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DRILLING PIPE

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(57) Claim

1. Drilling pipe, comprising at least

- one pipe element, which is provided externally with a continuous thread or thread-like profile, said element having a central longitudinal channel, which is continuous and being provided with a uniform internal thread along its entire length,
- a coupling part (3), being intended and constructed for connecting two of said pipe elements, consisting of a base, having on both end faces threaded sections, intended for screwing into a pipe element, and having a continuous longitudinal channel, and of an annular body, preferably in the centre of said base, fulfilling the function of a stop, and
- a drilling head (1) being provided with at least one axial discharge hole and having a pipe section (12) for a screwed connection with the drilling pipe to be screwed into one of its ends, and

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- with the diameter of said annular body of the coupling part (3) corresponding to that of the to be - connected pipe element,

- said annular body being provided with an external thread or a thread-like profile, said drilling-head (1) consisting of an axially short, plate-like drill bit (4) with cutting edges, a pipe element (5) welded onto this, and a pipe cylinder (6) which is shorter than the pipe element (5) and has the same diameter as the drilling pipe and is mounted with a corresponding external thread or a corresponding external thread-like deformation on the pipe element (5) by leaving out an undercut (29) and the pipe section (12) having an external thread on the other,

with the pipe sections (12) of the drilling head (1) and (27,28) of the coupling part (3) being intended and constructed for complete screwing into the facing ends of the drilling pipe,

with the drilling rod being extended with the use said coupling part (3) having the same outer diameter and especially an external thread or a thread-like profile of the same shape starting from the pipe cylinder (6) of the drilling head (1) up to its end, averted from the drilling head (1).

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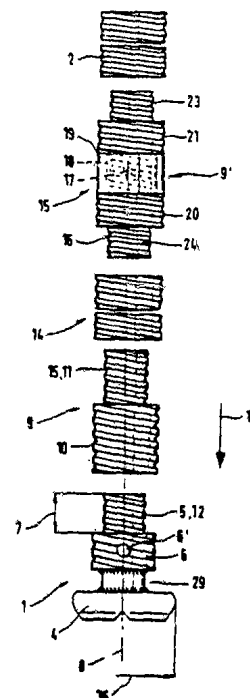
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(54) Title: DRILLING PIPE

(54) Bezeichnung: BOHRROHR

(57) Abstract

In order to improve the discharge conditions of a cleaning fluid containing rock particles loosened during the drilling stage, the proposal is for an injection drilling anchor, of which the anchor rods (2), coupling sections (3), compression valves (15), an intermediate component containing a nonreturn valve (9) and a drilling head (1) are designed so that these components can always be screwed together to provide a complete uniform structure on the outside from the drilling head (1) when assembled. A feature of said structure is an outside thread extending uniformly over the entire length and hence a uniform diameter, so that once drilling is completed, a spacer can be pushed from the drill-hole aperture over the anchor rods (2) to any point along the entire length inside the drill-hole. The anchor rods (2) are uniformly internally threaded over their entire length so that even sectioning does not adversely affect their suitability for use in connection with the injection drilling anchor (1). The coupling component, the compression valve (15), the intermediate component (9) and the drilling head (1) have tubular cylinders (20, 21; 10; 6) for this purpose, the internal and external threads of which correspond structurally to the anchor rods (2) and form a stop for screwing-in positions.



01

DRILL PIPE

The invention concerns a drilling pipe according to the generic part of claim 1.

- 05 Drilling pipes are known in many forms and are used in different applications. They can, for example, used as elements of injection drilling anchors, which, as is known, in their construction correspond basically to a drilling rod and after the production of the drilled
10 hole they remain inside of it as a lost tool. In this case after filling the drilled hole with a mortar suspension, the drilling rod is used as a sort of a rock anchor, which in the region of the opening of the drilled hole is braced against the rocks by an
15 anchoring plate in conjunction with a bracing nut. From the German patent 936 082 for example, an injection drilling anchor is known, on one end of which a drilling head and on the other end of which an offset threaded section is provided, which serves for the
20 screwed connection by means of the bracing nut mentioned. The anchor rod over its entire length is provided with a helically wound bead as well as with transverse holes, which are connected with a centrally situated longitudinal channel, through which the rock
25 dust developed during the drilling operation is evacuated. After the completion of the drilled hole a mortar suspension is introduced through the longitudinal channel and the transverse holes for the

- 01 purpose of filling and anchoring the anchor rod, while
this suspension penetrates into the existing cracks and
gaps of the rock and, particularly due to the bead-like
forms on the outside of the anchor rod after hardening
05 enables a reliable positive connection between the
anchor rod and the surrounding rocks.

- It is known to make use of construction elements known
from drilling rods to construct injection drilling
anchors. The German patent 14 83 840, for example,
10 shows a rock drilling rod with a centrally provided
flushing channel, which is provided with discharge
holes in the region of a drilling head which can be
screwed on. The rock drilling rod or anchor rod can be
extended by using a connecting sleeve which has an
15 internal thread, into which connecting sleeve a further
anchor rod is screwed in and the anchor rods used are
equipped over their entire length with a relatively
rough thread the like of a round thread. Such a rock
drilling rod is suitable in principle for the use as
20 an injection drilling anchor, wherein the external
thread of the anchor rods performs a transport function
during the drilling, inasmuch that the reverse flow of
a flushing fluid charged with rock particles is being
supported. The same thread performs in conjunction with
25 the hardened mortar an anchoring function, inasmuch
that it produces the positive connection between the
anchor rod and the surrounding wall of the drilled
hole. Finally, the thread also performs the function of
a screwed connection, inasmuch it makes the screwing
30 together with a connecting sleeve and with a drilling
head, feasible.

For a trouble-free operation of a rock anchor,
especially observed in the course of time, it is

01 essential for the anchor to be arranged as centrally as
possible inside the drilled hole, so that a uniform
mortar cover of the anchor is achieved along the entire
length covered by the mortar. An adequate corrosion
05 protection is present only in case of an anchor
reliably covered with mortar. However, this
requirement is often difficult to realise in practice,
at least without additional measures. For example, if
the anchor rod, due to local heterogeneity along the
10 wall, is eccentrically situated in the drilled hole, a
uniform filling, especially a cover or bedding in of
the drilling rod cannot be assured. At the same time an
eccentric placement of the anchor rod inside the mortar
body brings with it the danger that a portion of the
15 anchor rod is exposed to increased corrosion attack,
due to which, as time progresses, the main function of
the rock anchor, namely the nailing down of different
rock layers, is to be questioned.

From the German patent 38 28 335 distance spacers are
20 known in conjunction with injection drilling anchors,
which consist of a mounting boss directly surrounding
the anchor rod, which can be displaced relative to the
anchor rod, while on this mounting boss three radially
situated webs are provided, which are held together by
25 an outer annular body. Thus the use of this distance
spacer permits that during the production of a drilled
hole, in fact before attaching an extension anchor rod,
this distance spacer with its mounting boss is pushed
over the end of the anchor rod situated in the drilled
30 hole, while as a consequence of an abutting of the
mounting boss against a coupling nut which makes the
connection of an extension anchor rod feasible, the
distance spacer is introduced together with the anchor
rod into the drilled hole during the further drilling

- 01 operation. Thus in case of this embodiment the position
of the distance spacer is determined by the position of
the coupling nut. During the drilling and after the
completion of the drilled hole it is practically
05 impossible or not very easy to check the condition and
the trouble-free functioning of the distance spacer.
Thus, for example, as a consequence of high mechanical
stresses during the drilling operation, as well as due
to local heterogeneity of the drilled rock the distance
10 spacer can become damaged, so that it is possible that
it will not provide a centring effect. The distance
spacer may also hinder in some cases the removal or
drilling operation by a flushing medium depending from
the local rock conditions and composition.
- 15 The German patent application DE 32 34 406 discloses a
drill pipe connection in which individual drill pipe
elements have an inner thread extending either over its
whole length or only over partial end portions. The
drill pipe elements can also be provided with an outer
20 thread or a corresponding thread-like profile over a
whole length or only over partial end portions. For the
coupling of two drill pipe elements coupling parts are
provided and screwed into the ends of the drill pipes
and joined by central ring-shaped stop members for
25 abutment against the ends of the drill pipe. The ring
members can have an outer diameter which corresponds to
the outer diameter of the drill pipe or a smaller
diameter, so that the ring member is overlapped
outwardly by the projecting ends of the drill pipe
30 elements. The external thread-like profile of the drill
pipe elements is interrupted in the coupling region.

Finally, in conjunction with the so called cased holes
it is known to use distance spacers during the setting

01 of rock anchors, by which the rock anchors are centred
inside the outer pipe of the hole. As it is known, in
these cases the rock anchor is introduced into a pipe
filled with mortar and it is to be held inside of same
05 as centrally as possible. The distance spacers used in
this case are made of plastic material and in any case,
as far as strength is concerned, are completely
unsuitable to be used for injection drilling anchors of
the known type, so that they are hardly a match to the
10 high mechanical stresses arising during the drilling
process.

The object of the invention is to develop a drilling
pipe of the type described in the introduction to that
extent, that optimum discharge conditions will result
15 for a flushing medium which is charged with rock
particles during the drilling operation and the
drilling pipe is suitable especially for the use as an
injection drilling anchor. This object is achieved for
a drilling pipe of this type by the features of the
20 characterizing part of claim 1.

Thus the use of a pipe element as a drilling pipe is
essential for the invention, which has a uniform
internal thread along its entire length. According to
the invention this internal thread is connected with a
25 suitable coupling part for the purpose of extension,
i.e. for the screwing on a further pipe element and it
provides the possibility to carry out this extension
without the use of external construction elements, like
for example, connecting sleeves or the like. At the
30 same time this means that the external profile of the
pipe element remains uniform, in particular continuous,
despite the extension, in fact even in the region of
the joint of two pipe elements. Due to this optimum



01 discharge conditions will result during the drilling
 operation for the flushing medium charged with rock
 particles, in fact uniformly along the entire length of
 the hole. The uniform profile adds further to the
 05 suitability of the drilling pipe as an injection
 drilling anchor, which in this manner is subjected to a
 uniform anchoring effect along its entire length.
 Finally, the uniform internal thread makes it also
 feasible to shorten, if necessary, the pipe element and
 10 to connect correspondingly shortened lengths with other
 drilling pipes.

The external profile of the pipe element is also
 constructed as a thread. This provides the further
 possibility to produce the external and internal thread
 15 of the pipe element in one operation, for example by
 cold forming the external side. In the case of an
 extension, i.e. in case of connection two pipe elements
 which are equipped in this manner, the thread extends
 uniformly over the entire length of the drilling pipe,
 20 as a matter of fact with the consequence that during
 the drilling operation a uniform conveying effect is
 exerted over the entire length on the flushing medium
 charged with rock particles.

Two pipe elements are connected by means of a coupling
 25 part. It is essential that on the one hand this
 coupling part is intended for screwing into drilling
 pipe ends which oppose each other at their faces and on
 the other it should ensure in the simplest manner equal
 screwed-in lengths for both to-be-connected pipe
 30 elements. According to the invention this is achieved
 in a particularly simple manner by that the coupling
 part consists practically of two pipe parts which are
 pressed into each other, and are consequently coaxial

01 with each other, namely an outer pipe element provided
with at least an external thread and an inner pipe
element which is inserted, for example, screwed into
this, which protrudes at the end faces from the outer
05 the outer pipe element preferably symmetrically and
forms the threaded section with its protruding
sections, which threaded sections are intended for
screwing into two drilling pipe elements to be
connected at their end faces. Thus in a particularly
10 simple manner both the outer and the inner pipe
elements are constructed as threaded pipe elements,
which have internal and external threads, so that the
outer pipe element is screwed onto the inner one and is
appropriately secured in a central position by welding.
15 Because the outer pipe element's radial dimensions and
its other characteristics correspond practically to a
drilling pipe element, it ensures, when connected, that
despite two pipe elements being connected their
exterior in the region of connection has no external
20 discontinuities.

The drilling head, apart from its plate-like drill bit,
can be manufactured from construction elements which
correspond to those of the coupling part. In this case
one obtains a drilling head, which, starting from the
25 drill bit has first of all an undercut and which is
intended for a screwed connection with a drilling pipe
element, i.e. for screwing into this. For this purpose
the drilling head on its side averted from the drill
bit has a pipe section with an external thread for the
30 purpose of screwing it into the drilling pipe element.
An inner pipe element is joined directly to the drill
bit, onto which pipe element a relatively shorter
outer pipe element is screwed on (by leaving out the
mentioned undercut opposite the drill bit), while the

- 01 pipe section of the inner pipe element, which protrudes
from the outer pipe element, forms the pipe section
intended for the screwed connection, i.e. the section
intended for screwing into a drilling pipe element, In
05 this case the outer pipe element forms once again a
stop in the screwed connection with the drilling pipe
element and is constructed regarding its radial
dimensions and particularly its external thread
preferably identical with the drilling pipe element.
- 10 Thus in the screwed-on state of the drilling head,
starting from the mentioned outer pipe element up to
the end of the drilling rod an externally uniform
construction of the drilling bar will result, in fact
even when it is extended.
- 15 In principle the drilling rod constructed in the above
manner can be used in a manner known per se as a
drilling rod and rock anchor, namely as an injection
drilling anchor.

- The features of claims 4 to 6 are directed in
20 particular towards the development of the drilling pipe
in accordance with the invention with regard of its use
as an injection drilling anchor and in this conjunction
exhibit special developments, which concern the
introduction of mortar or another hardenable medium.
- 25 In this connection a non-return valve is to be
mentioned in the vicinity of the drilling head of the
drilling anchor as well as one or several injection
valves. Both the non-return valve mentioned and the
injection valve are provided in intermediate elements,
30 which in turn are intended as screwed connections, in
this case for screwing into drilling pipe elements or
anchor rod elements which are to be connected with each
other. The number as well as the arrangement of the

- 01 injection valves can be arbitrary due to the module-
like construction of the intermediate elements
mentioned. In certain cases only one non-return valve
or one or several injection valves may be provided.
- 05 Essential is in the case of simultaneous application of
non-return and injection valves, that both can be
considered as spring-loaded valves, which, however, are
never in the open position at the same time. Thus the
non-return valve is to be opened by the flushing
10 medium only during the drilling operation, while the
relatively light pressure of the flushing medium is
inadequate to open the injection valves, so that the
latter remains in the closed position during the
drilling and flushing processes. In reverse, during the
15 injection, i.e. the subsequent introduction of mortar
suspension which will be explained later in detail, it
will practically flow out only through the injection
valves, while due to the hardening of the original
mortar filling the non-return valves are functionless
20 at this stage and closed.

The feature of claims 7 and 8 are directed towards the
nature of the intermediate elements mentioned. The
essential structural elements of these intermediate
elements are again inner and outer pipe elements,
25 wherein the outer pipe element is provided with
internal and external threads and is intended for
screwing onto the inner pipe element and its radial
dimension corresponds once again to those of the
drilling or anchor pipe element. The pipe sections of
30 the inner pipe element which protrude from the outer
pipe element form again the screwed joint sections
which are intended for screwing into the connected
anchor pipe elements, wherein the outer pipe elements
in a definite manner determine once again the screwed-

01 in depth. Once again the outer pipe elements are
secured in their final position relative the inner pipe
elements preferably by welding.

The features of claims 9 are directed towards the
05 construction of the injection valve. It is essential
that the enveloping bodies which fulfil the actual
valve function, which may be made, for example, of a
rubber-elastic material, are secured axially between
two pipe cylinders having the same diameters, wherein
10 the radial dimensions as well as the external
conditions of these pipe cylinders once again
correspond to those of the anchor pipe element provided
with external thread. Two enveloping bodies are
preferably used, in fact an inner one, consisting of a
15 relatively soft elastic material which fulfils the
sealing function and an outer one, once again
consisting of an elastic, for example rubber-elastic
material, which fulfils a support function and, if
necessary, the elastic properties of which are modified
20 by a webbing. In the mounted condition of this
injection valve the enveloping bodies fit into the
"smooth" structure of the anchor rods, extended if
necessary, in the same manner as the pipe cylinders
adjacent to it on both sides and consequently the
25 injection valve does not form construction elements
which would protrude radially from the structure of the
anchor rod, which structural elements, as already
explained at the beginning, could hinder the flow of a
flushing medium.

30 The features of claims 11 and 12 are directed towards a
distance spacer, which, as far as its practical use is
concerned, is constructed especially for the drilling
pipes or anchor rods according to the invention.

01 Essential feature of this distance spacer are two
centring bodies which are connected by tensioning
elements formed radially and fulfilling the function of
distance keeping, which centring bodies are provided
05 for pushing it over the anchor rod and wherein for the
pushing forward a special pressure bar is provided,
which engages a receiving device arranged on the guide
body facing the bottom of the drilled hole. The
pressure bar is constructed so that it can be inserted
10 into the receiving device. It is essential, that the
distance spacer is introduced into the drilled hole
only after its completion, which is possible because
the anchor rod, even if extension rods are used, as
well as the injection valves have the same diameter
15 over their entire length and the resistance to pushing
over of the centring body at least is the same along
the entire anchor rod. Thus this distance spacer is
introduced subsequently into the drilled hole along the
anchor rod, as a matter of fact in every case to
20 predetermined positions. As a rule, several distance
spacers are used at indicated distances, which is
feasible without any problem with the aid of the
pressure bar mentioned. If there is resistance to the
introduction of the distance spacer due to
25 heterogeneity in the wall, the distance spacer, after
the pressure has been transferred by the pressure bar
to the guide body facing the bottom of the drilled
hole, is stretched by the radial inward deformation of
the tensioning elements, so that the heterogeneity in
30 the wall, e.g. a slight constriction of the diameter of
the drilled hole can be overcome. On the other hand, if
the heterogeneity of the wall exceeds a certain limit,
namely that the resulting constriction is too great,
this can be recognized not only by the resistance to
35 the introduction of the distance spacer but also the

- 01 distance of this "trouble spot" from the opening of the
drilled hole can be established in the simplest manner.
Especially advantageous is in this case that the
distance spacer does not need to be constructed with
05 regard the mechanically highly stressed drilling
operation and can be made completely of plastic.
However, preferably it is still made of metal.

The features of claim 13 are directed towards an
improved guiding of the pressure bar.

- 10 The centring bodies are constructed in accordance with
the features of claim 14 as a pipe element. If
necessary, the pipe element facing the bottom of the
drilled hole can be rounded on its face, so that
heterogeneities of the wall could be smoothed out.
- 15 According to the features of claim 15 the pressure bar
can be inserted into the receiving device mentioned.
The pressure bar must have an inherent rigidity which
is adequate to overcome the resistance of the distance
spacer to being pushed forward. The pressure bar may be
20 a body which can be used from a coil.

- The features of claims 16 to 19 are directed towards
the special construction of that end of an injection
drilling rod which is at the opening of the drilled
hole, wherein once again the maximum use is made of the
25 basic structural elements of the other components of
the injection drilling rod, namely the pipe cylinders,
which externally, and preferably also internally, are
provided with a thread, as well as the pipe elements,
which have a thread at least externally and are
30 intended and constructed for insertion or screwing into
the pipe cylinders mentioned. The pipe elements



01 mentioned last form the screwed sections which are
intended for screwing into, for example, an anchor rod
element and the external thread of the pipe cylinder
forms a continuous extension of the external thread of
05 the anchor rods. Consequently, the threaded sections
intended for screwing into the "inner situated" pipe
element are constructed so that the mentioned pipe
cylinder with its face abuts against the corresponding
counter surfaces of an anchor rod. In conjunction with
10 an anchor head plate and a bracing nut the pipe element
which protrudes partially from the opening of the
drilled hole in the finally assembled state of the
injection drilling anchor serves the purpose of bracing
relative to the rock. However, another purpose of the
15 pipe element mentioned last according to the invention
is also the pushing over it of a plastic hose to ensure
a so called free anchor length in the region of the
opening of the drilled hole, which anchor length is not
joined by mortar with the surrounding rock. This
20 plastic hose is pushed forward until it abuts with its
face against the adjacent pipe cylinder, so that that
section of the pipe element which is enveloped by the
hose is shielded from any reciprocal action with
mortar.

25 In the following the invention is explained in detail
by referring to the embodiment illustrated in the
drawings. Shown is:

Fig.1 - an embodiment of an injection drilling anchor
according to the invention mostly in a
30 dismantled condition;

Fig.2 - an illustration of a coupling part according to
the invention to connect two anchor rods;

~~the invention for connecting two anchor rods;~~

Fig. 3 shows an embodiment of a spacer according to the invention for use with injection drilling anchors according to Fig. 1;

5 Fig. 4 shows the end region of an injection drilling anchor according to Fig. 1 at the borehole mouth end, for the greater part in a dismantled state.

10 The essential components of the injection drilling anchor shown in Figs. 1 and 2 are a drill head 1, an anchor rod 2 and a coupling member 3 which is sized and shaped for the connection of two identical drill rods 2 below one another.

15 The drill head 1 consists of a plate-like drilling crown 4 which is comparatively short axially and which is equipped with cutting edges or the like. To the crown is welded a tubular member 5. The tubular member 5 is provided with an external thread over its full length. A tubular cylinder 6 is screwed on to this tubular member 5 and is welded to it in the fitted position. The tubular cylinder 6 is shorter in dimensions than the tubular member 5 and the fitted position is characterised by the fact that the tubular member 5 projects from the cylinder 6 by a distance 7 at the end of the tubular cylinder which is remote from the drilling crown 4. The tubular cylinder 6 is for its part provided with an external thread, the reason for which will be explained in more detail hereinafter.

20 25 30 A central longitudinal passage extending into an outlet bore of the drilling crown 4 which is not shown in the drawings extends along the axis 8. Additional outlet bores may be provided in the region of the drilling crown 4.

35 At 6' is indicated a transverse bore which extends through both the tubular member 5 and also the tubular cylinder 6 and provides communication with the

aforesaid longitudinal passage. Through all the outlet bores, including the transverse bore or bores 6' a flushing medium, for example water or air, is passed during the drilling operation. After the making of the
5 drill hole a cement suspension or another comparable hardenable medium is caused to flow into the borehole through these bores.

At 9 is indicated an intermediate member which consists overall of a tubular cylinder 10 and a
10 tubular member 11. The tubular member 11 is screwed partially into the tubular cylinder 10 and can be fixed in the screwed-in position by welding for example. The tubular cylinder 10 for its part is designed to be screwed on to the tubular member 5, particularly on to
15 its tubular section 12.

The intermediate member 9 incorporates a non-return valve which is not shown in the drawings and which is arranged within the longitudinal passage which extends along the axis 8. This non-return valve is
20 spring-loaded and operates at a predetermined pressure. It is arranged such that under pressure it releases a through flow in the direction of the arrow 13, while preventing a reverse flow in the direction opposite to the arrow 13. The reason for this non-return valve
25 will be described in more detail hereinafter.

It is essential that in the position where the intermediate member 9 is screwed on to the drill head 1 the tubular cylinders 6 and 10 should be in direct contact with one another.

At 14 is indicated an anchor rod member which corresponds in terms of its diameter to the tubular cylinders 6 and 10 and which is provided on the outside as well as on the inside with a thread extending over
30 its full length. The anchor rod member 14 can have an
35 individually adapted length and, in the assembled

state, is screwed on to the tubular section 15 of the tubular member 11 which projects from the tubular cylinder 10, such that the anchor rod member 14 at its lower end is in contact with the tubular cylinder 10.

5 At 15 is indicated an injection valve which consists of a tubular member 16 which has one or more transverse bores 17 in a central region, with these bores being equally distributed circumferentially if there is more than one. The transverse bores 17 are
10 surrounded by a first sleeve member 18 of a relatively soft elastic material, which for its part is surrounded on the outside by a coaxial sleeve member 19 which is also of elastic material and which exerts a supporting function. The sleeve members 18 and 19 create a
15 reliable sealing of the transverse bores 17 in the state where the tubular member 16 is without pressure internally.

 At 20 and 21 are indicated comparatively short tubular cylinders which are screwed axially on to
20 the tubular member 16 at respective ends of the sleeve members 18, 19 and which provide axial retention for the sleeve members. The tubular cylinders 20, 21 can be secured in the final screwed-on position by being welded to the tubular member 16. The tubular cylinders
25 20, 21 as well as the sleeve member 19 are dimensioned to have the same diameter. The tubular cylinders 20, 21 in combination with the sleeve members 18, 19 have an axial length overall such that at both ends of the injection valve 15 tubular portions 23 and 24 are
30 created which can be screwed into the anchor rod member 14 on the one hand and into the anchor rod 2 on the other hand. The reason for the injection valve 15 and its method of operation will be described in more detail hereinafter.

35 The components embracing the injection valve

15 constitute a further intermediate member 9'. The design of the injection valve in the manner described above is not absolutely necessary and it could have other, alternative forms. It is only essential that
5 the injection valve should have no component projecting radially beyond the tubular cylinders 20, 21 and that it should function in the manner of a spring-loaded non-return valve which first opens the pressure which is necessary for the subsequent injection, while
10 remaining in the closed state during the flushing process.

An essential feature of the coupling member 3 shown in Fig. 2 is again a tubular member 25 which corresponds in terms of its diameter to the tubular
15 members 5, 11, 16 and which carries, approximately in the middle, a screwed-on tubular cylinder 26 which corresponds in diameter to the anchor rod 2. Tubular portions 27 and 28 of the tubular member 25 extend approximately symmetrically on both sides of the
20 tubular cylinder 26. The position of the tubular cylinder 26 can be secured by welding it to the tubular member 25.

The coupling member 3 serves for the coupling of a further anchor rod 2 such that its tubular
25 portions 27, 28 are screwed into the anchor rod ends to be connected, and indeed such that the ends of the anchor rods to be connected are in direct contact with the tubular cylinder 26.

It is a basic feature of the injection
30 drilling anchor according to the invention that there are anchor rods 2 and anchor rod elements 14 which are provided both internally and externally with a thread over their entire length, and wherein the individual elements of this drilling anchor, namely drill head 1,
35 intermediate members 9, 9', anchor rod member 14,

anchor rod 2 and further anchor rod portions 2 connected by means of coupling members 3, are all fixed to one another by internal screw threads. Because of the fact that the anchor rods 2 and 14 are provided over their full length with a uniform internal and external threading, these can be shortened as necessary in any manner and can be adapted to the particular needs. By an appropriate length dimensioning of the tubular portions 12, 15, 23, 24 one achieves in the simplest way an arrangement in which the final screwed-in position is determined by the length dimension of these tubular portions and consequently no further stops are necessary. The same applies also for the coupling member 3 whose central tubular cylinder 26 exerts a stop function for the adjacent ends of the anchor rods which are screwed on to the tubular portions 27 and 28.

It will already be appreciated from the description given above that the injection drilling anchor according to the invention, in spite of being composed of different functional elements, in the assembled state has an external contour beginning with the tubular cylinder 6 of the drilling crown 1 which is characterised by an external thread of uniform character extending up to the region of the borehole mouth, and which also has no parts projecting beyond this contour. Apart from the threaded configuration of the outside of the anchor, the assembled injection drilling anchor has an externally "smooth" surface.

This injection drilling anchor is used, in a manner known per se, primarily as a drilling rod, i.e. a flushing medium, for example water or alternatively air, flows through the central longitudinal passage which extends in the direction of the axis 8. This flushing medium exits during the drilling operation

only through the outlet bores in the drilling crown 4 and through the transverse bores 6' of the drill head, taking away the rock particles which are freed by the drilling crown 4 as a consequence of the drilling operation, in order to flush these in the direction opposite to that of the arrow 13, thus in the direction towards the mouth of the borehole. Simultaneously, the flushing medium exerts a cooling effect on the drilling crown. It is particularly advantageous that an undercut zone 29 is provided immediately behind the drilling crown 4, considered in the direction opposite to that of the arrow 13. This favours the removal of the freed rock particles or of the other drilled matter.

As already mentioned above, the spring-loaded non-return valve arranged within the intermediate member 9 as well as within the aforesaid longitudinal passage is dimensioned such that it opens under the pressure at which the flushing medium is present during the drilling operation, and permits a through flow in the direction of the arrow 13. The injection valve 15 on the other hand is designed by appropriate use of materials and other means for the sleeve members 18 and 19 that it does not open under the flushing pressure, so that this injection valve 15 is in practice without any function during the drilling operation.

The uniform external thread extending over the whole length of several anchor rods 2 is advantageous during the drilling operation, in that by means of this, not only is a conveying effect exerted on the rock particles which are to be removed from the borehole, but also, because of the substantially "smooth" surface of the injection drilling anchor which is characterised by having structural elements without external projections, optimum through flow conditions

are created for the flushing medium charged with drilled matter.

After completion of the drill hole, the injection drilling anchor, particularly its longitudinal bore, is used for the introduction of a cement suspension or some other hardenable medium which, in a first phase, exits only through the outlet bores and other transverse bores of the drill head 1, and gradually fills up the borehole, beginning with the foot of the borehole and rising in the direction opposite to that of the arrow 13. After complete filling of the borehole a reverse flow of the cement suspension into the said longitudinal passage is prevented by means of the non-return valve within the intermediate member 9.

After this the longitudinal passage is flushed out in order to remove any cement suspension remaining therein.

After hardening of the initially introduced cement, a renewed introduction of cement suspension is effected, which now is under high pressure and exits through the injection valve 15. The pressure of this cement suspension introduced under compression is such that it causes an opening of the injection valve 15 which during the initial introduction of cement was practically without function and had sealed off the transverse bores 17. During this injection, a further passage of cement suspension out through the drill head 1 does not take place or scarcely takes place.

By means of the cement suspension exiting through the injection valve 15, the body of cement surrounding the injection drilling anchor in this region and undergoing the hardening process at least in the initial phase cracks open and further cement suspension flows into the borehole to take up the gaps

forming between the particles. On account of the high pressure of the cement it spreads out, strongly reinforcing gaps within the rock and the said cement body is in part considerably enlarged.

5 The process of flushing out the longitudinal passage, as well as the fresh introduction of cement and splitting of the cement body, can be repeated several times, with the splitting being effected by cement or alternatively being possible also by the use
10 of water. As a result, the body of cement encircling the injection drilling anchor is widened in the region of the injection valve and a reliable anchoring effect is produced. Naturally, one or even several injection valves may be provided along the structure of the rock
15 anchor, which, because of the modular design of the individual structural elements of the injection drilling anchor, can be introduced into this structure at practically any points.

20 It is important for a reliable functioning of an injection drilling anchor, particularly when considered over a period of time, that there should be an overlay of a cement or some other hardenable material which is as uniform as possible and which is effective on all sides within the borehole. This
25 serves also to achieve a sufficient corrosion resistance and consequently to achieve uniform strength properties of the total system consisting of injection drilling anchor and surrounding cement. Particularly with comparatively long boreholes and multi-part
30 injection drilling anchors there is always the danger of skewing faults, so that in order to centre the anchor the use of spacers is customary, which are supported against the borehole wall and exert a centering action on the anchor rods.

35 Fig. 3 shows one example of a spacer

according to the invention, which is specially designed for cooperation with an injection drilling anchor as shown in Figs. 1 and 2.

5 In Fig. 3 the spacer is indicated overall at 30. The spacer comprises inter alia two axially spaced tubular members 31 and 32 or centering bodies, which are coaxial with respect to each other and which are shaped and dimensioned in terms of their diameter so that they will slide over anchor rods 2 and tubular
10 cylinders 6, 10, 14, 20 and 21 of the same diameter. These tubular members 31, 32 are smooth on both the inside and outside and are connected by a system of four elastic tie members 34 which are arranged symmetrically in relation to a radial central plane 33.
15 If necessary, further such tie members 34 can be provided, and preferably equispaced circumferentially. It is important that - with reference to the central plane 33 - the parts of the tie members located respectively above and below this central plane 33 are
20 positioned on the surface of cones whose bases lie in the central plane 33.

In the relaxed state, the degree of inclination of the tie members 34 is such that the maximum radius 35 in the region lying in the central
25 plane 33 corresponds at most to the radius 36 of the drilling crown 4.

The system of tubular members 31, 32 and tie members 34 is made of steel in the embodiment which is illustrated in Fig. 3. In this embodiment the tie
30 members 34 are welded in a suitable manner to the

tubular members 31, 32 or are connected to them in some other manner. It is to be noted however that it is alternatively possible to make these spacers from a
35 suitable plastics material.

So far as their elasticity is concerned, the tie members 34 are dimensioned such that there is a certain degree of springiness possible in the direction of the arrow 37, although in every case there must be a sufficient supporting function for the anchor rods which are guided in the tubular members 31, 32, and indeed such that these anchor rods are held centred as far as possible within the borehole. Further reference to this will be made hereinafter.

At 38 is indicated a socket member welded to the outside of the tubular member 31. The socket member is provided with a blind bore 39 which extends parallel to the axis 40 of the tubular member. Coaxially in relation to the blind bore 39 there extends a bore 41 through a guide member 42 which is welded on to the tubular member 32.

The blind bore 39 and the through bore 41 have approximately the same diameter and serve to receive a push rod 43 which is arrested in its movement in the direction of the arrow 44 in the blind bore 39 and which is freely movable in relation to the through bore 41.

A brief description will now be given of the use of the injection drilling anchor according to the invention.

The device is used primarily as a drill rod provided with a drill head, wherein a flushing medium, for example air, is guided through the central longitudinal passage. The flushing medium picks up rock particles freed as a result of the drilling operation and carries these out through the annular chamber between the inside wall of the borehole and the outside of the anchor rods in the direction towards the mouth of the borehole. After creation of the borehole, as soon as this has reached its final depth, a first

spacer 30 is pushed over the end which is at the mouth of the borehole. Its tubular members 31, 32 - as already explained above - are dimensioned such that they can be pushed without noticeable resistance over the anchor rods 2, injection valves 15, coupling members 3 and the like. The fitting of the spacer 30 is effected in such a manner that the tubular member 31 which is fitted with the socket member 38 is located at the end adjacent to the foot of the borehole.

The advancing movement of the spacer 30 is effected by the use of the push rod 43 which acts directly on the tubular member 31 which is adjacent to the foot of the borehole and consequently exerts, by means of the tie members 34, a tractive force on the tubular member 32 which is at the end nearer the mouth of the borehole. The degree of inclination of the tie members 34 in the central plane 33 is arranged to be such that the region of maximum radius of the tie members 34 rests resiliently against the borehole wall, so that the tubular members 31, 32 and consequently also the anchor rods 2 are guidingly centred. The push rod 43 must have such a length as in practice to correspond to the final assembly position of the spacer. It can be made of an elastic material which can be unwound for example from a roll but which nevertheless has at least sufficient inherent stiffness to be able to bring about the aforesaid tractive force.

It is important, for the situation where there are unevennesses in the borehole wall which would, among other things, block a further advancement of the spacer and which would exert a holding back effect on the angled tie members 34, that there should be a certain lengthening of the spacer on the basis of the compression force transfer to the tubular member 31, and consequently an overcoming of these wall

unevennesses during its advance along the drill rod. It is particularly advantageous in this connection if the external diameter of the injection drilling anchor is practically the same as the drill head, so that an
5 advancing movement of the spacer is not prevented in any way by any structural elements projecting from the outer surface.

If the unevenness of the wall of the borehole should reach a sufficient degree that in spite of the
10 elastic springiness of the tie members 34 in the direction of the arrow 37 a further advancement of the spacer is not possible, then it has to be concluded that the borehole wall at the particular point of the blockage has a completely insuperable condition. Thus,
15 the state of the borehole is controllable by means of the introduction of the spacer.

Simultaneously, the final position of the spacer 30 within the overall length of the borehole can be established by means of the length of the push rod
20 43. After the spacer 30 has in this way reached its final position, the push rod 43 is removed in the direction opposite to that of the arrow 44, so that as a consequence of the outward springing of the tie members 34 the spacer is fixed sufficiently in its
25 position.

Subsequently, in the same manner, depending upon the overall length of the injection drilling anchor, further spacers 30 can be introduced in
30 predeterminable positions along the overall length of the borehole and can be fixed in the same manner in contact with the borehole wall. As a result, the injection drilling anchor is in the end centred sufficiently over its full length within the borehole, so that the cement suspension can then subsequently be
35 introduced.

The latter is not hindered by the spacers retainers, since comparatively large-volume throughflow spaces remain between the individual tie members 34, so that a uniform filling is possible. The aforesaid non-
5 return valve 9, as well as the injection valve or valves 15 are used as already described above during the introduction of the cement.

In the final state the injection drilling anchor is consequently overlaid by a uniform layer of
10 cement extending over its full borehole length, and consequently is given a correspondingly reliable corrosion resistance. Because of the true and unequivocal centering of the anchor rod or rods within the borehole one achieves uniform strength properties
15 for the anchoring in relation to the surrounding rock, and for the rest this injection drilling anchor is utilised just as a conventional injection drilling anchor, i.e. an anchor plate together with nut is set over the part projecting from the mouth of the
20 borehole. However, in the representation shown in the drawings these two structural elements which are known per se have been omitted.

At 45 in Fig. 4 is indicated a terminating member which consists overall of a tubular cylinder 46
25 which, in terms of its external and internal threads as well as its radial dimensions, corresponds to the anchor rod 2. Into this tubular cylinder 46 is screwed a tubular member 47, and indeed such that it projects from the first component at one end by a longitudinal
30 distance 48. This projecting portion of the tubular member 47 forms a screwing section which is designed to be screwed into one end of an anchor rod 2, and indeed such that in the screwed-in state the tubular cylinder 46 is in direct contact with the anchor rod 2 and thus
35 constitutes an extension thereof.



5 The end 50 of the tubular member 47 which is
remote from the screw-in section is located within the
tubular cylinder 46, and indeed up to a distance 49
from its adjacent end. This end thus forms a stop or a
screw-in limit for an end piece 51 which, in terms of
its external thread as well as its radial dimensions,
corresponds to the tubular member 47. This end piece
51 is the end projecting from the mouth of the borehole
which in the final state of the injection drilling
10 anchor serves for the screw fitting of a tightening nut
and an anchor plate.

 In accordance with the invention, a plastics
sleeve 52 is fitted over this end piece 51. The tube
can be made for example of PVC (polyvinyl chloride). In
15 the screwed-in state of the end piece 51 the plastics
sleeve 52 is in contact in substantial sealing manner
with the associated end of tubular cylinder 46 and, by
means of the length dimension of this plastics sleeve
52, the free length of the injection drilling anchor at
20 the end adjacent to the mouth of the borehole and which
is not cemented to the borehole wall, is determined,
since the plastics sleeve 52 excludes any adherence
between this end piece 51 and the surrounding cement.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Drilling pipe, comprising at least

- 05 - one pipe element, which is provided externally with a continuous thread or thread-like profile, said element having a central longitudinal channel, which is continuous and being provided with a uniform internal thread along its entire length,
- 10 - a coupling part (3), being intended and constructed for connecting two of said pipe elements, consisting of a base, having on both end faces threaded sections, intended for screwing into a pipe element, and having a continuous longitudinal channel, and of an annular body, preferably in the centre of said base, fulfilling the function of a stop, and
- 15 - a drilling head (1) being provided with at least one axial discharge hole and having a pipe section (12) for a screwed connection with the drilling pipe to be screwed into one of its ends, and
- 20 - with the diameter of said annular body of the coupling part (3) corresponding to that of the to be - connected pipe element,
- said annular body being provided with an external thread or a thread-like profile,



01 - said drilling-head (1) consisting of an axially
short, plate-like drill bit (4) with cutting edges,
a pipe element (5) welded onto this, and a pipe
05 cylinder (6) which is shorter than the pipe element
(5) and has the same diameter as the drilling pipe
and is mounted with a corresponding external thread
or a corresponding external thread-like deformation
on the pipe element (5) by leaving out an undercut
(29) and the pipe section (12) having an external
10 thread on the other,

- with the pipe sections (12) of the drilling head
(1) and (27,28) of the coupling part (3) being
intended and constructed for complete screwing into
the facing ends of the drilling pipe,

15 - with the drilling rod being extended with the use
said coupling part (3) having the same outer
diameter and especially an external thread or a
thread-like profile of the same shape starting from
the pipe cylinder (6) of the drilling head (1) up
20 to its end, averted from the drilling head (1).

2. Drilling pipe according to claim 1, characterized in
that the base is formed by a pipe provided with an
external thread, onto which a relatively short outer
pipe is screwed on and/or is secured in some other
25 manner, which outer pipe forms the annular body.

3. Drilling pipe according to claim 1 or 2,
characterized in that the drilling head (1) is
provided with further axial, approximately axial or
radial discharge holes (6').

30 4. Drilling pipe according to any one of the preceding

- 01 claims 1 to 3, characterized in that for the purpose
of using it as an injection drilling anchor a non-
return valve is provided within the longitudinal
channel in the vicinity of the drilling head.
- 05 5. Drilling pipe according to claim 4, characterized in
that the non-return valve is spring-loaded and is
provided in an intermediate element (9).
6. Drilling pipe according to any one of the preceding
claims 1 to 5, characterized in that for the purpose
10 of using it as an injection drilling anchor one or
several injection valves (15) are provided, which in
turn are provided in intermediate elements (9').
7. Drilling pipe according to claim 5 or 6,
characterized in that the intermediate elements
15 (9,9') are provided on at least one end face with
pipe sections (15,15'), which are intended and
constructed for complete screwing into the facing
ends of the drilling pipe functioning as anchor rod
(2).
- 20 8. Drilling pipe according to claim 7, characterized in
that the intermediate element (9') containing the
non-return valve has a pipe cylinder (1), which
surrounds a pipe element (11) carrying the pipe
section (15) and is constructed with the same
25 diameter as the anchor rod (2) as well as it has a
corresponding external thread or a corresponding
external thread-like deformation.
9. Drilling pipe according to any one of the preceding
claims 6 to 8, characterized in that an injection
30 valve consists of a pipe element (16) which has at



01 least one transverse hole (17) and is provided with
an external thread, of at least one enveloping body
which (envelops) the pipe element (16) in the region
of the transverse hole (17) closing it in a sealing
05 manner, which enveloping body is made of an elastic
material and is arranged coaxially with the pipe
element (16), that on both sides of the enveloping
bodies (18,19), with their positions axially secured,
pipe cylinders (20,21) having external threads are
10 provided, which are secured relative to the pipe
element (16) and that the pipe cylinders (20,21) as
well as the enveloping bodies (18,19) have roughly
the same diameter.

10. Drilling pipe according to claim 9, characterized in
15 that the anchor rods (2) as well as the pipe
cylinders (20,21) are constructed with the same
diameter and have a corresponding external thread
or a corresponding external thread-like deformation.

11. Drilling pipe according to any one of the preceding
20 claims 4 to 10, characterized by distance spacers
(30), which are intended and constructed to be pushed
over the anchor rod situated in the drilled hole.

12. Drilling pipe according to claim 11, characterized in
that a distance spacer (30) consists of two centring
25 bodies which are at an axial distance from each other
and have coaxial bores, that the centring bodies are
joined with each other by means of elastically
deformable tensioning elements (34) which are
radially formed to fulfil the function of distance
30 keeping and that for the forward moving of the
distance spacer (30) inside the drilled hole the
front centring body facing the bottom of the drilled

- 01 hole is provided with a receiving device for a pressure bar (43).
13. Drilling pipe according to claim 12, characterized in that for the guiding of the pressure bar (43) a guide
- 05 body (42) is provided on the centring body which is averted from the bottom of the drilled hole and the guide body has a hole (41) accomodating the pressure bar (43).
14. Drilling pipe according to claim 12 or 13,
- 10 characterized in that the centring bodies are constructed as pipe elements (30,31).
15. Drilling pipe according to any one of the claims 12 to 14, characterized in that the pressure bar (43) can be inserted into the receiving device mentioned.
1516. Drilling pipe according to any one of the preceding claims 4 to 15, characterized by an ending on the side of the opening of the drilled hole which is intended and constructed for the pushing over of a plastic hose (52) to achieve a free, non-mortar bound
- 20 anchoring position.
17. Drilling pipe according to claim 16, characterized in that the ending consists of a closing element (45) intended for screwing onto the end of an anchor rod (2) and an end part (51), that the end part (51) is
- 25 intended for pushing over the plastic hose (52) and for a screwed connection with a bracing nut known per se and that the end part (51) is intended and constructed for screwing it into the closing element (45).



0118. Drilling pipe according to claim 17, characterized in
that the end part (51) is a pipe element provided
with an external thread, the radial dimensions of the
pipe element corresponding to those of the pipe
05 elements (5,11,16,25).

19. Drilling pipe according to any one of the preceding
claims 17 or 18, characterized in that the closing
element (45) consists of a pipe cylinder (46), which
in its radial dimensions and its external and,
10 preferably also, internal threads corresponds to the
anchor rod (2), that into the pipe cylinder (46) a
pipe element (47) is inserted, preferably screwed in,
the radial dimensions of which correspond to those of
the pipe elements (5,11,16,25), that one end (50) of
15 the pipe element (47) which is situated within the
pipe cylinder (46) forms a stop for the screwing in
of the end part (51) and that the other end of the
pipe element (47) protrudes from the pipe cylinder
(46) and is intended for screwing in into the end of
20 an anchor rod (2).

20. A drilling pipe as hereinbefore described with reference to the accompanying drawings.

DATED this 29th day of June 1994

GD-ANKER GMBH
Patent Attorneys for the
Applicant:

F.B. RICE & CO.

ABSTRACTDRILL PIPE

5 In order to achieve improved flow properties
for a flushing medium charged with rock particles freed
during the drilling phase, an injection drilling anchor
is proposed whose anchor rods (2), coupling members
10 (3), injection valves (15), an intermediate member (9)
containing a non-return valve, as well as drill head
(1) are designed such that these components are
connected one to the other below one another always by
screw fittings, so that in the assembled state one has
15 a fully homogeneous structure from the drill head (1)
upwards. The drill head is characterised by an
external thread extending uniformly over the full
length and consequently has a uniform diameter, so that
after drilling has taken place, starting from the mouth
20 of the borehole, a spacer can be pushed within the
borehole along the full length of the borehole over the
anchor rods (2) to any desired point. The anchor rods
(2) are provided over their full length with a uniform
internal threading, so that a cutting to a particular
25 length does not hinder their utility for use in the
framework of the injection drilling anchor (1). The
coupling members, the injection valves (15),
intermediate member (9) and the drill head (1) for this
purpose comprise tubular cylinders (20, 21; 10; 6)
30 which correspond in terms of their internal and
external threading with the anchor rods (2) and which
each have a stop function for the positional screwing
together of the parts.

(Fig.1)

Fig. 2

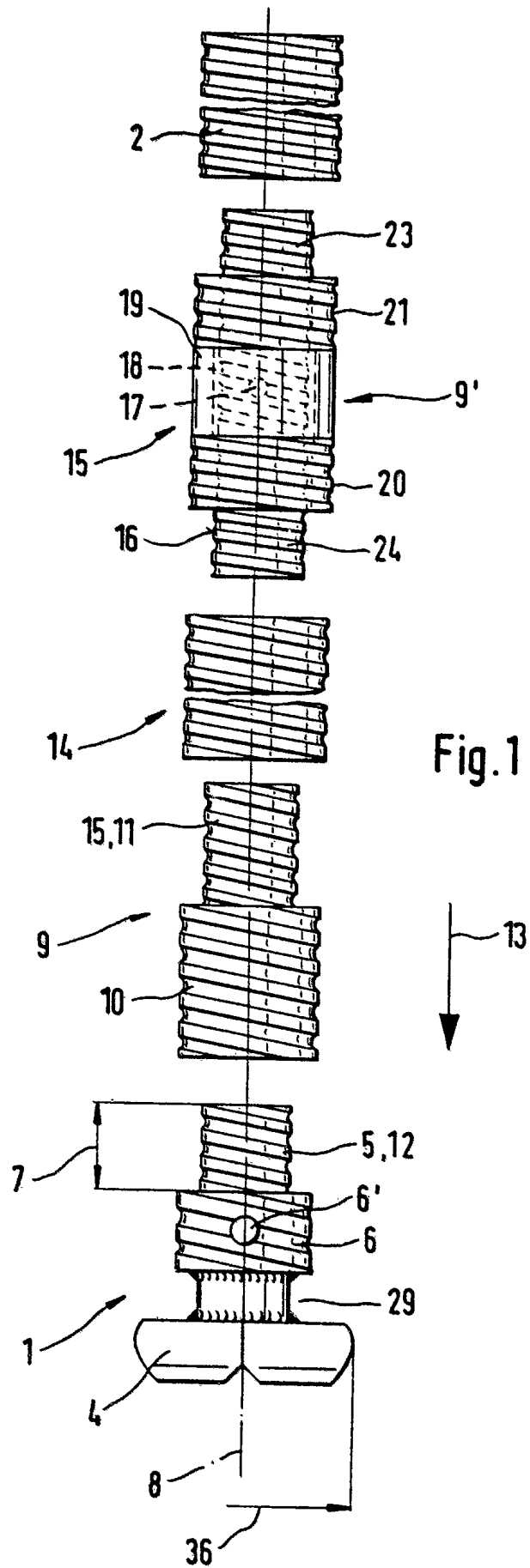
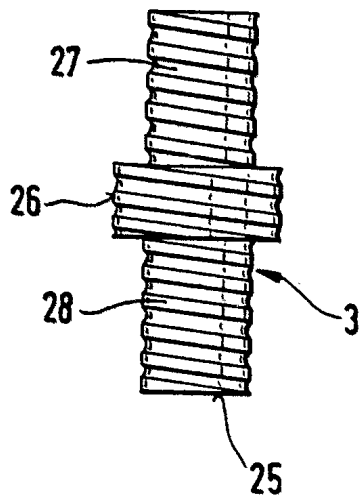
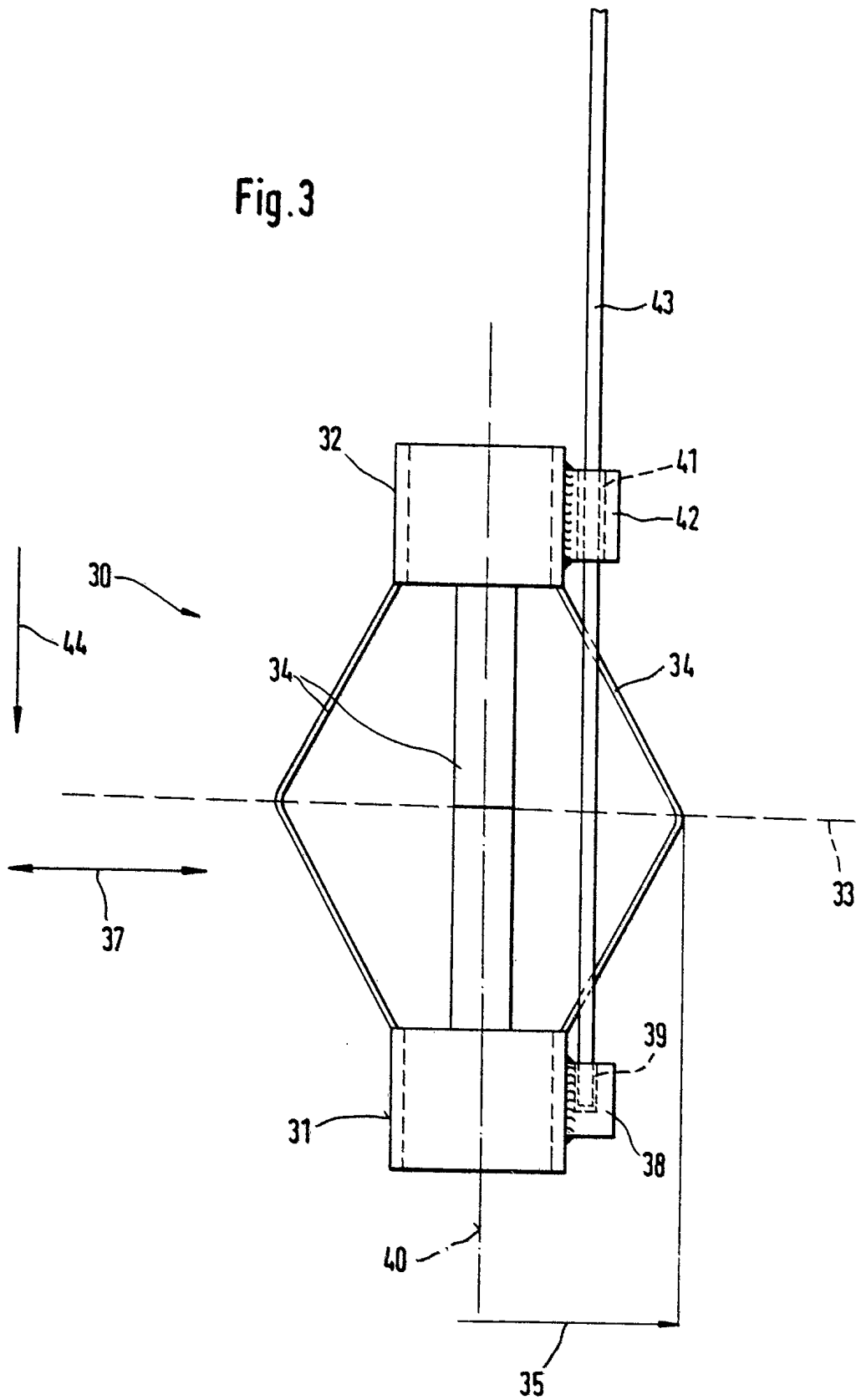


Fig. 3



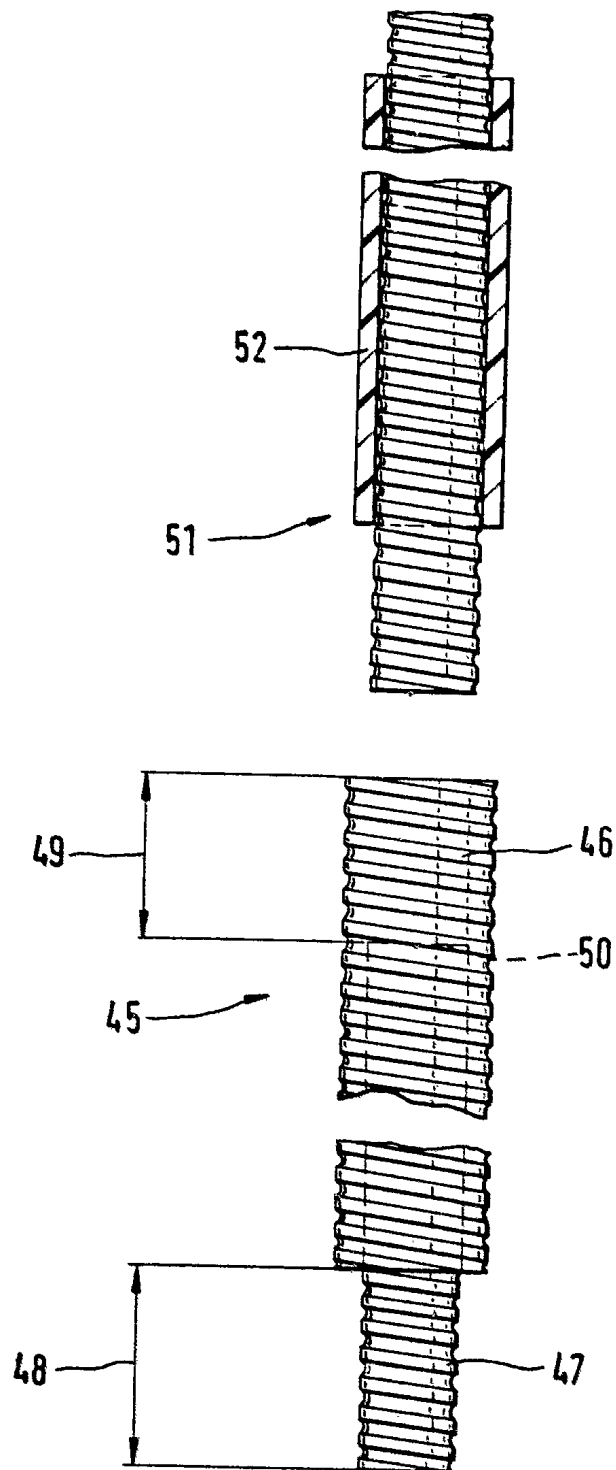


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP 92/01149

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl.⁵ E21B17/042; E21B17/10; E21D21/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.⁵ E21B; E21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,A,3234406 (JOY MANUFACTURING CO.) 22 March 1984 see page 10, line 11 - line 14 see page 11, line 14 - line 17 see figures 3,4,6	1,2
Y		5
A		3
Y	US,A,2318326 (PADLEY ET AL.) 06 March 1941 see figures 5-7	5
A	EP,A,0274719 (GD-ANKER GMBH) 20 July 1988 see abstract, see figures	1,2
	./...	

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:

"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 when the document is taken alone

"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

Date of the actual completion of the international search

17 February 1993 (17/02/93)

Date of mailing of the international search report

26 February 1993 (26.02.93)

Name and mailing address of the ISA/

EUROPEAN PATENT OFFICE

Facsimile No.

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 92/01149

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,B,1170887 (DEMAG AG) 27 May 1964 see figure 3	3
A	GB,A,632556 (ATLAS DIESEL AKTIEBOLAGET) 28 November 1949 see figures -----	6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP 92/01149

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
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. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

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

- CLAIMS 1-4, 8 (partially)
- CLAIMS 5-7, 8 (partially)
- CLAIMS 9-24

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
1-4, 8 (partially),
5-7, 8 (partially)
4. ☐ 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 claims Nos.:

Remark on Protest

☐

The additional search fees were accompanied by the applicant's protest.

☒

No protest accompanied the payment of additional search fees.

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

EP 9201149
SA 59979

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 17/02/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A-3234406	22-03-84	None	
US-A-2318326		None	
EP-A-0274719	20-07-88	DE-A- 3700758	21-07-88
		AU-B- 600070	02-08-90
		AU-A- 1024688	14-07-88
		JP-A- 63180334	25-07-88
DE-B-1170887		None	
GB-A-632556		None	

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen

PCT/EP 92/01149

I. KLASSEIFIKATION DES ANMELDUNGSGEGENSTANDS (bei mehreren Klassifikationssymbolen sind alle anzugeben) ⁶		
Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC Int.Kl. 5 E21B17/042; E21B17/10; E21D21/00		
II. RECHERCHIERTE SACHGEBIETE		
Recherchierter Mindestprüfstoff ⁷		
Klassifikationssystem	Klassifikationssymbole	
Int.Kl. 5	E21B ; E21D	
Recherchierte nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Sachgebiete fallen ⁸		
III. EINSCHLAGIGE VERÖFFENTLICHUNGEN ⁹		
Art. ^o	Kennzeichnung der Veröffentlichung ¹¹ , soweit erforderlich unter Angabe der maßgeblichen Teile ¹²	Betr. Anspruch Nr. ¹³
X	DE,A,3 234 406 (JOY MANUFACTURING CO.) 22. März 1984 siehe Seite 10, Zeile 11 - Zeile 14 siehe Seite 11, Zeile 14 - Zeile 17 siehe Abbildungen 3,4,6	1,2
Y	---	5
A		3
Y	US,A,2 318 326 (PADLEY ET AL.) 6. März 1941 siehe Abbildungen 5-7	5
A	EP,A,0 274 719 (GD-ANKER GMBH) 20. Juli 1988 siehe Zusammenfassung siehe Abbildungen	1,2

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<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>^o Besondere Kategorien von angegebenen Veröffentlichungen ¹⁰ :</p> <p>"A" Veröffentlichung, die den allgemeinen Stand der Technik definiert, aber nicht als besonders bedeutsam anzusehen ist</p> <p>"E" älteres Dokument, das jedoch erst am oder nach dem internationalen Anmeldedatum veröffentlicht worden ist</p> <p>"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)</p> <p>"O" Veröffentlichung, die sich auf eine mündliche Offenbarung, eine Benutzung, eine Ausstellung oder andere Maßnahmen bezieht</p> <p>"P" Veröffentlichung, die vor dem internationalen Anmeldedatum, aber nach dem beanspruchten Prioritätsdatum veröffentlicht worden ist</p> </div> <div style="width: 48%;"> <p>"T" Spätere 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</p> <p>"X" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als neu oder auf erfinderischer Tätigkeit beruhend betrachtet werden</p> <p>"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</p> <p>"&" Veröffentlichung, die Mitglied derselben Patentfamilie ist</p> </div> </div>		
IV. BESCHEINIGUNG		
Datum des Abschlusses der internationalen Recherche	Absenddatum des internationalen Recherchenberichts	
17.FEBRUAR 1993	26. 02. 93	
Internationale Recherchenbehörde	Unterschrift des bevollmächtigten Bediensteten	
EUROPAISCHES PATENTAMT	RAMPELMANN J.	

III. EINSCHLAGIGE VERÖFFENTLICHUNGEN (Fortsetzung von Blatt 2)

Art °	Kennzeichnung der Veröffentlichung, soweit erforderlich unter Angabe der maßgeblichen Teile	Betr. Anspruch Nr.
A	DE,B,1 170 887 (DEMAG AG) 27. Mai 1964 siehe Abbildung 3 ---	3
A	GB,A,632 556 (ATLAS DIESEL AKTIEBOLAGET) 23. November 1949 siehe Abbildungen -----	6

Feld I Bemerkungen zu den Ansprüchen, die sich als nicht recherchierbar erwiesen haben (Fortsetzung von Punkt 1 auf Blatt 1)

Gemäß Artikel 17(2)a) wurde aus folgenden Gründen für bestimmte Ansprüche kein Recherchenbericht erstellt:

1. ☐ Ansprüche Nr.
weil Sie sich auf Gegenstände beziehen, zu deren Recherche 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 es sich dabei um abhängige Ansprüche handelt, die nicht entsprechend Satz 2 und 3 der Regel 6.4 a) abgefaßt sind.

Feld II Bemerkungen bei mangelnder Einheitlichkeit der Erfindung (Fortsetzung von Punkt 2 auf Blatt 1)

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

- Ansprüche 1-4, 8 (teilweise)
- Ansprüche 5-7, 8 (teilweise)
- Ansprüche 9-24

1. ☐ Da der Anmelder alle erforderlichen zusätzlichen Recherchegebühren rechtzeitig entrichtet hat, erstreckt sich dieser internationale Recherchenbericht auf alle recherchierbaren Ansprüche der internationalen Anmeldung.
2. ☐ Da für alle recherchierbaren Ansprüche die Recherche ohne einen Arbeitsaufwand durchgeführt werden konnte, der eine zusätzliche Recherchegebühr gerechtfertigt hätte, hat die Internationale Recherchenbehörde nicht zur Zahlung einer solchen Gebühr aufgefordert.
3. ☒ Da der Anmelder nur einige der erforderlichen zusätzlichen Recherchegebühren rechtzeitig entrichtet hat, erstreckt sich dieser internationale Recherchenbericht nur auf die Ansprüche der internationalen Anmeldung, für die Gebühren entrichtet worden:
1-4, 8 (teilweise),
5-7, 8 (teilweise)
4. ☐ Der Anmelder hat die erforderlichen zusätzlichen Recherchegebühren nicht rechtzeitig entrichtet. Der internationale Recherchenbericht beschränkt sich daher auf die in den Ansprüchen zuerst erwähnte Erfindung; diese ist in folgenden Ansprüchen erfaßt:

Bemerkungen hinsichtlich eines Widerspruchs

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

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

EP 9201149
SA 59979

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
Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

17/02/93

Im Recherchenbericht angeführtes Patentedokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
DE-A-3234406	22-03-84	Keine	
US-A-2318326		Keine	
EP-A-0274719	20-07-88	DE-A- 3700758	21-07-88
		AU-B- 600070	02-08-90
		AU-A- 1024688	14-07-88
		JP-A- 63180334	25-07-88
DE-B-1170887		Keine	
GB-A-632556		Keine	

EPO FORM P0073

Für nähere Einzelheiten zu diesem Anhang : siehe Amtsblatt des Europäischen Patentamts, Nr.12/82