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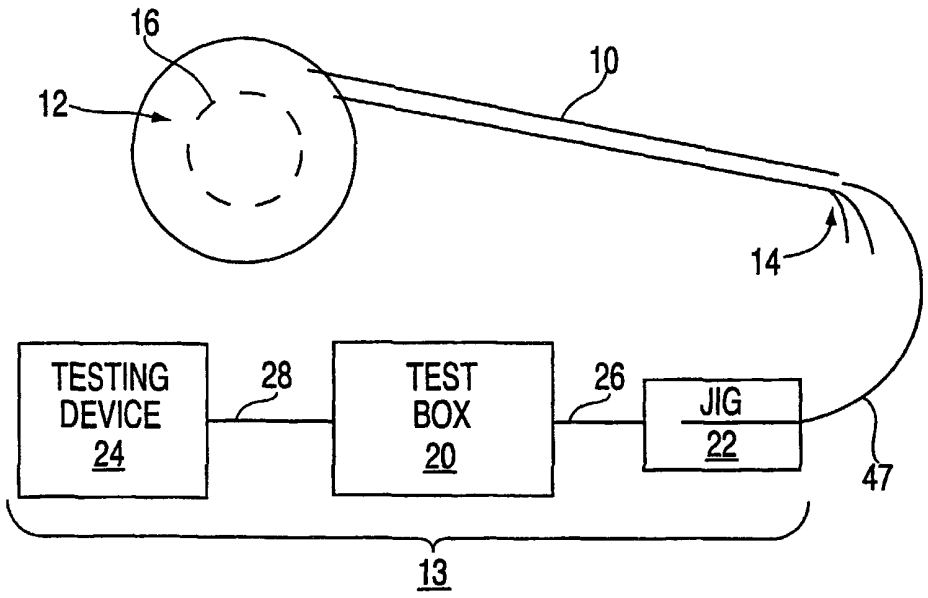
(54) Title: APPARATUS FOR OPTICAL CABLE TESTING



(57) Abstract: An apparatus for testing a multifilament fiberoptic cable includes a test box (20) adapted to be coupled to a known testing device (24) such as an optical time domain reflectometer, or OTDR, a connector with a ribbon of optical fibers (14), and a jig (22) adapted to selectively couple light from the test box (20) and the OTDR through the connectors to some of the fibers of the cable (28). Preferably, the OTDR is connected to the test box (20) by another connector. The test box (20) is arranged so that a length of the first connector may be coiled up and stored within it when not required. The jig (22) includes alignment elements used to assist a user in aligning the facing ends of the fibers in an abutting relationship.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

APPARATUS FOR OPTICAL CABLE TESTING

BACKGROUND OF THE INVENTION

A. FIELD OF INVENTION

This invention pertains to an apparatus for testing an optical cable formed of a plurality of fibers, and more particularly, to an apparatus in which multiple filaments can be tested quickly and efficiently.

B. DESCRIPTION OF THE PRIOR ART

Fiberoptic cable is presently manufactured and distributed on rolls similar to standard copper wire cables. A typical fiberoptic cable consists of a plurality of bundles, each comprising ribbons formed of a plurality of filaments. During transportation, and installation, a fiberoptic cable is subjected to various forces which may cause individual filaments to rupture or otherwise distort the cable thereby affecting its capability to transmit optical signals efficiently. Ruptures or other distortions may also occur during the manufacturing process. Once a cable is installed, it is very expensive to replace it. Therefore it is imperative that cables with defective filaments are discovered before a cable is installed.

Some prior art apparatus used for testing fiberoptic cables are disclosed in the following references. U.S. Patent No. 5,179,420 discloses the use of an optical time domain reflectometer (OTDR) for testing cables using a variable wavelength laser.

U.S. Patents 5,871,559 and 5,970,749 disclose an automatic apparatus for fiberoptic fiber with a combined splicer/cutter (Fig. 1).

U.S. Patent No. 5,473,423 discloses a method and apparatus for testing light waveguides in which a coupling device is used to conduct a light spot in a predetermined sequence toward one of the guides.

U.S. Patent No. 5,459,564 discloses an apparatus for inspecting the ends of optical fibers using an interferrometer.

U.S. Patent No. 5,767,957 discloses an apparatus for testing an optical cable using an OTDR unit.

U.S. Patent No. 5,179,420 discloses an OTDR used to test an optical fiber.

OBJECTIVES AND SUMMARY OF THE INVENTION

It is an objective of the present invention is to provide an apparatus for testing fiberoptic cables which can be used easily and without extensive training.

A further objective is to provide an apparatus which can be used to test a plurality of fibers or filaments in a cable quickly and accurately.

Yet a further objective is to provide an apparatus which can be made relatively inexpensively. Other objectives and advantages of the invention, will become apparent from the following description.

Briefly, a tester constructed in accordance with this invention includes a test box adapted to be coupled to a standard device for testing optical fibers, and a jig coupled to the test box by a fiberoptic connector. The jig is adapted to position the ends of the fiber optic connector to the ends of a ribbon from a cable to be tested. In order to facilitate the proper positioning and placement of the fibers from the fiberoptic connector and the ribbon being tested, the jig is formed with a trough arranged to receive the fiberoptic connector and the ribbon in an abutting relationship. The jig is further provided with a

cover which can be closed over the trough. Advantageously a portion of the cover is provided with a magnifying glass that can be used to check that the fibers are properly aligned. Preferably a jell is used to maintain the fiber ends in position. The jig may also be provided with a battery powered lamp oriented to illuminate the fiber ends while they are being checked.

More particularly, the subject application pertains to a tester provided to test a multifilament fiberoptic cable having a free end, said tester including:

a test box adapted to be coupled to an optical fiber test device;

a jig adapted to receive said free end; and

a first connector extending between said test box and said jig and having a connector end, wherein said jig is arranged and constructed to position said connector end and said free end in an abutting relation; and

wherein said test box and said first connector cooperate to transmit light signals from the optical fiber test device to said free end to determine characteristics of said cable.

Preferably the optical fiber test device is an optical time domain reflectometer (OTDR) which generates light at various wavelengths which are transmitted by the subject tester to the free ends of the cable filaments. Reflections intercepted from the fiber ends are analyzed by the OTDR using known techniques to determine the characteristics, and hence the condition of the cable.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a cross-sectional somewhat diagrammatic view of a cable with several bundles of optical fiber filaments;

Figure 2 shows a block diagram of the subject apparatus being used to test a cable on a reel;

Figure 3 shows elements of the test box for the subject apparatus; and

Figure 4 shows an orthogonal view of the jig used in the subject apparatus for selectively coupling light from a test device to the fibers of the cable of Fig. 1.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a somewhat diagrammatic cross-sectional view of a typical cable 10. As can be seen in this Figure, the cable 10 consists of several ribbons, each ribbon being substantially flat and consisting of a row of six optical fibers or filaments (not shown) disposed side by side. A plurality of ribbons, for example 12 may be grouped together in bundles, each bundle being disposed in an individual protective sheath 10A. As previously discussed, during manufacture and/or transportation, some of the fibers of the cable may be damaged.

Figure 2 shows a reel 12 which may hold for instance up to 10,000 feet of cable or more, depending on the diameter of the cable 10 and the size of the reel 12. The cable 10 has one free end 14 which has been opened so that its individual ribbons, such as ribbon 47, may be tested and an end 16 which is wound on reel 12 and may be accessible for testing purposes. As shown in Figure 2, the present application provides a tester 13 including a test box 20, a connection jig 22 and a testing device 24. Extending from the test box 20 to the jig 22 is a connector 26 with a plurality of filaments. The connector 26 is arranged so that each of its filaments is disposed in an abutting relationship with some of the filaments of cable 10, as described more fully below. Another connector 28 couples the box 20 to testing device 24.

Fig. 3 shows some of the elements of the test the box 20. The box 20 includes a housing 30. Disposed in the housing 30 is a coupling plate 32. A jack 34 is disposed on a wall of the housing 30. The jack 34 includes a plurality of individual optical connectors 36.

Mounted on plate 32 there are a plurality of parallel sleeves 38. Sleeve 38 may be mounted on the plate 32 via an adhesive, by a bracket or by any other means.

A plurality of optical fibers 40 in the form of filaments extend between the plate 32 and jack 34. More particularly, each filament 40 has one end connected to one of the optical connectors 36 and the other end extends into one of the sleeves 38 as shown. Since filaments 40 are disposed inside the housing 30, they may be termed internal filaments.

A second set of filaments 42 extend away from the connectors 38 and are joined to form one or more ribbons 43. The ribbon 43 may be formed into circular coils (if necessary) and stored in the housing 30. The free end of ribbon 44 extends outwardly of housing 30 through an opening 45 to comprise the connector 26. Since connector 26 extends outside the housing 30, its filaments 42 may be termed external filaments.

Inside sleeve 38, the end of each of the filament 40 is optically coupled to the end of a corresponding filament 42 using a standard optical coupler (not shown). After the coupling is made, the sleeves 38 may be heat shrank around the filaments to provide support and protection for the filament ends and the optical couplings within the sleeves.

Referring to Fig. 4, the jig 22 includes a box-shaped housing 44 formed with a trench 46 sized and constructed to receive the ends of one or more of the ribbons 47 of cable 10 and the end of the ribbon 43 of connector 26. The end of ribbon 43 is held securely by a latch 48. A similar latch (not shown) may be use to secure the end of a

ribbon 47 from cable 10.

The housing 44 also includes a cover 52 attached to the rest of the housing 44 by a hinge 54. A portion of the cover is transparent and may be shaped to form a magnifier 56. The jig 22 further includes a battery 58 which provides current via a switch 60 to a light 62. The battery 58 and switch 60 may be incorporated into the housing 44 however, are shown externally for the sake of clarity. The magnifier 56 and the light 62 act as alignment elements that assist a user in aligning the ends of the fibers in an abutting relationship.

The jig 22 may be provided with other implements useful for testing, installing or splicing the ends of cable 10. For example, the jig 22 may provided with a cutter 53 which may be used to make a clean cut at the end of ribbon 47.

In order to test one or more fibers, for example of ribbon 47, is placed into and secured within trench 46. The ribbon connector 43 is secured in the trench by latch 48. The ribbons 43, 47 are arranged within the trench so that their individual filaments are aligned and abut each other within a zone A. This alignment may be checked by closing cover 52 and inspecting the ends of the ribbons through the magnifier 56. This inspection is further assisted by the light 62 which can be selectively activated by switch 60. Importantly, in order to insure that continuous light paths are established between the filaments of the connector 26 and ribbon 50, an appropriate gel is deposited on the ends of the filaments in zone A where they abut.

Next, the testing device 24 is preferably an OTDR tester is attached to the optical connectors 36 via connector 28 and is used to test the ribbon 47 by transmitting light at particular wavelengths, through the jack 34, filaments 40, sleeves 38, and filaments 42. The operation of an OTDR is well known in the art, as described in the patents

referenced above, and need not be described in any further details. After the testing is completed, the ribbon 47 is removed and another ribbon from cable 10 is placed on the jig 22 to be tested.

Once the testing of the whole cable is complete, the connector 28 can be removed thereby disconnecting the test box from the testing device. In addition, the ribbons 43 forming the connector 26 can be drawn into the housing 30 and coiled up to save space and to protect these ribbons from damage in between tests.

The invention was described in conjunction with a cable formed of ribbons with six filaments. However, it can be extended to test cables and ribbons with a different number of filaments, such as 12, 24, 36 etc.

The inventive apparatus has been described herein as having three distinct components: test box 20, testing device 24 and jig 22. However, some or all of these components may be combined. For example, both the testing device 24 and/or the jig can be disposed in or mounted on the test box 20.

Obviously numerous modifications may be made to the invention without departing from its scope as defined in the appended claims.

I claim:

1. A tester provided to test a multifilament fiberoptic cable having a free end, comprising:

a test box adapted to be coupled to an optical fiber test device;

a jig adapted to receive said free end; and

a first connector extending between said test box and said jig and having a connector end, wherein said jig is arranged and constructed to position said connector end and said free end in an abutting relation; and

wherein said test box and said first connector cooperate to transmit light signals from the optical fiber test device to said free end to determine characteristics of said cable.

2. The tester of claim 1 further comprising a second connector adapted to connect said test box to said optical fiber test device.

3. The tester of claim 1 wherein said connector end and said free end each include a plurality of filaments with filaments ends and wherein said jig is adapted to align said filament ends in an abutting relationship.

4. The tester of claim 1 wherein said jig includes an alignment element arranged and constructed to assist a user to align said connector and said free end.

5. The tester of claim 4 wherein said alignment element include a magnifier

positioned to allow a user to check the relative position of said free end and said cable end.

6. The tester of claim 4 wherein said alignment element includes a lamp which can be selectively activated to illuminate said free and said cable ends.

7. A tester provided to test a fiberoptic cable formed of a plurality of ribbons formed of filaments, each having a free end, said tester comprising:

a testing device adapted to generate light at different wavelengths to test characteristics of filaments;

a test box having a jack adapted to receive said light;

a first connector coupled to said test box and having a connector end; and

a jig adapted to align said connector end and said free ends, wherein said test box and connector cooperate to transmit said light to said free ends, thereby enabling said testing device to determine characteristics of said cable.

8. The tester of claim 7 wherein said test box includes a housing supporting said jack, a plurality of interior filaments connected to said jack and a coupling member that couples said interior filaments to said first connector.

9. The tester of claim 8 wherein said first connector includes external filaments, each external filament being coupled optically by said coupling member to one of said internal filaments.

10. The tester of claim 9 wherein said coupling member includes a plurality of sleeves, each of said internal and external filaments extending into one of said sleeves.

11. The tester of claim 10 wherein said coupler further includes a plate, said sleeves being attached to said plate.

12. The tester of claim 7 wherein said jig include a housing with a trough formed thereon to support said connector and said free ends in an aligned configuration.

13. The tester of claim 12 wherein said jig further comprises a cover attached to said housing and arranged to selectively extend over said trough to protect said ends during testing.

14. The tester of claim 12 wherein said tester further comprises an alignment element arranged to facilitate the alignment of said ends.

15. The tester of claim 14 wherein said alignment element includes a magnifier used to inspect said ends.

16. The tester of claim 14 wherein said alignment element includes a lamp arranged to selectively illuminate said ends during alignment.

17. The tester of claim 7 wherein said jig comprises a cutter arranged to cut an end of a filament.

18. A method of testing a cable formed of fiberoptic filaments having free ends comprising:

aligning said free ends on a jig with the free ends of a connector;

applying a jell to said free ends to maintain said free ends in a preselected configuration; and

applying light from a tester device through said connector to said free ends to determine characteristics of said cable.

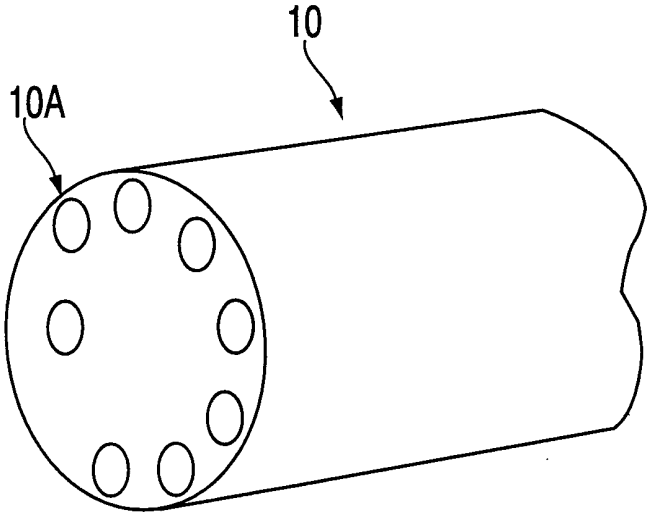
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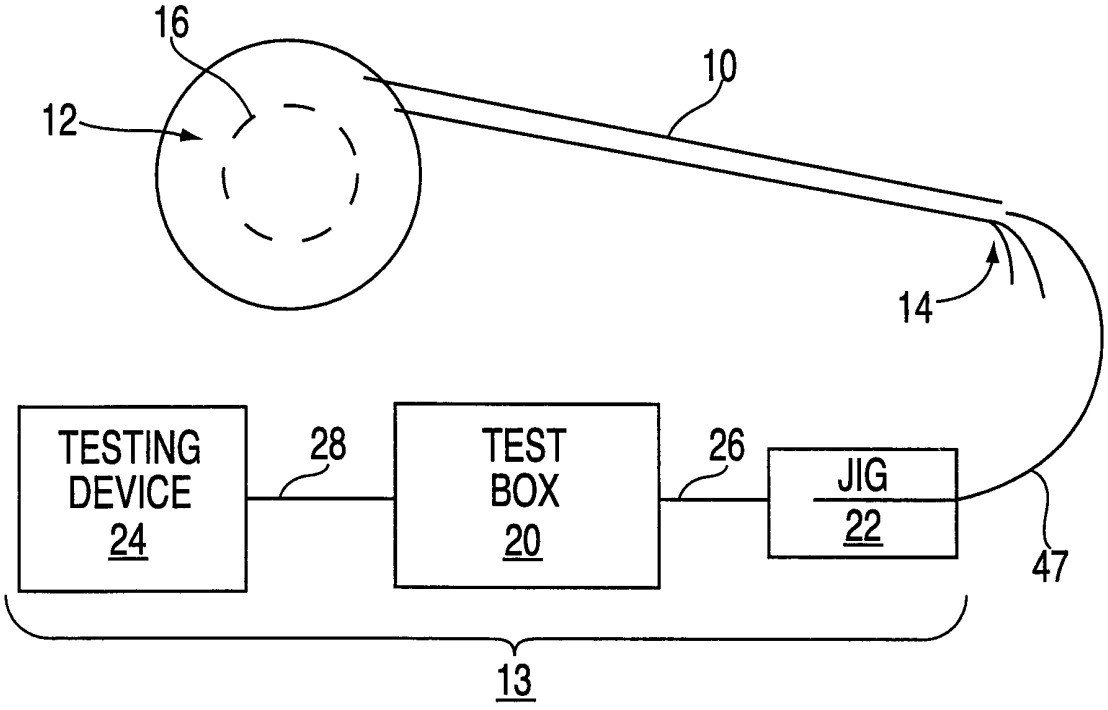
FIG. 1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TESTING DEVICE 24
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TEST BOX 20
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JIG 22
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FIG. 2

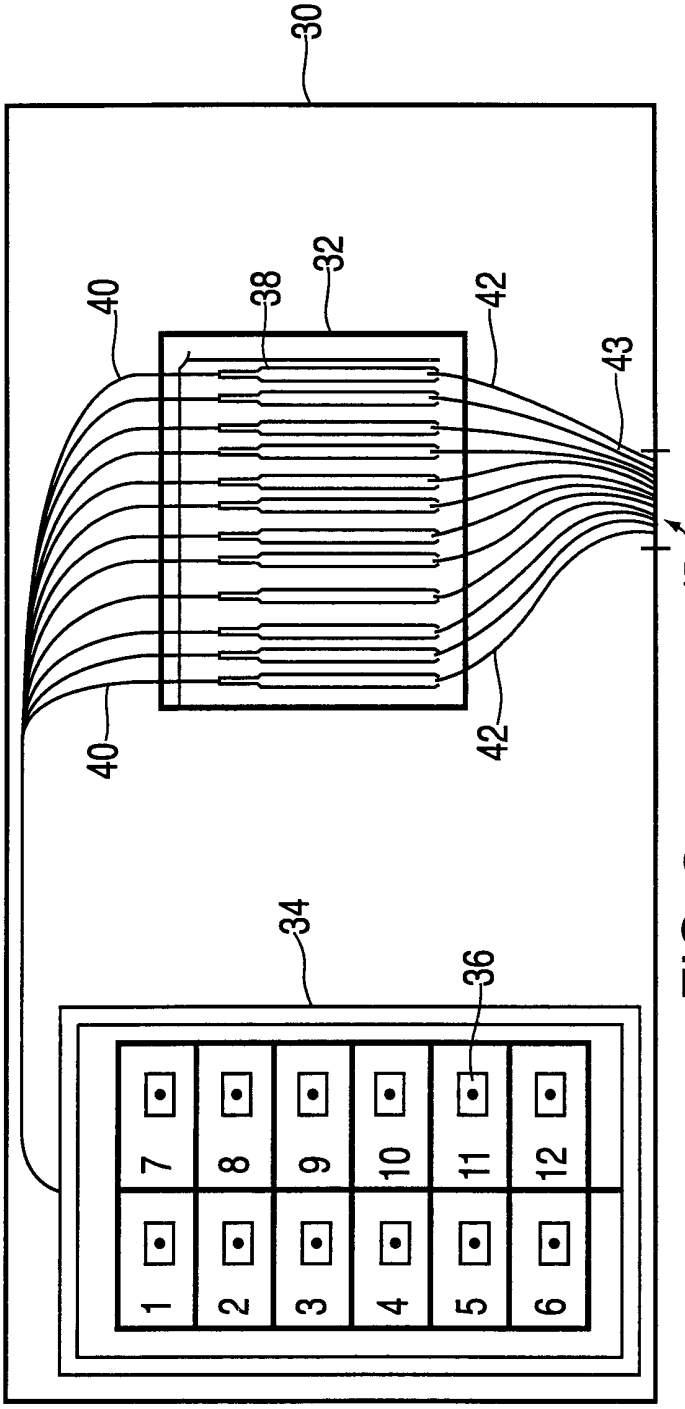
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FIG. 3

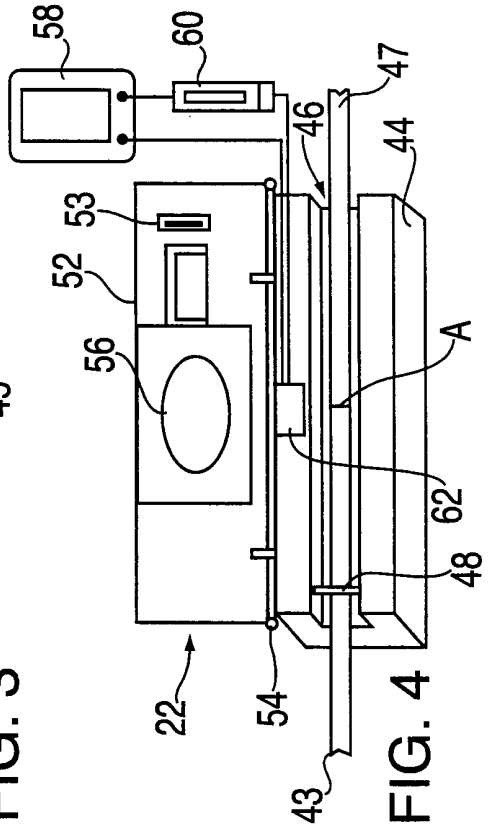
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FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/04325

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G01N 21/00
US CL : 356/73.1

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)

U.S. : 356/73.1; 385/54, 55, 85, 114, 120

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

None

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

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,473,423 A (RUEGENBERG et al.) 05 DECEMBER 1995 (05.12.1995), see entire document.	1-18
Y	US 5,767,957 A (BARRINGER et al.) 16 JUNE 1998 (16.06.1998), see entire document.	1-18
Y	US 5,179,420 A (SO et al.) 12 JANUARY 1993 (12.01.1993), see entire document.	1-18

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

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier document published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
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