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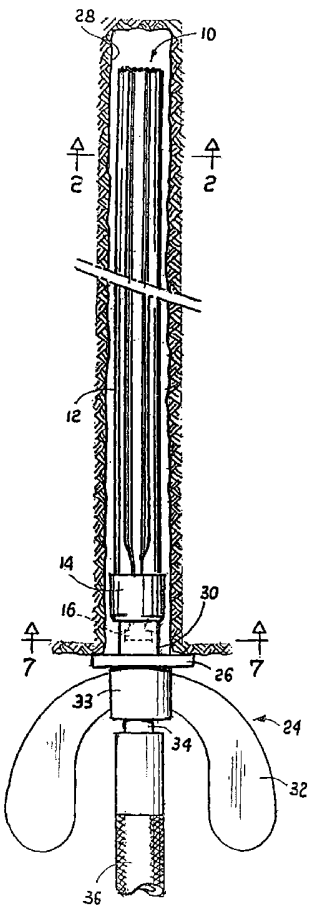
(54) **Title:** EXPANDABLE ROCK ANCHOR



(57) **Abstract:** This invention relates to a method of locating a rock anchor (10) which includes an elongated metal tube (12) which is transversely expansible by a liquid which is fed into it under pressure to lock the tube (13) to the side wall of a hole (28) in which it is located in use including the steps of releasably attaching a connector (30) on a liquid hose (36) to a liquid inlet formation into the tube at one of its ends, feeding the tube (12) into a predrilled hole (28) in which it is to be located, setting the tube (12) in the hole (28) by expanding it with liquid under pressure and releasing the connector (30) from the tube inlet formation to leave the set rock anchor (10) located in the hole (28) with no portion of it projecting from the mouth of the hole.

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FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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EXPANDABLE ROCK ANCHOR

FIELD OF THE INVENTION

[0001] This invention relates to a rock anchor, a method of locating the rock anchor in a predrilled hole and to apparatus for carrying out the method.

BACKGROUND TO THE INVENTION

[0002] The proximal ends of all rock bolts or anchors, other than perhaps unmodified split sets, which are used in underground mining and tunnelling operations project from the holes in which the anchors are located. In mechanised mines moving machinery in the mine workings from time to time impact against the exposed ends of the anchors to damage the machinery and, invariably, compromise the anchoring or support capability provided by the anchor. This is particularly so in vertically narrow mine workings such as stopes in which the projecting ends of the anchors which support the hanging often additionally result in physical injury to workers in the work area.

SUMMARY OF THE INVENTION

[0003] A method of locating a rock anchor of the type which includes an elongated metal tube which is transversely expansible by a liquid which is fed into it under pressure to lock the tube to the side wall of a hole in which it is located, in use, according to the invention includes the steps of releasably attaching a connector on a liquid hose to a liquid inlet formation into the tube at one of its ends, feeding the tube into a predrilled hole in which it is to be located until the end of the tube carrying the liquid inlet formation is fully located in the hole, setting the tube in the hole by expanding

it with liquid under pressure through the hose connector and inlet formation and releasing the connector from the tube inlet formation and removing it from the hole to leave the set rock anchor located in the hole with no portion of it projecting from the mouth of the hole.

[0004] The liquid inlet formation into the tube may be attached to a one-way liquid inlet valve which is fixed into an end portion of the inside of the tube and includes a connector formation having a liquid passage through it and with which a formation on the hose connector is releasably engageable. Conveniently the connector formation on the valve projects from the end of the tube.

[0005] In one form of the invention the connector formation on the valve formation may be T-shaped with its leg extending from the valve in the axial direction of the tube.

[0006] The connector formation on the hose is a keyhole-type aperture into the hose connector with the method of the invention perhaps including the steps of placing the crossbar of the connector formation on the valve in the aperture of the hose connector and rotating one of the components relatively to the other to cause the crossbar of the connector formation on the valve to be situated across a portion of the hose connector aperture which has a lesser dimension than the length of the valve formation crossbar to lock the two components against separation in the axial direction of the rock anchor tube.

[0007] A rock anchor for use in the rock anchor locating above method according to the invention could comprise an elongated metal tube which; is transversely expansible by liquid in it under pressure, is closed at a first end and carries in its second end a liquid

inlet body which includes a holed hose connector formation which is releasably engageable with a formation on a connector on a liquid hose by rotation of one of the formations relatively to the other, when engaged with each other, characterised in that the rock anchor is fully locatable, in use, in a hole at a position at which it is to be anchored with its hose connector formation remote from the mouth of the hole. The rock anchor liquid inlet body may be a one-way valve.

[0008] The valve connector formation and the liquid hose formation may be bayonet-type engageable formations. The valve formation may be T-shaped with a liquid passage through the leg of the T and the hose connector formation may be a keyhole type aperture in an end of a socket on the hose connector in which the crossbar of the valve formation is releasably located, in use, and which on relative rotation of the formations engages lands in the connector socket on opposite sides of the aperture to lock the hose connector to the rock anchor against separation in an axial direction from the rock anchor.

[0009] Alternatively the valve connector formation and the liquid hose formation may be spigot and socket formations which are threadedly engaged, in use.

[0010] A connector for use in the rock anchor locating method of the invention according to the invention includes a socket formation which is fixed to and extends from the hose by a distance to its free end which corresponds to at least the distance at which the outer end of the rock anchor is required to be located fully in and from the mouth of the hole, a liquid passage through the socket, a formation at or adjacent the free end of the socket for releasably engaging the rock anchor valve formation on

rotation of the rock anchor relatively to the hose connector socket or vice versa to releasably lock the hose connector to the rock anchor against separation in the axial direction of the rock anchor tube.

[0011] The hose connector socket formation may be connected to a liquid hose through a swivel connector to enable the hose connector to rotate about the axis of the socket relatively to the hose.

[0012] The socket formation may include a transversely extending stop formation which is so positioned on the socket formation when the stop formation abuts material surrounding the mouth of a hole in which the rock anchor is located, in use, the valved end of the rock anchor is located at the desired position in the hole.

[0013] The hose connector may include means for rotating it relatively to the rock anchor, in use.

[0014] In one form of the invention the rock anchor and the hose connector formations may be bayonet-type fittings.

[0015] In another form of the invention the valve connector formation and the liquid hose formation are spigot and socket formations which are threadedly connected, in use.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The rock anchor locating method of the invention and the apparatus for carrying out the method are now described by way of non-limiting examples only with reference to the drawings in which :

Figure 1 is side elevation of the rock anchor of the invention being located in a predrilled hole according to the method of the invention,

Figure 2 is an end elevation of the Figure 1 anchor tendon shown sectioned on the line 2-2 in Figure 1,

Figure 3 is a cross-sectional end elevation of the rock anchor illustrating the manner in which the anchor filler valve is located in the anchor tendon,

Figure 4 is an inverted side elevation of the lower end portion of the rock anchor of Figure 1,

Figure 5 is a plan view of the anchor end of Figure 3,

Figure 6 is a side elevation of a coupling formation on the end of the anchor of Figure 1,

Figure 7 is a plan view of the Figure 6 coupling formation,

Figure 8 is an end elevation of a socket on the hose connector of the invention shown sectioned on the line 7-7 in Figure 1, and

Figure 9 is a partially sectioned fragmentary side elevation of the coupling arrangement of Figure 8.

DETAILED DESCRIPTION OF THE METHOD AND APPARATUS

[0017] The rock anchor 10 of the invention is shown in Figures 1 to 7 to include an elongated transversely expansible tubular tendon 12, an end collar 14 and a hose connector coupling formation 16.

[0018] The tendon tube 12 is made from a ductile metal such as mild steel. The tube 12 which is originally circular in cross-section, is deformed, as shown in Figure 2, by pressing a portion of its wall into the tube to provide a deep outwardly widening recess 18 in the tube which extends from the collar 14 over the remaining length of the rock anchor to its rear end. The upper end of the tube in Figure 1 is closed by welding the C-shaped cavity (see Figure 2) of the tendon 12 closed. The opposite end of the anchor carries a one-way inlet valve 20 which is located in the cavity of the tendon 12 in the collar 14, as shown in Figure 3. The end of the collar 14 and the crimped portion of the tendon around the valve is then welded closed with the welding 21, shown in Figures 4 and 5, extending between the periphery of the collar and the valve 20 to close the tendon to form the tendon into a closed pressure vessel and to hold the end of the tendon and collar 14 together.

[0019] The inlet to the valve 20 is through the hose coupling 16 of Figures 6 and 7 with the outer portion of the coupling being, as shown in Figure 6, T-shaped, as shown in the drawing with a liquid passage 22 passing through it into the valve.

[0020] The hose coupler 24 of the invention is shown in Figure 1 to include a stop member 26 which is dimensioned to abut a rock face surrounding the mouth of a hole 28 in which the bolt is to be located, a connector socket 30 which is fixed to the stop member 26, a pair of handles 32 which are fixed to a boss 33 which is fixed to the underside of the stop member 26 and a swivel 34 the upper end of which is sealingly

rotatable in the lower portion of the stop member with its lower end held fixed in the bore of a liquid high pressure hose 36, as shown in the drawing.

[0021] The length of the hose connector socket 30 is such that with the rock anchor 10 connected to it, as shown in Figure 1, the underside of the end collar 14 on the anchor 10 will be located at a desired position in the hole 28 at which its hose connector coupling formation 16 on the inside of the hole is well clear of the mouth of the hole 28 when the anchor 10 is set in the hole. The socket 30 and the stop member 26 carry an axially located bore 38 which passes through these components, as shown only fragmentally in Figure 9. The upper end of the socket 30 has a keyhole type aperture 40 which is open into a chamber 42 adjacent the upper end of the socket. Both the keyhole aperture 42 and the chamber 42 are elongated with rounded ends. The long axes of the chamber 42 and the aperture 40 of the socket 30 are angled at about 30° relatively to each other, as shown in Figure 8, to provide two lands 44 on opposite sides of the keyhole aperture in the upper surface of the chamber 42. The relatively angled wall of the chamber 42 prevents full rotation of the crosshead portion of the anchor formation 16 beyond its locked position on the lands 44, as shown in Figure 8. The keyhole aperture 40 is dimensioned and shaped to be a little larger than the crossbar of the T-shaped hose connector 16 of the rock anchor for easy passage of the formation 16 in and out of the socket chamber 42.

[0022] In use, at the place at which the rock anchor 10 is to be located in a predrilled hole 28, the hose connector coupling formation 16 of the bolt is passed through the aperture 40 in the end of the hose connector socket 30 and rotated relatively to the socket to cause the crossbar of the formation 16 to engage the lands 44 in the socket,

as shown in Figure 7. The tendon tube 12 is then fed into the hole 28 until the stop member 26 on the hose connector abuts the material surrounding the mouth of the hole, as shown in Figure 1. A valve, not shown, in the hose 36 is then opened to cause water at high pressure to flow through the valve hose connector, the rock anchor inlet valve and into the tendon tube 12. The high pressure water causes the tube 10, on the outside of the collar 14, to unfold from its deformed shape as shown in Figure 2 to cause the tube to increase in radial dimension and bring its outer surface into high pressure bearing contact with the wall of the larger diameter hole 28 to lock the rock anchor solidly in position in the hole. The hose valve is then closed. With the water filled rock anchor so anchored in the hole the handles 32 on the hose connector are rotated in the appropriate direction to bring the crossbar of the formation 16 into alignment with the socket aperture 40 to enable the hose connector to be released from the bolt. With the hose connector 24 removed the coupling formation 16 on the bolt is located in the hole well clear of its mouth, as will be appreciated from Figure 1. The actual position of the valved end of the rock anchor from the mouth of the hole 28 may be varied, to suit mining requirements, in dependence on the axial length of the socket 30 on the hose coupler 24.

[0023] Should it be necessary to provide permanent or temporary service lines of one sort or another in the work place against walls which carry a pattern of rock bolts 10, this could be achieved by locating a socket such as a the socket 30 on a hangar bracket or the like, not shown, and connecting the bracket to selected rock bolts in the working in exactly the same manner as the hose coupler is connected to the formation 16 on the rock bolt 10 in Figure 1. The socket 30 is preferably adapted to be axially rotatable on

the hanger bracket for ease of alignment of the brackets with the service line paths in the mine working.

[0024] The invention is not limited to the precise details as herein described. For example the hose coupler stop member 26 in this specification is described as being a circular disc or purely cylindrical body but it could as well be two diametrically opposite trunnion-like formations which are fixed to the outer wall of the socket 30 to, in use, abut a rock face on opposite sides of the mouth of the hole 28. Additionally, the formation 16 on the rock anchor 10 and the coupling formations on the socket 30 could be replaced by a spigot or socket on both components which are threadedly engageable with each other with the coupling formation on the rock anchor providing the water inlet to the rock anchor tendon tube 12. Still further, the bayonet-type fitting described above and illustrated in the drawing could be replaced with a conventional bayonet fitting arrangement in which the socket on the rock bolt valve could include two radially outwardly projecting trunnions which are releasably engageable in slots, such as those found in a conventional bulb-type light fitting, in the wall of an open ended socket which is carried by the stop member 26.

CLAIMS

1. A method of locating a rock anchor of the type which includes an elongated metal tube which is transversely expansible by a liquid which is fed into it under pressure to lock the tube to the side wall of a hole in which it is located, in use, characterised in that the method includes the steps of releasably attaching a connector on a liquid hose to a liquid inlet formation into the tube at one of its ends, feeding the tube into a predrilled hole in which it is to be located until the end of the tube carrying the liquid inlet formation is fully located in the hole, setting the tube in the hole by expanding it with liquid under pressure through the hose connector and inlet formation and releasing the connector from the tube inlet formation and removing it from the hole to leave the set rock anchor located in the hole with no portion of it projecting from the mouth of the hole.

2. A method as claimed in claim 1 wherein the liquid inlet formation into the tube is attached to a one-way liquid inlet valve which is fixed into an end portion of the inside of the tube and includes a connector formation having a liquid passage through it and with which a formation on the hose connector is releasably engageable.

3. A method as claimed in claim 2 wherein the connector formation on the valve projects from the end of the tube.

4. A method as claimed in either one of claims 2 or 3 wherein the connector formation on the valve formation is T-shaped with its leg extending from the valve in the axial direction of the tube.

5. A method as claimed in claim 4 wherein the connector formation on the hose is a keyhole-type aperture into the hose connector with the method of the invention including the steps of placing the crossbar of the connector formation on the valve in the aperture of the hose connector and rotating one of the components relatively to the other to cause the crossbar of the connector formation on the valve to be situated across a portion of the hose connector aperture which has a lesser dimension than the length of the valve formation crossbar to lock the two components against separation in the axial direction of the rock anchor tube.

6. A rock anchor for use in the rock anchor locating method of claim 1 comprising an elongated metal tube which; is transversely expansible by liquid in it under pressure, is closed at a first end and carries in its second end a liquid inlet body which includes a holed hose connector formation which is releasably engageable with a formation on a connector on a liquid hose by rotation of one of the formations relatively to the other, when engaged with each other, characterised in that the rock anchor is fully locatable, in use, in a hole at a position at which it is to be anchored with its hose connector formation remote from the mouth of the hole.

7. A rock anchor as claimed in claim 6 wherein the rock anchor liquid inlet body is a one-way valve.

8. A rock anchor as claimed in claim 7 wherein the valve connector formation and the liquid hose formation are bayonet-type engageable formations.

9. A rock anchor as claimed in claim 8 wherein the valve formation is T-shaped with a liquid passage through the leg of the T and the hose connector formation is a keyhole type aperture in an end of a socket on the hose connector in which the crossbar of the valve formation is releasably located, in use, and which on relative rotation of the formations engages lands in the connector socket on opposite sides of the aperture to lock the hose connector to the rock anchor against separation in an axial direction from the rock anchor.

10. A rock anchor as claimed in claim 7 wherein the valve connector formation and the liquid hose formation are spigot and socket formations which are threadedly connected, in use.

11. A hose connector for use in the rock anchor locating method of claim 2, including a socket formation which is fixed to and extends from the hose by a distance to its free end which corresponds to at least the distance at which the outer end of the rock anchor is required to be located fully in and from the mouth of the hole, a liquid passage through the socket, a formation at or adjacent the free end of the socket for releasably engaging the rock anchor valve formation on rotation of the rock anchor relatively to the hose connector socket or vice versa to releasably lock the hose connector to the rock anchor against separation in the axial direction of the rock anchor tube.

12. A hose connector as claimed in claim 11 wherein the hose connector socket formation is connected to a liquid hose through a swivel connector to enable the hose connector to rotate about the axis of the socket relatively to the hose.

13. A hose connector as claimed in either one of claims 11 and 12 wherein the socket formation includes a transversely extending stop formation which is so positioned on the socket formation when the stop formation abuts material surrounding the mouth of a hole in which the rock anchor is located, in use, the valved end of the rock anchor is located at the desired position in the hole.

14. A hose connector as claimed in either one of claims 12 or 13 including means for rotating it relatively to the rock anchor, in use.

15. A hose connector as claimed in claims 11 to 13 wherein the rock anchor and the hose connector formations may be bayonet-type fittings.

16. A hose connector as claimed in any one of claims 11 to 14 wherein the valve connector formation and the liquid hose formation are spigot and socket formations which are threadedly connected, in use.

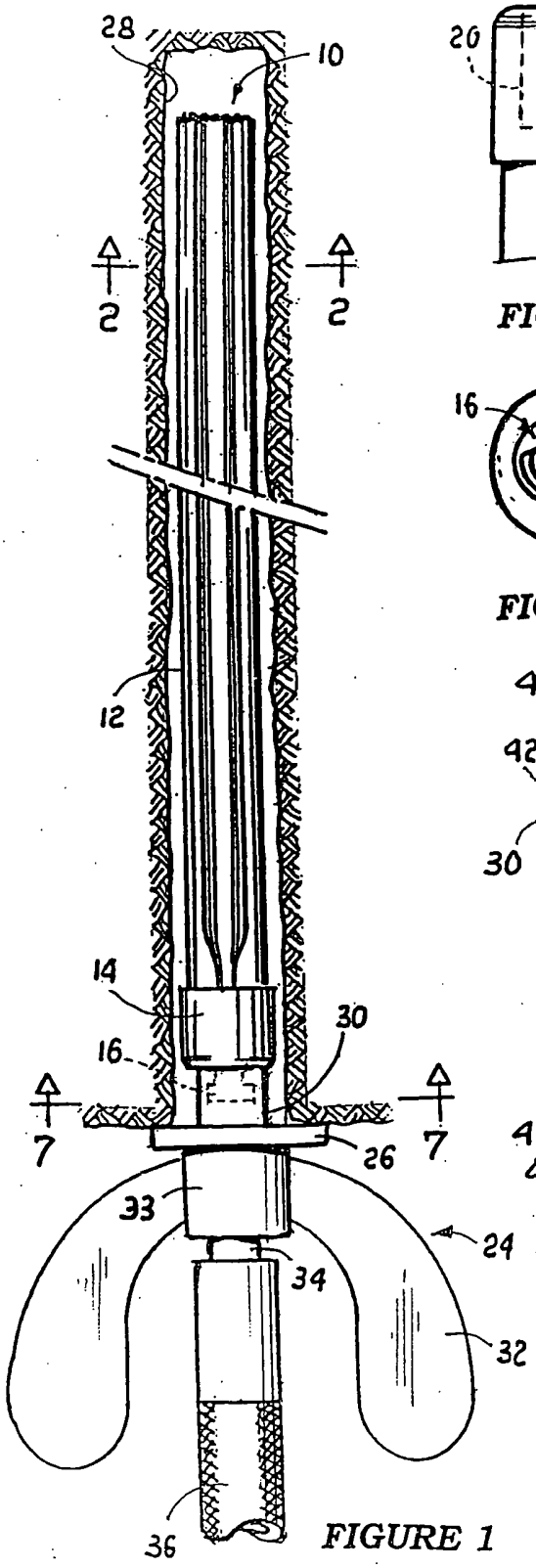

FIGURE 1

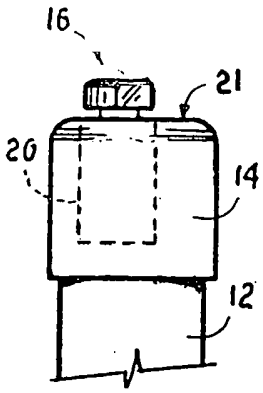

FIGURE 4

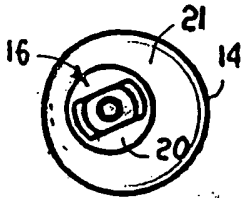

FIGURE 5

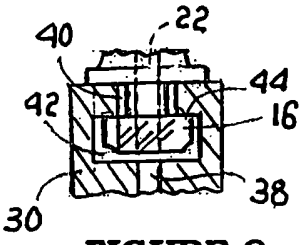

FIGURE 9

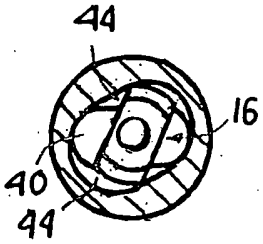

FIGURE 8

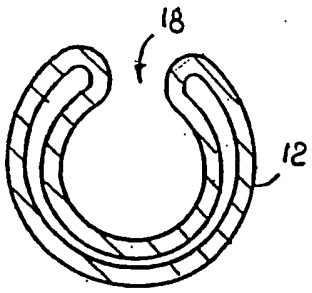

FIGURE 2

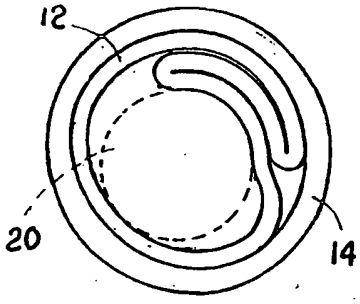

FIGURE 3

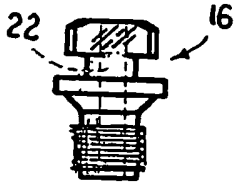

FIGURE 6

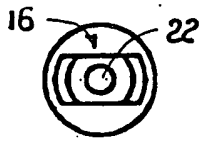

FIGURE 7

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 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)
IPC 7 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 practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 4 696 606 A (HERRON ET AL) 29 September 1987 (1987-09-29) abstract	1-16
A	US 4 012 913 A (SCOTT ET AL) 22 March 1977 (1977-03-22) figures 3,7	1,6,11
A	DE 79 19 838 U1 (BERGWERKSVERBAND GMBH, 4300 ESSEN, DE) 14 April 1983 (1983-04-14) figure 4	1,6

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

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Information on patent family members

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