints.

In the drawing according to Fig. 1 a single use prop or support element 2 consisting of the elements 1 is shown in the form of a stemple. The single use prop 2 here consists of two tube sections namely an inner tube and outer tube which are sized so that they may be telescopically displaced relative to each other. Accordingly, the inner tube 4 has a smaller diameter than the outer tube 5. After extension and bracing between a roof and floor, or topwall and footwall (not shown), a filling or settable material 6 shown in Fig. 1 in the form of a building material core is introduced into the prop 2 making it possible for the single use prop 2 to absorb high loads. Experiments have shown that a 4.4 m long prop with 300 mm diameter can support a load of 395 tons. A 6 m long prop with the same diameter still has a 255 ton support strength. A 4 m long prop with 200 mm diameter has a 170 ton support strength. Since the inner tube 4 without a bottom moves within the outer tube 5 without a top, it is possible to fill both tubes simultaneously with building material.

In order to be able to brace the single use prop 2 between the roof and floor, i.e. to install it with a certain preload, bands 7,8 run between inner tube 4 and outer tube 5 and pass through openings 9 through the respective wall of the inner tube or outer tube. The openings are designated with 9 or 9' and have a special shape in as far as they form a tab by folding down a corresponding partial section. Fig. 4 shows this particularly clearly in the bottom area.

The bands 7,8 are fastened at the free end of the outer tube 5 and attached in the area of the lower end of the inner tube 4 at a collecting plate 10 which is located there. In the version shown in Fig. 1 and 2, three bands



7,8 each are fastened to the collecting plate 10 by a loop. On the top of the collecting plate 10 a center band 11 which is attached at the opposite inner tube end 12 in the area of the head plate 13 at a spool 14, is deflected. This spool 14 is operated from the outside so that the winding up of the central band 11 changes the position of the collecting plate 10, which simultaneously pulls the inner tube 4 from the outer tube 5. In this way a bracing of the steel pipe 1 is achieved. In the process it is important that the individual bands 7,8 are attached at the top edge 15 of the outer tube 5 in such a way that a shortening of the center band 11 also safely makes the inner tube 4 leave the outer tube 5. For this purpose a guide ring 57 at the open end of the outer tube 5 is provided.

The spool 14 is safely mounted via a mounting 16 which is connected with the head plate 13. The mounting 16 consists of two spaced U-sheets 17,18, the spool 14 thereby being supported at a total of four points and being rotatable from the outside without problems.

Fig. 2 shows an application of the single use prop. Here a headway 28 is shown which is secured by support arches 29. These support arches 29 consist of various segments 31,32 which are held together via connections 30, which move into each other when the friction forces produced by the connection 30 are exceeded, so that the cross-section of the headway 28 secured by the support element correspondingly decreases. In order to delay this moving-in as long as possible, the single use prop 2,33 is inserted between floor 36 and roof 37 in such a way that it is able to absorb forces. This ensures that the cross-section necessary for the passage of conveyors 34 and trolleys 35 through the headway 28 is maintained for as long as possible.

In the area of the head plate 13, the inner tube 4 has a bore 65 (Fig. 5), through which the building material may be introduced into the entire element 1. This borehole is closed by a flap valve 67 in order to prevent the introduced building material from flowing back



out after the filling process.

Fig. 3 shows a top area of a prop which is used for supporting the top segment of the support arch 29 according to Fig. 2. Between this support arch 29 and the head plate 13, a tissue cushion 91 is provided. The cushion 91 closely surrounds the support arch 29 and head plate 13, so that after the building material contained in the tissue cushion 91 hardens, a form-fitting connection is achieved.

Figs. 5 and 6 show the top area of the single use support element 2. The enlarged drawing details the simple and useful support of the spool 14 and its safeguarding against unintentional return or unravelling during the filling in of building material 6. The seal 64 is located in the front area of the spool 14. Its exact position is defined both by the wall of the inner tube 4 and the U-shaped sheet 17. This sheet 17 ensures safe positioning of the seal 64 which effectively seals the area around the borehole 65. The U-sheet 17 also ensures an overall thrust-resistant position of the spool 14 by holding between the two walls of the U-sheet 17 an external ring 71 which has a tension bar 70 which simultaneously functions as a support for the return spring 69 of the flap valve 67. The flap valve 67 which is equipped with an inside guide 68 securely closes the internal chamber 66 of the inner tube 4 and outer tube 5. The filling in of the building material moves the flap valve 67 in such a way that the building material is able to flow into the internal chamber 66. When the building material stream slows down the flap valve 67 automatically recloses.

The U-sheet 17 is connected to the head plate 13 via a screw 72, in the same manner as the U-sheet 18 is connected via a screw 78 to the head plate 13. Numeral 73 indicates attachment screws with which the central band 11 is fastened to the spool 14.

A simple brake for the spool 14 is provided via the return block 74 consisting of a rope wound several times around the spool 14 which is fastened at the end via a

rope fastener 79. The rope loop 76 holds a spring 77 which ensures the rope 75 with its various turns always lies tight to the spool 14. The function and attachment are shown especially clearly in Fig. 6, whereby the rope fastener 79 grabs both sides of the rope 75.

Over and above this, Fig. 6 shows that a particularly advantageous fill pipe is provided by the spool 14. For use with this type of fill pipe, a winding bolt has been provided which may be inserted into the spool 14 and which is fastened to the tension bar 70 via angled and transverse slits corresponding to it.

Figs. 7 and 8 show another version of the fill pipe 108 which is secured with a slide 109 which again is loaded by a spring 111 in such a way that it automatically closes the borehole 65 in the inner tube 4 after withdrawal of the filling hose.

Fig. 9 shows the deformation element 95 located in the lower area of the outer tube 5 (already indicated in Fig. 1) i.e. in the form of a prefabricated cartridge 96. As a supplement to this, Fig. 10 should be referred to, Fig. 10 showing a version where a specific breeze concrete 97 is located inside the cartridge 96 which resists the telescoping together of the parts of the cartridge 96 which have interfitting edges 98,99. With the deformation of the breeze concrete 97 the single use prop 2 may be moved in as far as inner and outer tubes 4,5 move inside each other, i.e. as far as the breeze concrete permits.

According to Fig. 9, a cartridge 96 with two chambers 100,101 is provided which is integrated into the single use prop 2, whereby the bottom chamber 101 is filled with a pasty mass 102. Both chambers 100,101 are separated by a rupture disk 103 which ensures that an unintentional compression of the deformation element does not take place. The upper chamber 100 is filled with gravel 104 into which the pasty mass 102 must be pressed during the crushing of the rupture disk 103. The pressing of the pasty mass 102 into the chamber 100 and thus into gravel 104 compresses the deformation element 95 and the single use prop 2 yields.



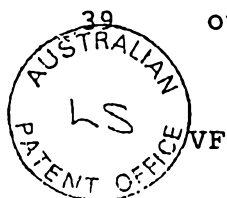
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Fig. 11 shows the already described version in which a corresponding band 7,8 is fastened on one side at the fixing point 113, and is then passed around the bottom of the inner tube 4 and the deflection rollers 112 located there, then upward towards the edge 15 where a spool 14 is positioned within in a case 110. The winding up of the band 7,8 causes this spool 14 to lift the inner tube 4 out of the outer tube 5.

Fig. 12 shows a version in which the spool 14 is also mounted on the top edge 15 of the outer tube 5. However, the spool 14 here consists of an endless screw 20 which engages with a sheet metal strip 19 set onto the outside wall of the inner tube 4. The endless screw 20 has a hexagon socket 21 at its free end 22 so that it can be turned easily. The sheet metal strip 19 is equipped with a semi-thread as is found in adjustable hose clamps. The top edge 15 of the outer tube 5 supports the endless screw 20 which is equipped with the hexagon socket 21, whereby the mounting 16 is provided in the form of a simple push-over cap.

Another version is shown in Fig. 13, where ropes and bands are distributed around the circumference of the tubes 4 and 5. The steel bands 24, in this version are fixed at the lower end of the inner tube 4, are passed e.g. via the attachment plate and then the intermediate space between inner tube 4 and outer tube 5 and are again returned to the outside at the top end of the outer tube 5. In addition, a band end section 25 is also fastened to the top end of the outer tube 5 in the form of a steel band, so that with a commercially available tightening and closing apparatus, the two bands are moved relative to one another to telescope the inner and outer tubes 4 and 5. Corresponding apparatus for the connection of the steel bands 24,25 are known e.g. from the packaging industry.

Fig. 14 clarifies how the moisture in the filled-in building material core 6, may be drained quickly and evenly. The corresponding drainage elements 47 which are arranged evenly over the length of the inner tube 4 and outer tube 5 consist of drainage boreholes 49,50 in the



wall 48 which are covered with a filter cloth 51 or 52 covering the inside of the inner tube 4 or outer tube 5. While water may drain unhindered, the building material is retained within the tubes so that a stable building material core 6 forms inside the tubes. In the transition area 46, a reinforcement 45 is located in order to stabilize the building material core 6.

As has already been explained above, by connecting the various steel pipes 1, 1', 1'', 1''' a support arch 89 may be produced from the single use prop 2, whereby the individual steel tubes or props have on their respective ends connecting butt straps 85,86 with bolt boreholes 88 and bolts 87. This facilitates installation and enables a bracing in that some of these props consist as described of telescopic tubes and some only of simple tubes. In the area of the bending points or connections, tissue cushions 92 may be arranged which are filled with building material. This results overall in an arch shape resembling a circular arch support.

Finally, it is to be understood that various alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the spirit or ambit of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A support element for use in underground mining and tunnel construction, particularly to secure mining cavities at a longwall face and headway, comprising an outer tube and an inner tube which are telescopically movable relative to each other, in which the outer ends of the tubes are closed off and the inner ends of the tubes open into each other, said inner and outer tubes being adapted to receive a settable material which on setting and hardening is operative to keep the tubes spaced from each other such that the tubes can absorb loading and form a prop, said inner and outer tubes having mechanical bracing means for mechanically bracing the tubes at a plurality of extension lengths prior to the introduction of the settable material thereto and said inner and outer tubes further including a plurality of drainage bore holes formed in each of the tubes for permitting the drainage of liquid out of the inner and outer tubes.

2. A support element according to claim 1, wherein said mechanical bracing means comprises:

a plurality of bands extending between the outer tube and the inner tube, each band passing through an opening towards a bottom end of the inner tube having one end fastened to the outer tube towards a top end thereof and an opposed end fastened to a collecting plate within the inner tube; and

a center band having one end fastened to the collecting plate and an opposed end fastened to a rotatable spool located towards an upper end of the inner tube, said spool being operable on rotation in one direction to displace the collecting plate away from the bottom end of the inner tube and thereby brace the inner tube relative to the outer tube.

3. The support element of claim 2, further including first and second U-sheets attached to a head plate closing off a top end of the inner tube, to which the spool is mounted, said spool being in the form of an open ended spool tube through which said settable material can be introduced into the inner and outer tubes, the

spool tube having a closure means at an inner end thereof for closing off said spool tube after said settable material has been introduced to the prop therethrough.

4. The support element of claim 3, including a brake means for the spool comprising a rope wound several times around the spool, which is attached to a spring means, each end of the rope ultimately being attached to a fastening means, the spring means generating the necessary friction to prevent unravelling of the spool.

5. The support element of claim 1, wherein the mechanical bracing means comprises a gypsy spool mounted on an outer side of the outer tube towards a top end thereof, and a plurality of bands extending along the outside of the inner tube which are operatively connected to both the spool and the inner tube.

6. The support element of claim 1, wherein the mechanical bracing means comprises a plurality of longitudinal strips mounted on the inner tube along the length thereof, the strips being semi-threaded and in engagement with an endless screw means fastened to the outer tube towards a top end thereof, the endless screw means having a hexagon socket.

7. The support element of any one of claims 1 to 5, wherein a plurality of bands and the center band are of a plastic material such as cordstrap polyester.

8. The support element of any one of claims 1 to 7, wherein the settable material comprises a dual component plastic provided with a reinforcement in a transition area between the outer and inner tubes.

9. The support element of any one of claims 1 to 7, wherein the settable material includes a deformation element which resists transverse expansion, the deformation element preferably being in the form of a cartridge having edges movable telescopically relative to each other.

10. The support element of claim 9, wherein the cartridge has at least two interconnected chambers, one chamber for filling with a pasty mass or grainy material and the other chamber for filling with steel balls or



gravel, communication between the two chambers or atmosphere being facilitated by the rupture of a rupture disk.

11. The support element of Claim 3, wherein a
5 tissue cushion is fixed on an outer side of the head plate.

12. A support element for use in underground mining and tunnel construction substantially as herein described with reference to any one of the embodiments illustrated in the accompanying drawings.

10 DATED: 15 April 1993

PHILLIPS ORMONDE & FITZPATRICK

Attorneys for:

15 HEINRICH QUANTE BERG- UND INGENIEURTECHNIK

GmbH & CO. KG

David B. Fitzpatrick

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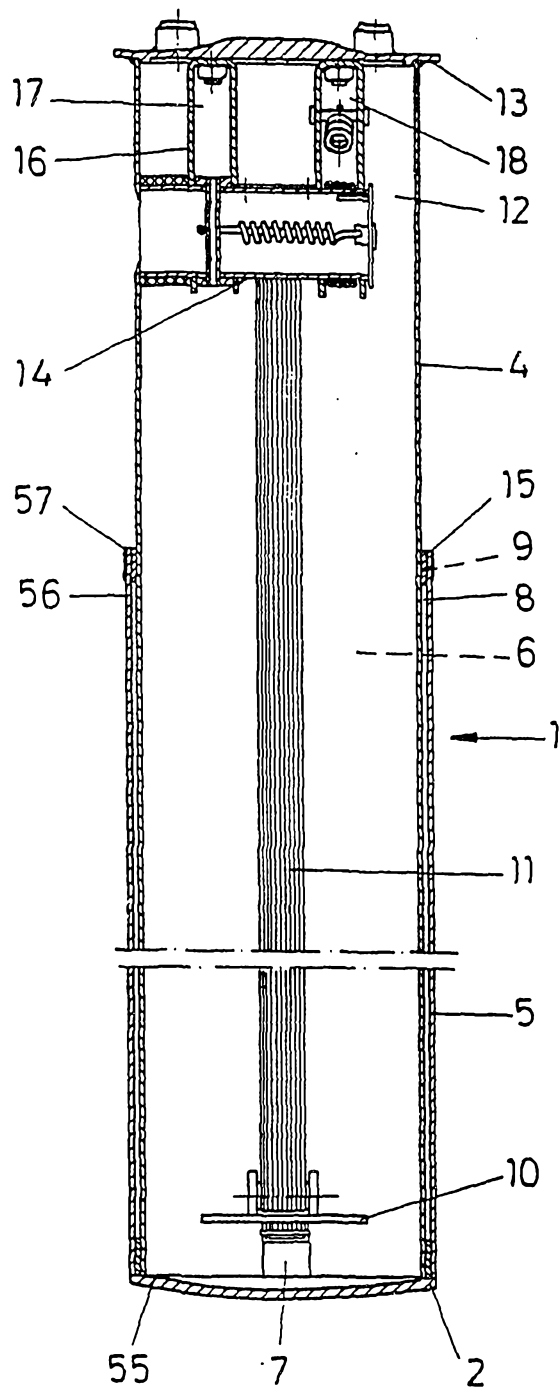
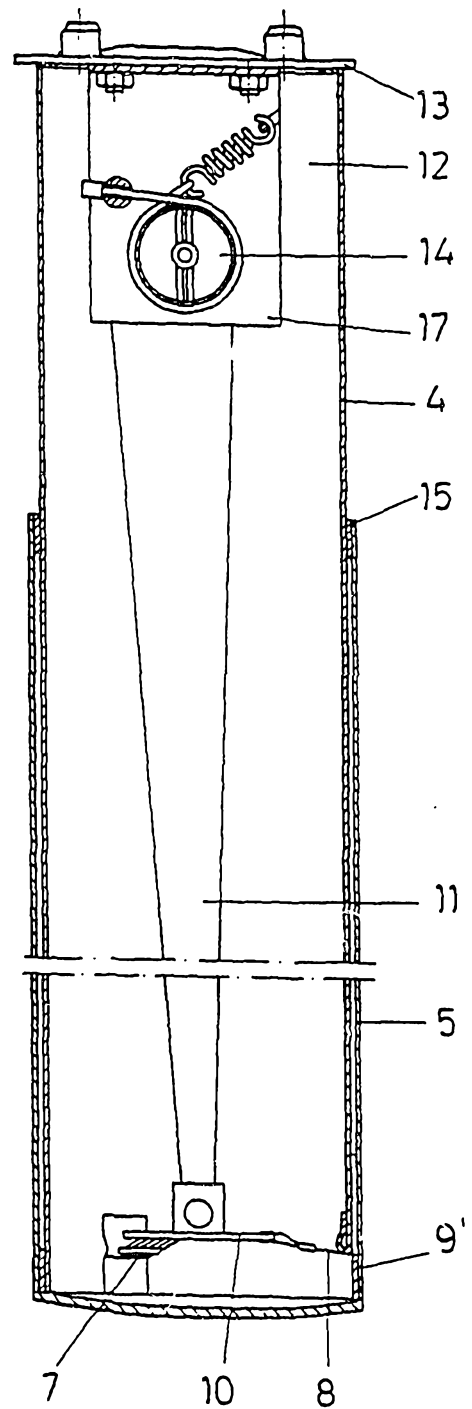
Abstract

For the security of mining cavities in underground mining and tunnel construction a structure is provided which consists of props or components filled with building material (6). The components are composed of several inner and outer tubes (4,5) which can be telescoped into each other, and which can be braced by suitable mechanics against each other and between overlying stratum and bottom. The telescopic prop is for a start braced in this manner and is only then filled with building material (6). By means of a building material drainage device, in particular by means of drainage boreholes (49,50), the charged building material (6) can harden quickly and advantageously so that such a structure can take up high support forces. The building material core is secured by the outer and inner tube (4,5) which functions as an envelope, whereby a reinforcement (45) can also be introduced in order to further increase the support forces to be absorbed. From these telescopic props having a single inner and outer tube (4,5) a multi-membered structural arch (89) can be produced, whereby in each case the ends of the inner and outer tube (4,5) have interconnecting loops (85,86) with boreholes (88) so that a very simple joint connection has been achieved.

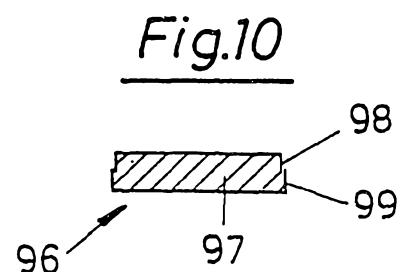
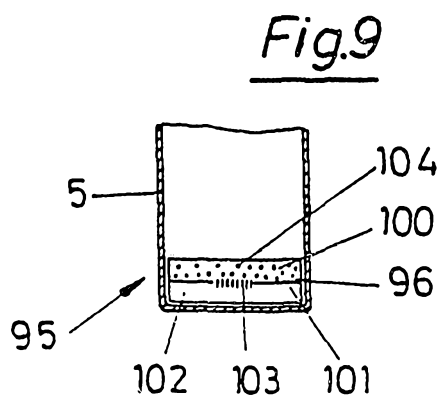
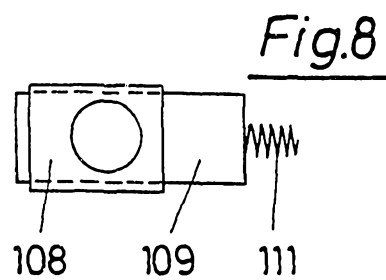
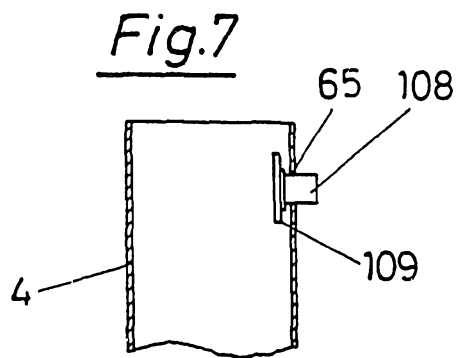
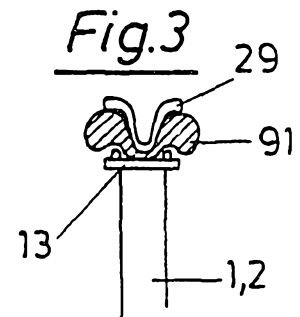
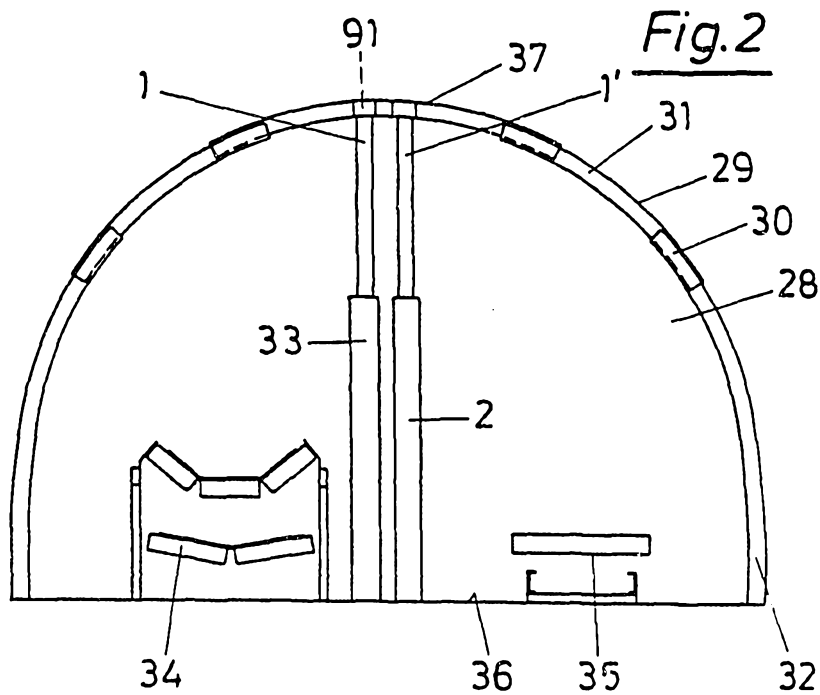


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Fig.1Fig.4

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4 / 5

Fig.11

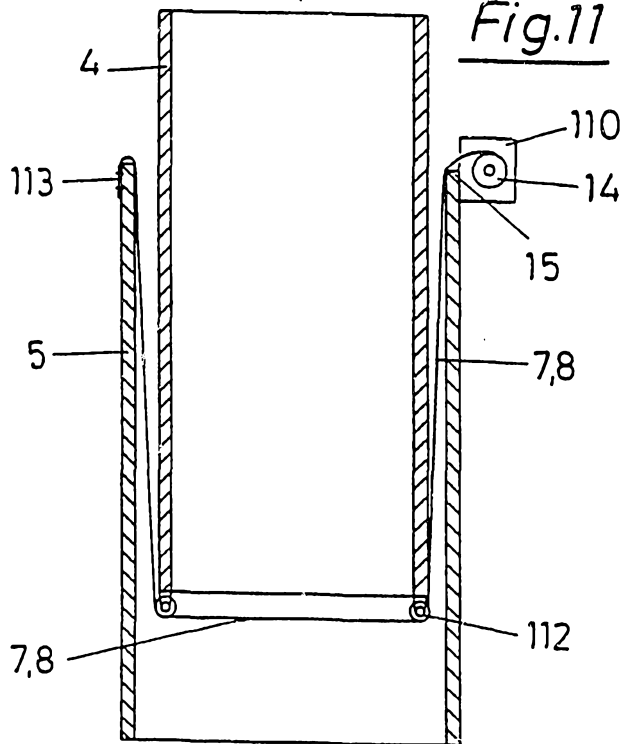


Fig.12

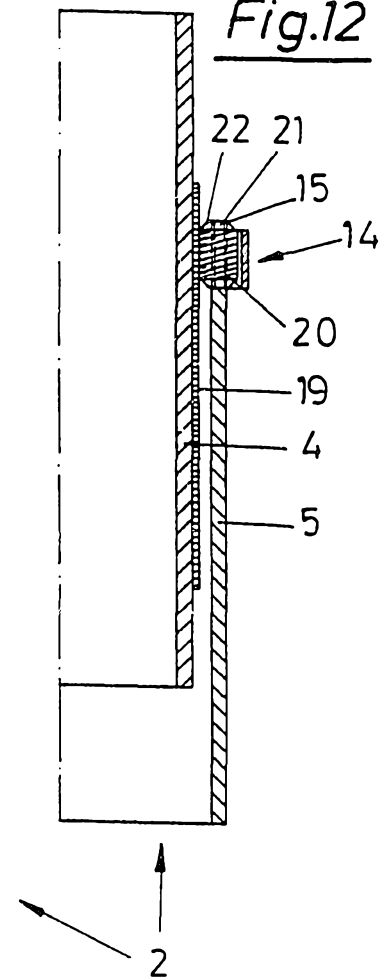


Fig.13

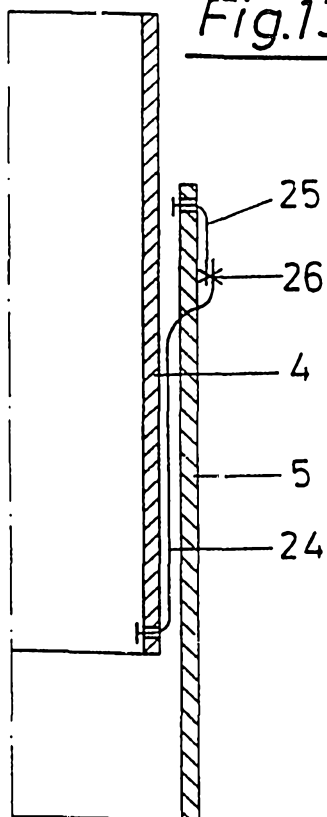
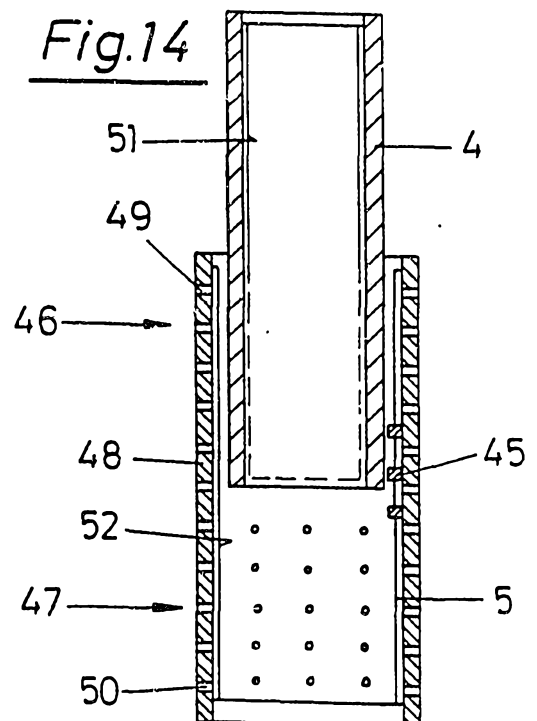


Fig.14



ERSATZBLATT

Fig.15

INTERNATIONAL SEARCH REPORT

International Application No PCT/DE 90/00330

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. ⁵ E 21 D 15/18		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int. Cl. ⁵	E 21 D, B 66 F, E 04 C	
Documentation Searched other than Minimum Documentation to the extent that such Documents are Included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁸		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	DE, A, 2847906 (HEINTZMANN) 10 May 1979, see page 18, line 11 - page 20; figs. 1-10 --	1,8
X	GB, A 2100318 (OGC RESEARCH AND DEVELOPMENT) 22 December 1982, see abstract; fig. 1 --	1,8
A	GB, A, 2114183 (BARKER) 17 August 1983, see abstract; fig. 3 --	1
A	US, A, 3891184 (FIELDS) 24 June 1975, see abstract; figs. --	2,5
A	DE, A, 3236421 (RUHRKOHLE) 17 May 1984 (cited in the application) --	
A	DE, C, 818332 (MANNESMANN) 25 October 1951 (cited in the application) --	
A	GB, A, 128580 (ARROW GRIP) 8 January 1920, see fig. 1 --	6
A	DE, C, 476783 (HUNDT et al.) 29 May 1929, see claim 1; figs. -----	9
* Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
26 November 1990 (26.11.90)	15 January 1990 (15.01.90)	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE		

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET		

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim numbers because they relate to parts of the International application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING: 2

This International Searching Authority found multiple inventions in this international application as follows:

1. Claims 1-5,7,8
2. Claim 6
3. Claims 9,10

./.

- ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
- ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
1. Claims 1-5,7,8 || Claims 9,10
2. Claim 6
- ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☒ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION

./.

4. Claim 11

5. Claim 12

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

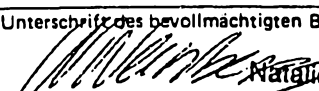
DE 9000330
SA 36585

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 21/12/90
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 2847906	10-05-79	US-A- 4185940	29-01-80
GB-A- 2100318	22-12-82	None	
GB-A- 2114183	17-08-83	None	
US-A- 3891184	24-06-75	None	
DE-A- 3236421	17-05-84	None	
DE-C- 818332		None	
GB-A- 128580		None	
DE-C- 476783		None	

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen **PCT/DE 90/00330**

I. KLASSEFIZKATION DES ANMELDUNGS-GE-GENSTANDS (bei mehreren Klassifikationssymbolen sind alle anzugeben) ⁶		
Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC		
Int.Cl. ⁵ E 21 D 15/18		
II. RECHERCHIERTE SACHGEBIETE		
Recherchierter Mindestprüfstoff ⁷		
Klassifikationssystem	Klassifikationssymbole	
Int.Cl. ⁵	E 21 D, B 66 F, E 04 C	
Recherchierte nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Sachgebiete fallen ⁸		
III. EINSCHLÄGIGE VERÖFFENTLICHUNGEN⁹		
Art*	Kennzeichnung der Veröffentlichung ¹¹ , soweit erforderlich unter Angabe der maßgeblichen Teile ¹²	Betr. Anspruch Nr. ¹³
X	DE, A, 2847906 (HEINTZMANN) 10. Mai 1979, siehe Seite 18, Zeile 11 - Seite 20; Figuren 1,10 --	1,8
X	GB, A, 2100318 (OGC RESEARCH AND DEVELOPMENT) 22. Dezember 1982, siehe Zusammenfassung; Figur 1 --	1,8
A	GB, A, 2114183 (BARKER) 17. August 1983, siehe Zusammenfassung; Figur 3 --	1
A	US, A, 3891184 (FIELDS) 24. Juni 1975, siehe Zusammenfassung; Figuren --	2,5
A	DE, A, 3236421 (RUHRKOHLE) 17. Mai 1984 (In der Anmeldung erwähnt) --	
A	DE, C, 818332 (MANNESMANN) 25. Oktober 1951 (In der Anmeldung erwähnt)	./.
* Besondere Kategorien von angegebenen Veröffentlichungen¹⁰: "A" Veröffentlichung, die den allgemeinen Stand der Technik definiert, aber nicht als besonders bedeutsam anzusehen ist "E" älteres Dokument, das jedoch erst am oder nach dem internationalen Anmeldedatum veröffentlicht worden ist "L" Veröffentlichung, die geeignet ist, einen Prioritätsanspruch zweifelhaft erscheinen zu lassen, oder durch die das Veröffentlichungsdatum einer anderen im Recherchenbericht genannten Veröffentlichung belegt werden soll oder die aus einem anderen besonderen Grund angegeben ist (wie ausgeführt) "O" Veröffentlichung, die sich auf eine mündliche Offenbarung, eine Benutzung, eine Ausstellung oder andere Maßnahmen bezieht "P" Veröffentlichung, die vor dem internationalen Anmeldedatum, aber nach dem beanspruchten Prioritätsdatum veröffentlicht worden ist "T" Späters Veröffentlichung, die nach dem internationalen Anmeldedatum oder dem Prioritätsdatum veröffentlicht worden ist und mit der Anmeldung nicht kollidiert, sondern nur zum Verständnis des der Erfindung zugrundeliegenden Prinzips oder der ihr zugrundeliegenden Theorie angegeben ist "X" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als neu oder auf erfinderischer Tätigkeit beruhend betrachtet werden "Y" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als auf erfinderischer Tätigkeit beruhend betrachtet werden, wenn die Veröffentlichung mit einer oder mehreren anderen Veröffentlichungen dieser Kategorie in Verbindung gebracht wird und diese Verbindung für einen Fachmann naheliegend ist "&" Veröffentlichung, die Mitglied derselben Patentfamilie ist		
IV. BESCHEINIGUNG		
Datum des Abschlusses der internationalen Recherche		Absenddatum des internationalen Recherchenberichts
26. November 1990		15. 01. 91
Internationale Recherchenbehörde		Unterschrift des bevollmächtigten Bediensteten
Europäisches Patentamt		 Natalie Weinberg

WEITERE ANGABEN ZU BLATT 2

A GB, A, 128580 (ARROW GRIP) 8. Januar 1920,
siehe Figur 1

6

A DE, C, 476783 (HUNDT et al.) 29. Mai 1929,
siehe Anspruch 1; Figuren

9

V. BEMERKUNGEN ZU DEN ANSPRÜCHEN, DIE SICH ALS NICHT RECHERCHIERBAR ERWIESEN HABEN¹

Gemäß Artikel 17 Absatz 2 Buchstabe a sind bestimmte Ansprüche aus folgenden Gründen nicht Gegenstand der internationalen Recherche gewesen:

1. ☐ Ansprüche Nr., weil sie sich auf Gegenstände beziehen, die zu recherchieren die Behörde nicht verpflichtet ist, nämlich
2. ☐ Ansprüche Nr., weil sie sich auf Teile der internationalen Anmeldung beziehen, die den vorgeschriebenen Anforderungen so wenig entsprechen, daß eine sinnvolle internationale Recherche nicht durchgeführt werden kann, nämlich
3. ☐ Ansprüche Nr., weil sie abhängige Ansprüche und nicht entsprechend Satz 2 und 3 der Regel 6.4 a) PCT abgefaßt sind.

VI. ☒ BEMERKUNGEN BEI MANGELNDER EINHEITLICHKEIT DER ERFINDUNG²

Die Internationale Recherchenbehörde hat festgestellt, daß diese internationale Anmeldung mehrere Erfindungen enthält:

1. Patentansprüche 1-5,7,8
2. Patentanspruch 6
3. Patentansprüche 9,10

./.

1. ☐ Da der Anmelder alle erforderlichen zusätzlichen Recherchegebühren rechtzeitig entrichtet hat, erstreckt sich der internationale Recherchenbericht auf alle recherchierbaren Ansprüche der internationalen Anmeldung.
2. ☒ Da der Anmelder nur einige der erforderlichen zusätzlichen Recherchegebühren rechtzeitig entrichtet hat, erstreckt sich der internationale Recherchenbericht nur auf die Ansprüche der internationalen Anmeldung, für die Gebühren gezahlt worden sind, nämlich

1. Patentansprüche 1-5,7,8
2. Patentanspruch 6

Patentansprüche 9,10

3. ☐ Der Anmelder hat die erforderlichen zusätzlichen Recherchegebühren nicht rechtzeitig entrichtet. Der internationale Recherchenbericht beschränkt sich daher auf die in den Ansprüchen zuerst erwähnte Erfindung; sie ist in folgenden Ansprüchen erfaßt:
4. ☐ Da für alle recherchierbaren Ansprüche eine Recherche ohne einen Arbeitsaufwand durchgeführt werden konnte, der eine zusätzliche Recherchegebühr gerechtfertigt hätte, hat die Internationale Recherchenbehörde eine solche Gebühr nicht verlangt.

Bemerkung hinsichtlich eines Widerspruchs

- ☒ Die zusätzlichen Gebühren wurden vom Anmelder unter Widerspruch gezahlt.
- ☐ Die Zahlung zusätzlicher Gebühren erfolgte ohne Widerspruch.

WEITERE ANGABEN

./.

4. Patentanspruch 11
5. Patentanspruch 12

**ANHANG ZUM INTERNATIONALEN RECHERCHENBERICHT
ÜBER DIE INTERNATIONALE PATENTANMELDUNG NR.**

DE 9000330
SA 36585

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten internationalen Recherchenbericht angeführten Patentedokumente angegeben.

Die Angaben über die Familienmitglieder entsprechen dem Stand der Datei des Europäischen Patentamts am 21/12/90

Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

Im Recherchenbericht angeführtes Patentedokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
DE-A- 2847906	10-05-79	US-A- 4185940	29-01-80
GB-A- 2100318	22-12-82	Keine	
GB-A- 2114183	17-08-83	Keine	
US-A- 3891184	24-06-75	Keine	
DE-A- 3236421	17-05-84	Keine	
DE-C- 818332		Keine	
GB-A- 128580		Keine	
DE-C- 476783		Keine	

EPO FORM P0473