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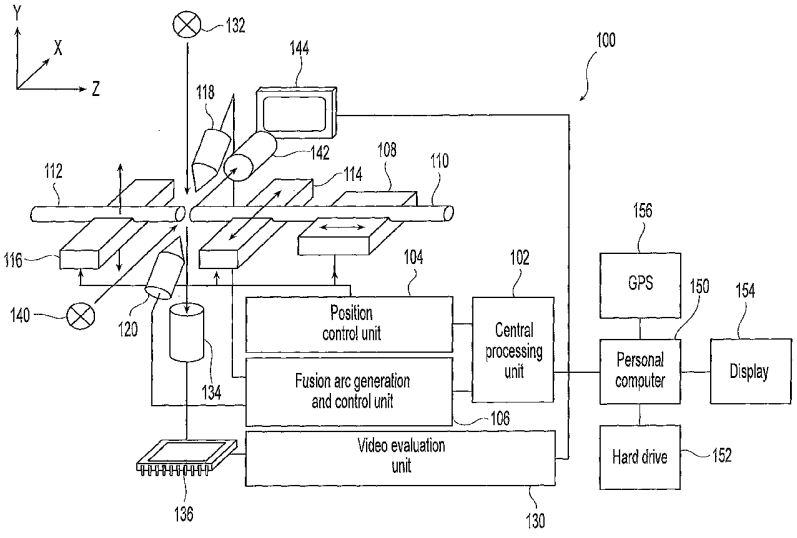
(54) Title: OPTICAL FIBER FUSION SPLICER WITH PERSONAL COMPUTER FUNCTIONALITY



(57) Abstract: An optical fiber fusion splicer includes a personal computer (150) and splicing elements in communication with and controlled by the personal computer for fusion splicing at least one pair of opposed optical fibers (110,112). The personal computer is integral with the splicing elements within the fusion splicer and provides personal computer functionality to the fusion splicer. The fusion splicer may further include a hard drive (152) in communication with the personal computer for storing and retrieving data, a display (154) in communication with the personal computer including a graphical user interface comprising a touch screen and one or more icons for controlling the personal computer, and a global positioning system in communication with and adapted to interface with the personal computer to assist with fusion splicing the optical fibers. The fusion splicer may also include a central processing uniAn optical fiber fusion splicer includes a personal computer and splicing elements in communication with and controlled by the personal computer for fusion splicing at least one pair of opposed optical fibers. The personal computer is integral with the splicing elements within the fusion splicer and provides personal computer functionality to the fusion splicer. The fusion splicer may further include a hard drive in communication with the personal computer for storing and retrieving data, a display in communication with the personal computer including a graphical user interface comprising a touch screen and one or more icons for controlling the personal computer, and a global positioning system in communication with and adapted to interface with the personal computer to assist with fusion splicing the optical fibers. The fusion splicer may also include a central processing unit in communication with the personal computer and the splicing elements.

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OPTICAL FIBER FUSION SPLICER WITH PERSONAL COMPUTER FUNCTIONALITY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority under 35 U.S.C. § 119(e) of U.S. Provisional Application Serial No. 60/564,859 filed on April 23, 2004.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates generally to an optical fiber fusion splicer that is preferably used in the field to splice optical fibers, and more particularly, to an optical fiber fusion splicer for splicing optical fibers in a fiber optic network where low loss performance is desired. The field fusion splicer includes a personal computer that allows interactive training, remote maintenance, and e-commerce functionality.

2. Technical Background

[0003] It is known to provide an optical fiber fusion splicer designed specifically for use in a controlled factory environment with external computing capability. Fusion splicers for splicing optical fibers in the field are also known. None of the known field fusion splicers, however, has the interactive communication and personal computing capability that is presently available for a factory fusion splicer. Furthermore, none of the known field fusion splicers includes the ability to quickly and accurately locate splice points and perform high-precision fusion splices in the field utilizing personal computer functionality.

[0004] Such a field fusion splicer would necessarily require a level of personal computer functionality that includes wireless communication, interactive training, and the ability to

import and retrievably store splice plans on a storage medium, obtain maintena assistance from remote service centers, and generate a video record of a fusion splice event. Accordingly, the present invention is directed to an optical fiber fusion splicer with personal computer functionality including wireless communication and interactive training, which may be utilized in the field to locate splice points, perform a high-precision fusion splice and generate a video record of the fusion splice event.

SUMMARY OF THE INVENTION

[0005] To achieve these and other advantages and in accordance with the purpose of the invention as embodied and broadly described herein, the invention is directed in one aspect to an optical fiber fusion splicer including at least a personal computer, splicing elements in communication with the personal computer to fusion splice at least one pair of opposed optical fibers, and a graphical user interface to control the personal computer.

[0006] In another aspect, the invention is directed to a portable field fusion splicer including a personal computer and splicing elements, the personal computer being integral with and in communication with the splicing elements within the fusion splicer to fusion splice at least one pair of opposed optical fibers, and a graphical user interface to control the personal computer.

[0007] In yet another aspect, the invention is directed to a portable field fusion splicer including a personal computer and splicing elements, the personal computer being integral with and in communication with the splicing elements within the fusion splicer to fusion splice at least one pair of opposed optical fibers, a graphical user interface to control the personal computer, and a global positioning system (GPS) adapted to interface with the personal computer to locate splice points and to assist with performing a high-precision fusion splice.

[0008] In yet another aspect, the invention is directed to a portable field fusion including a personal computer, splicing elements, a splice controller in communication with the personal computer and the splicing elements to fusion splice at least one pair of opposed optical fibers, and a graphical user interface to control the personal computer.

[0009] Additional features and advantages of the invention will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description which follows, the claims, as well as the appended drawings.

[0010] It is to be understood that both the foregoing general description and the following detailed description present exemplary and explanatory embodiments of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated into and constitute a part of this specification. The drawings illustrate various exemplary embodiments of the invention, and together with the description, serve to explain the principles and operations of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a schematic illustrating the arrangement and operation of an exemplary embodiment of an optical fiber fusion splicer according to the present invention;

[0012] FIG. 2 is a perspective view of an exemplary embodiment of a field fusion splicer that operates in accordance with the principles illustrated in FIG. 1;

[0013] FIG. 3 is a front view of the lower portion of the field fusion splicer of FIG. 2 showing the connector ports of the fusion splicer;

[0014] FIG. 4 is a right-hand side view of the field fusion splicer of FIG. 2;

[0015] FIG. 5 is a left-hand side view of the field fusion splicer of FIG. 2;

[0016] FIG. 6 is a rear view of the field fusion splicer of FIG. 2; and

[0017] FIG. 7 is schematic of another exemplary embodiment of a field fusion splicer according to the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0018] Reference will now be made in detail to exemplary embodiments of the invention, examples of which are described herein and shown in the accompanying drawings. Whenever practical, the same reference numerals are used throughout the drawings to refer to the same or similar parts or features. One embodiment of an optical fiber fusion splicer according to the present invention illustrated in FIG. 1 and shown in FIGS. 2-6 is designated generally throughout the following detailed description by the reference numeral **100**.

[0019] In accordance with the invention, an optical fiber fusion splicer **100** is illustrated schematically in FIG. 1. The fusion splicer **100** is a preferably a local injection and detection (LID) type fusion splicer, which injects light into at least one of a pair of opposed optical fibers **110,112** and positions the optical fibers relative to one another to optimize the fusion splice by maximizing the intensity of the transmitted light collected at a receiver (not shown). LID type fusion splicers are well known in the art and therefore the construction of the LID fusion splicer will not be described further except as necessary to explain the principles and operation of the present invention. As shown in FIG. 1 and described herein with respect to FIGS. 1-6, the fusion splicer **100** includes a central processing unit (CPU) **102** that interacts with a personal computer **150** to control the splicing functions of the fusion splicer **100**. As is shown in FIG. 7 and will be described hereinafter, the fusion splicer **100** need not include the CPU **102** and the personal

computer **150** may provide all of the capabilities and perform all of the functio
CPU **102**.

[0020] The CPU **102** controls a position control unit **104**. As is well known in the art, the position control unit **104** controls the positioning units for the x, y, and z axes. It should be noted that the x, y, and z planes illustrated in FIG. 1 are assigned for ease of explanation, but they could be assigned according to any other preference. In conventional practice, the x and y axes may be rotated approximately forty-five degrees (45°) about the z axis from the configuration shown. As shown in FIG. 1, the z-axis positioning unit **108** moves one of the optical fibers **110** along the z-axis (in this Figure, the z-axis is oriented along the longitudinal axis of the optical fibers **110,112**). Thus, the z-axis positioning unit **108** adjusts the axial distance between the optical fibers **110,112**. The x-axis positioning unit **114** controls the lateral alignment of optical fiber **110** relative to optical fiber **112** along the x-axis, which in the embodiment shown is the axis perpendicular to the z-axis and extending into and out of the plane of FIG. 1. The y-axis positioning unit **116** is responsible for adjusting the vertical alignment of the optical fibers **110,112** by moving the second of the two optical fibers **112** relative to the first optical fiber **110** along the y-axis, which in the embodiment shown is the axis perpendicular to the z-axis and the x-axis and extending in the plane of FIG. 1.

[0021] The CPU **102** also controls a fusion arc generation and control unit **106**. The fusion arc generation and control unit **106** in turn controls at least one, and as shown, a pair of fusion electrodes **118,120**. When energized, the fusion electrodes **118,120** create an arc to heat and thereby fuse the optical fibers **110,112** to one another. While the general operation of the fusion electrodes **118,120** is well known, they may be configured with an electrode cleaning arc and arc-stabilizers that ensure reliability, durability and precision, in the manner described below.

[0022] The fusion electrodes **118,120** and their control unit **106**, preferably in with the position control unit **104** and the x-axis, y-axis and z-axis positioning units **108,114,116**, make up the splicing elements of the fusion splicer **100**. Obviously, the positioning units **108,114,116** may be eliminated entirely and the optical fibers **110,112** provided with suitable support. Alternatively, the positioning units **108,114,116** may be manually operated rather than electrically operated, as shown. In the event the positioning units **108,114,116** are eliminated or manually operated, the splicing elements of the fusion splicer **100** would include only the fusion electrodes **118,120** and the fusion arc generation and control unit **106**.

[0023] The CPU **102** also controls a video evaluation unit **130**. The video evaluation unit **130** operates two video systems – namely an x-axis video system and a y-axis video system. The y-axis video system preferably includes a light source **132** to illuminate the optical fibers **110,112**, an imaging system **134**, and a camera chip **136** aligned with the imaging system **134** along the y-axis. Similarly, the x-axis video system preferably includes a light source **140** to illuminate the optical fibers **110,112**, an imaging system **142**, and a camera chip **144** aligned with the imaging system **142** along the x-axis. The two video systems generate a video record of the fusion splice event, as will be discussed in greater detail below. As is known in the imaging art, the function of the two video systems may be accomplished utilizing a single camera chip and a simple or complex lens depending upon the nature and quality of the video record desired.

[0024] The fusion splicer **100** also includes a personal computer (PC) **150**, that preferably comprises a storage device, such as a hard drive **152**, for storing and retrieving application software (e.g., a fusion splice program) and data. The hard drive **152** may be any of a conventional hard disk drive, Flash RAM chip or card, non-volatile RAM, memory stick or other device now known or hereafter devised for providing typical computer memory

function. The PC **150** further includes a display **154** comprising a graphical use for graphically displaying the application software and data, and a global positioning system (GPS) **156**. The GPS **156** may be configured with the PC **150** or may be a separate component that is in communication with the CPU **102** or with the PC **150** either directly or indirectly through the CPU **102**. The PC **150** is in communication with the CPU **102** and interfaces with the CPU to optimize the fusion splice and thereby ensure that the optical power loss in the fusion splice is minimized. Typically, the PC **150** will be in electrical communication with the CPU **102**. However, the PC **150** may advantageously be in wireless communication with the CPU **102**, such as through a Bluetooth or wireless Local Area Network (LAN).

[0025] The PC **150** is preferably a fully operational personal computer that runs the same type of operating software as conventional personal computers, such as desktop, workstation and laptop computers. The operating software may include any of the known personal computer operating systems, such as Windows 2000® (available from Microsoft Corporation of Redmond, Washington), Apple® or Linux. As described herein, the PC **150** utilizes the Windows XP® Professional operating system, which allows for the use of email, web browsing, and other personal computer functionality, as will be described in more detail below. The PC **150** also includes a suitable capacity hard drive **152** (preferably at least 1 GB, and more preferably at least about 10GB) to store the operating and applications software, hardware drivers and any other computer software program needed or desired by the end user. The hard drive also stores instructional videos and data relating to the operating and applications software, including the fusion splice files and video files generated by the field fusion splicer **100** and described in greater detail below.

[0026] It should be noted that the PC **150** may by-pass the CPU **102** (and the CPU **102** may be eliminated) such that the PC **150** directly control all of the positioning, splicing

and video functions in the fusion splicer **100**. For example, in an alternative er of the fusion splicer **100'** illustrated in FIG. 7, the PC **150** directly controls the position control unit **104** and fusion arc generation and control unit **106**, in addition to the other components in the fusion splicer **100'**. Thus, in the embodiment of FIG. 7, the PC **150** of fusion splicer **100'** physically and operationally replaces the CPU **102** of the embodiment illustrated in FIG. 1.

[0027] The display **154** for PC **150** is preferably a graphical display comprising a graphical user interface. In addition to the conventional touch screen features, the display **154** also allows for the use of on-screen keyboards and other intuitive interfaces with the end user. The display **154** is a video quality display having sufficient resolution capability for the end user to view interactive training videos stored on the hard drive **152** and any video records of the fusion splice event generated by the video evaluation unit **130**.

[0028] A conventional GPS **156** is also provided in communication with the PC **150**, giving the fusion splicer **100** several additional advantages over existing field fusion splicers. For example, the GPS **156** can be used to identify the physical location (i.e., longitude, latitude and altitude) of a splice point. Once the user is at the location of the splice point, the GPS **156** can be used to determine if there is a need to compensate for any effect of the altitude of the location. For example, at higher altitudes the parameters used to fuse the optical fibers may be different than at lower altitudes. The user may also incorporate mapping application software in conjunction with the GPS **156** and the PC **150** to facilitate voice navigation, navigating cable routes, or other advantageous features. The user may also store the longitude, latitude and altitude coordinates of the splice points determined by the GPS **156** on the hard drive **152** for verification and future reference. The GPS **156** also protects the field fusion splicer **100** by documenting the location of the equipment at all times. Thus, if the fusion splicer **100** is lost or stolen, its location may be

traced and the equipment recovered using the GPS **156**. One example of a GPS for use with the present invention is shown and described in German Patent Application Number 10122840.6.

[0029] An exemplary embodiment of a fusion splicer **100** according to the schematic illustrated in FIG. 1 is shown in FIG. 2. The fusion splicer **100** has a display **154** including a graphical user interface comprising a conventional touch screen. As shown, the display **154** has a medial portion **160** for displaying video, computer software application and data information, and preferably at least one outer portion **162** on the touch screen for graphical icons **164** and other interactive icons. The icons **164** may be utilized by the end user to execute certain commands, such as "yes-no" or "on-off" commands to the different components of the fusion splicer **100**. As shown in FIG. 2, the graphical user interface of display **154** preferably has two outer portions **162** for displaying icons **164** on the touch screen. The display **154** may also include one or more hard keys **166** having additional functions assigned to them by the operating system software or the applications software being used at any particular time. Typically, the function or feature of the hard keys **166** changes depending on the information displayed on the graphical user interface portion of the display **154**. Preferably, a description of the function and/or the feature assigned to the hard keys **166** will appear on either the central portion **160** or on the outer portions **162** to assist the end user. The fusion splicer **100** may also include a dedicated "on-off" power button **168** among the hard keys **166**. The touch screen buttons **164** and the hard keys **166** are used to control the PC **150**, and therefore, fusion splicing of the optical fibers, either directly or through the CPU **102**.

[0030] The fusion splicer **100** has a splicing portion **170** arranged laterally adjacent the top edge of the splicer and above the display **154**. The optical fibers **110,112** are positioned in the fusion splicer **100** under the fiber holding covers **172,174**. Both coarse and fine

alignment of the optical fibers **110,112** in the fusion splicer **100** is preferably p automatically in response to commands issued by the PC **150** and, if present, through the CPU **102**, that are executed by the position control unit **104** and the fiber positioning units **108,114,116.** The fusion splicing is done automatically when the user pushes a "SPLICE START" button, such as a hard key **166** or an icon **164** on the touch screen of the display **154**. The fusion splicer **100** may also be programmed to start automatically once the optical fibers **110,112** are placed into the fusion splicer under the fiber holding covers **172,174**.

[0031] Before the fusion splicer **100** begins the splice process, the optical fibers **110,112** are automatically aligned using the LID system previously described. The LID system injects light into the core of at least one of the optical fibers **110,112** and monitors the optical power. As the optical fibers **110,112** are aligned with one another, the fusion splicer **100** measures the optical power transmitted through the optical fiber splice and, when the optical power is greatest, completes the splice process. The electrodes **118,120** used in the splice process are preferably Precise and Durable Electrodes that are maintenance free due to an electrode cleaning arc that ensures reliability and precision. Additionally, the electrodes **118,120** preferably have arc-stabilizers that also ensure reliability and durability.

[0032] As best shown in FIG. 3, the fusion splicer **100** also includes a variety of connector ports for the PC **150** or CPU **102** located on the front of the lower portion of the field fusion splicer **100**. The PC **150** preferably has an Ethernet connector port **180**, at least one USB connector port **182** (1.1 and 2.0 as shown), an external VGA monitor output connector port **184**, a headphone jack output connector port **186**, and a microphone jack input connector port **188**. As best shown in FIG. 4, the right-hand side of fusion splicer **100** preferably has a serial interface (RS232) connector port **190**, an external LID

transmitter connector port **192**, and a video out connector port **194**. While the ports **190,192,194** are illustrated on the right-hand side of the fusion splicer **100**, they may be conveniently positioned elsewhere on the fusion splicer **100**. The right-hand side of the fusion splicer **100** also has a number of access openings **196** to allow the battery packs **208** (FIG. 5) that may be used for electrical power to be pushed out for removal from the fusion splicer **100**.

[0033] As best shown in FIG. 5, there may be a number of other connector ports provided on the left-hand side of fusion splicer **100**. First, there is preferably a connector port **198** for an external GPS antenna (not shown). An external antenna may be used with the GPS **156** for better reception. The left-hand side may also have a connector port **200,202** for a 12V DC output to power, for example, an external heat shrink oven (not shown). A 12V DC input connector port **204** may also be provided to power the fusion splicer **100**. Power from an external source may be supplied to the fusion splicer **100** through the connector port **204** from a 120V power supply (with appropriate conversion to 12V DC) or from the cigarette lighter of a vehicle. As noted above, power may also be supplied to the fusion splicer **100** by one or more batteries **208** positioned within corresponding battery ports **206**. The batteries **208** are preferably rechargeable 12V 2.3Ah batteries that are able to supply sufficient power to operate the fusion splicer **100** and any related accessories.

[0034] As best shown in FIG. 6, the rear of fusion splicer **100** preferably has an additional USB connector port **210** for supplying power to a USB work lamp (not shown). While in the exemplary embodiment shown and described herein the USB connector port **210** provides only power and does not have any USB functionality, it could be configured to provide either 1.1 or 2.0 USB functionality.

[0035] The Ethernet port **180** allows the PC **150** to be connected to the Internet for email communication (through appropriate application software, such as Lotus Notes®,

Microsoft Outlook®, etc.), downloading upgrades to the fusion splicer operatir application software, downloading additional application software, ordering supplies on-line, accessing on-line reference material, or connecting to a service center for real-time assistance with the splice process or GPS **156**. Preferably, the service center is also able to assume control of the fusion splicer **100** via PC **150** to run diagnostics and to correct any problems that the fusion splicer **100** may experience in the field. While the connection would be slower, the fusion splicer **100** may also be connected to the Internet via an internal or external modem and corresponding application software.

[0036] The USB port **182** allows for most USB accessories to be used with the fusion splicer **100**. For example, a USB memory device can be connected to the PC **150** or CPU **102** for storing and transferring data, a cellular telephone may be connected to access the Internet to transfer data or perform remote service, or a USB work lamp may be connected to operate the fusion splicer **100** in locations where there is inadequate ambient lighting.

[0037] One example of data that can be transferred from the fusion splicer **100** is the splice data that is recorded during the splice process. As noted above, the fusion splicer **100** monitors the optical power through the optical fibers **110,112** and then completes the splice when the optical power transmitted through the fibers is at a maximum. The fusion splicer **100** then measures the optical power after the splice is completed and compares it to the optical power before the splice was completed. This data can be stored on the hard drive **152** and/or transmitted back to the end user's facility or to a remote service center for assistance with the fusion splicer **100** or the splice process.

[0038] The x-axis and y-axis video systems, which are electrically connected to the PC **150**, can be used as real-time video systems or may be used to record a fusion splicing event. The PC **150** would have appropriate application software stored on the hard drive **152** to allow the use of the video evaluation unit **130** to view the fusion splicing event on

the display **154**. The fusion splicing event or splice process may also be viewe remote service center or other location by one of the telecommunications methods discussed above at the same time (i.e., real time) or at a later date. The PC **150** may also simultaneously record and store the video images generated by the video evaluation unit **130** and the x-axis and y-axis video systems on the hard drive **152** for later verification and evaluation, for example on the display **154**.

[0039] As noted above, the hard drive **152** may also have instructional videos stored for playback through appropriate application software on the display **154** of the PC **150**, or on an external display, such as an external video monitor. This capability is advantageous because the end user may need to review the fusion splicing event or the splice process while in the field. Since it may be inconvenient or impossible to speak with a knowledgeable person at the time, the end user may play back the instructional video on the display **154** to ensure that the splice process was performed correctly. The instructional videos may also include data and/or additional information to facilitate performing maintenance on the equipment.

[0040] As previously described, the fusion splicer **100** can be battery operated and/or plugged into an electrical AC or DC outlet. The battery is preferably a rechargeable battery that can operate the fusion splicer **100** and the PC **150** for at least a couple of hours. If the location in the field allows, the fusion splicer may be plugged into a 120V AC outlet, a 12V DC cigarette lighter in a vehicle, or other auxiliary power source.

[0041] As best shown in FIG. 4, the fusion splicer **100** also includes a handle **220** that rotates in the direction indicated by arrow **A** and can be used to carry the fusion splicer **100** when not stored in a protective case. A stand **222** that rotates in the direction indicated by arrow **B** may also be provided to elevate the upper portion of the fusion splicer **100**, and thereby increase the viewing angle of the display **154** and the splicing

portion **170**. When the stand **222** is rotated, the upper portion of the fusion spli will be elevated as best shown in FIG. 2. While the stand **222** is shown attached to the fusion splicer **100**, the fusion splicer **100** could also be placed on a separate stand.

[0042] It will be apparent to those skilled in the art that various modifications and variations can be made in the field fusion splicer of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

THAT WHICH IS CLAIMED IS:

1. An optical fiber fusion splicer for fusion splicing at least one pair of opposed optical fibers, the fusion splicer comprising:

a personal computer;

splicing elements in communication with and controlled by the personal computer for fusion splicing the at least one pair of opposed optical fibers; and

a display for controlling the personal computer.

2. The fusion splicer of claim 1, wherein the display includes a graphical user interface comprising a touch screen.

3. The fusion splicer of claim 1, further comprising a hard drive in communication with the personal computer for storing and retrieving data.

4. The fusion splicer of claim 1, further comprising a global positioning system adapted to interface with the personal computer.

5. The fusion splicer of claim 4, wherein the global positioning system allows the fusion splicer to compensate for differences in altitude.

6. The fusion splicer of claim 4, wherein the global positioning system allows the location of the fusion splicer to be determined from a remote location.

7. The fusion splicer of claim 4, wherein the global positioning system identifies a geographic location of a splice point.

8. The fusion splicer of claim 4, wherein the personal computer includes mapping application software and the global positioning system assists an end user to locate a splice point utilizing the mapping application software.

9. The fusion splicer of claim 1, further comprising at least one connector port to allow communication between the personal computer and a remote service center.

10. The fusion splicer of claim 9, wherein the connector port comprises an Ethernet connector port.

11. The fusion splicer of claim 1, wherein the personal computer is configured to be controlled by a user at a remote location.

12. The fusion splicer of claim 11, wherein the user at the remote location can control the splicing elements for fusion splicing the at least one pair of opposed optical fibers.

13. The fusion splicer of claim 11, wherein the user at the remote location can perform maintenance on the fusion splicer when the fusion splicer is at a location different from the remote location.

14. The fusion splicer of claim 1, wherein the personal computer is configured to receive data from a remote location.

15. The fusion splicer of claim 14, wherein the data is selected from the gr consisting of operating system software, application software, splice information, operating instructions, and instructional video.

16. The fusion splicer of claim 1, wherein the personal computer communicates with a computer network at a remote location through a connector port, the connector port being selected from the group consisting of USB, Ethernet, WiFi, and modem.

17. A field fusion splicer comprising:

a personal computer;

splicing elements in communication with and controlled by the personal computer to fusion splice at least one pair of opposed optical fibers, the splicing elements being integral with the personal computer within the fusion splicer; and

a graphical user interface for controlling the personal computer.

18. A field fusion splicer comprising:

a personal computer;

a splice controller, the splice controller in communication with the personal computer; and

splicing elements controlled by the splice controller to fusion splice at least one pair of opposed optical fibers;

wherein the personal computer is integral with the splice controller and the splicing elements within the fusion splicer.

19. A field fusion splicer comprising:

a personal computer;

a splice controller, the splice controller in communication with the personal computer;

splicing elements controlled by the splice controller to fusion splice at least one pair of opposed optical fibers; and

a graphical user interface for controlling the personal computer.

20. A field fusion splicer comprising:

a personal computer;

a splice controller, the splice controller in communication with the personal computer;

splicing elements controlled by the splice controller to fusion splice at least one pair of opposed optical fibers; and

a global positioning system adapted to interface with the splice controller through the personal computer to assist with fusion splicing the at least one pair of opposed optical fibers.

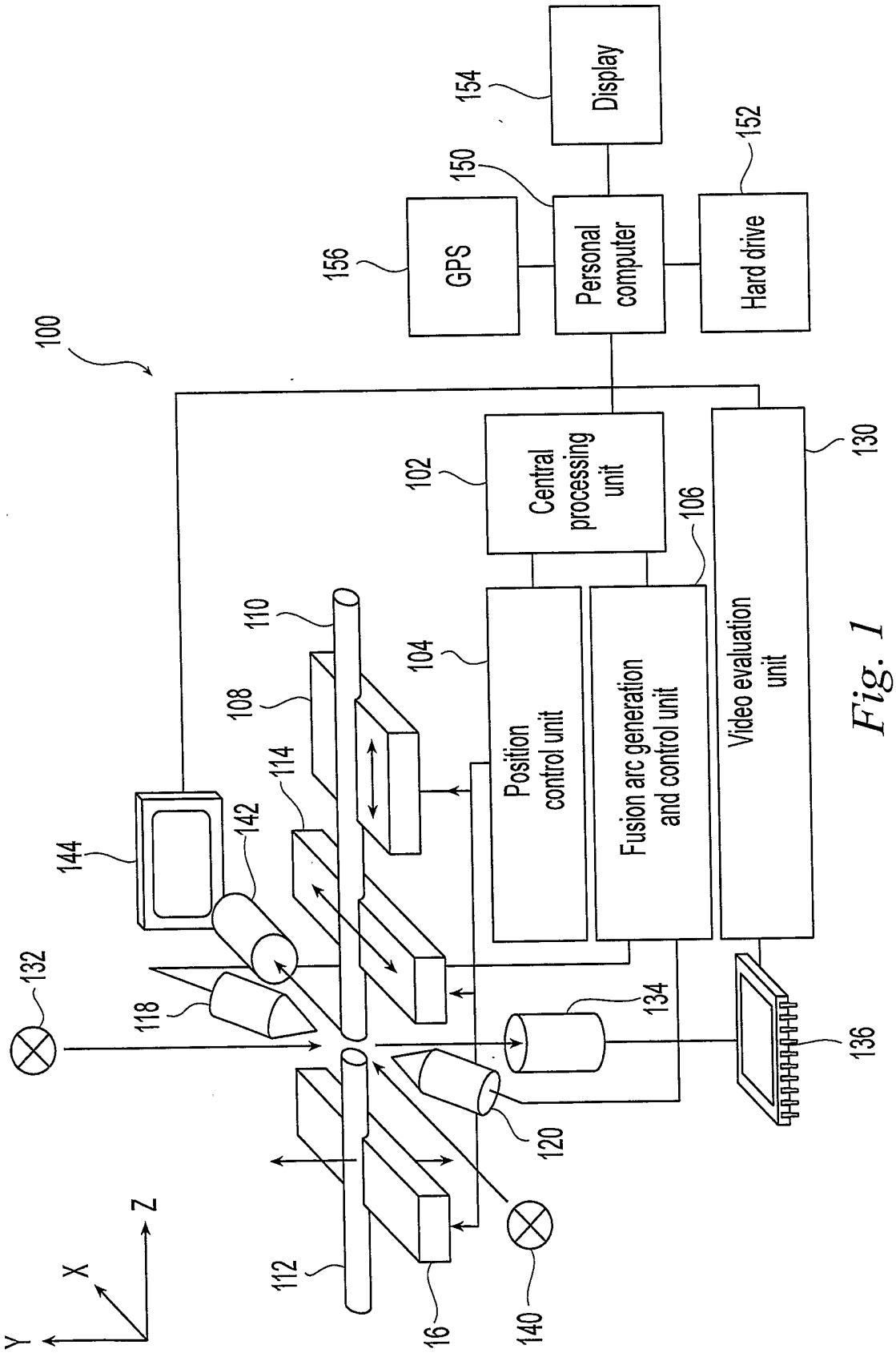
Display
154
152
150
GPS
Personal computer
Hard drive
156
100
102
Central processing unit
106
130
110
104
108
Position control unit
Fusion arc generation and control unit
Video evaluation unit
114
144
142
132
118
134
136
120
112
16
140
Z
X
Y

Fig. 1

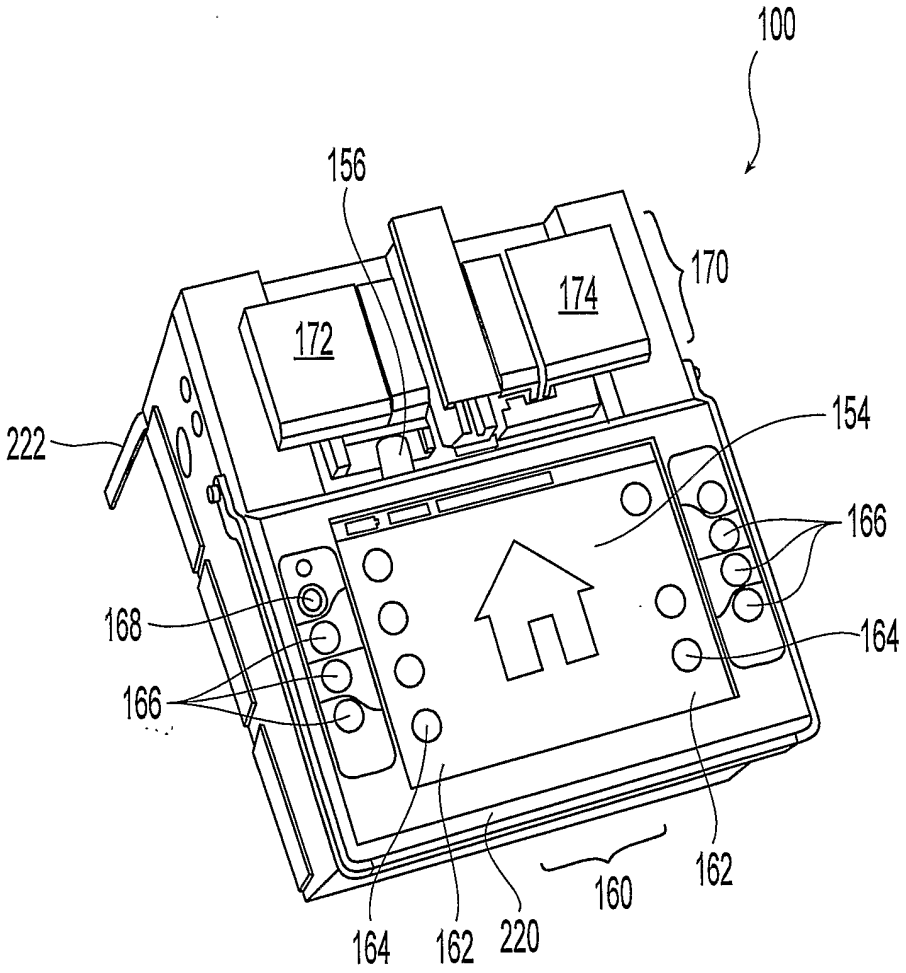

Fig. 2

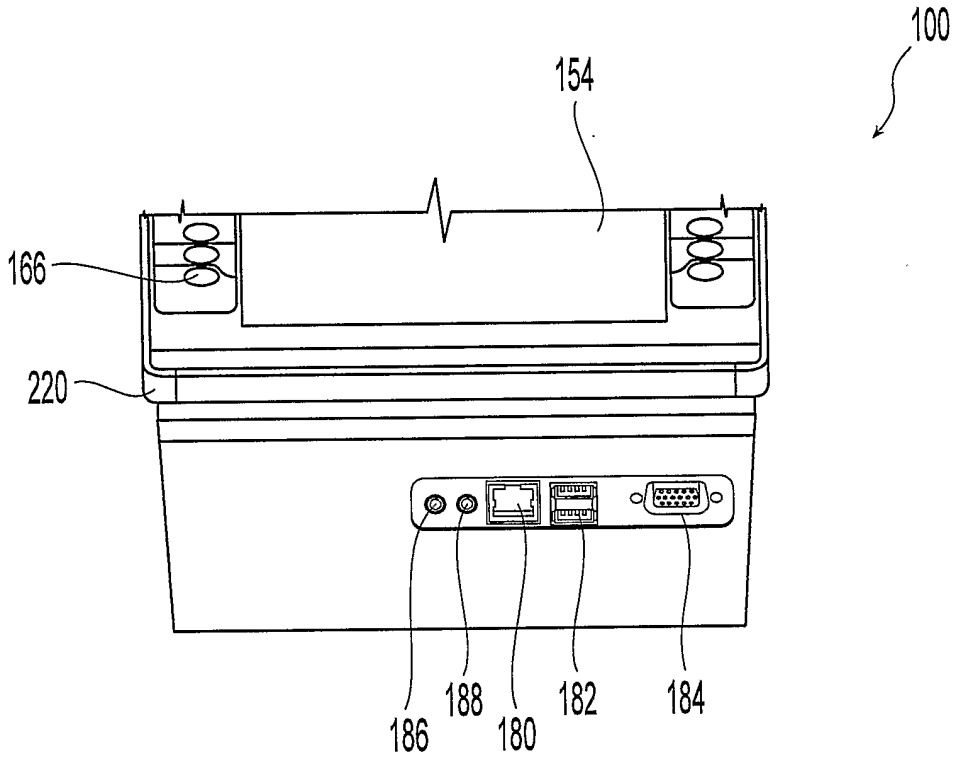

Fig. 3

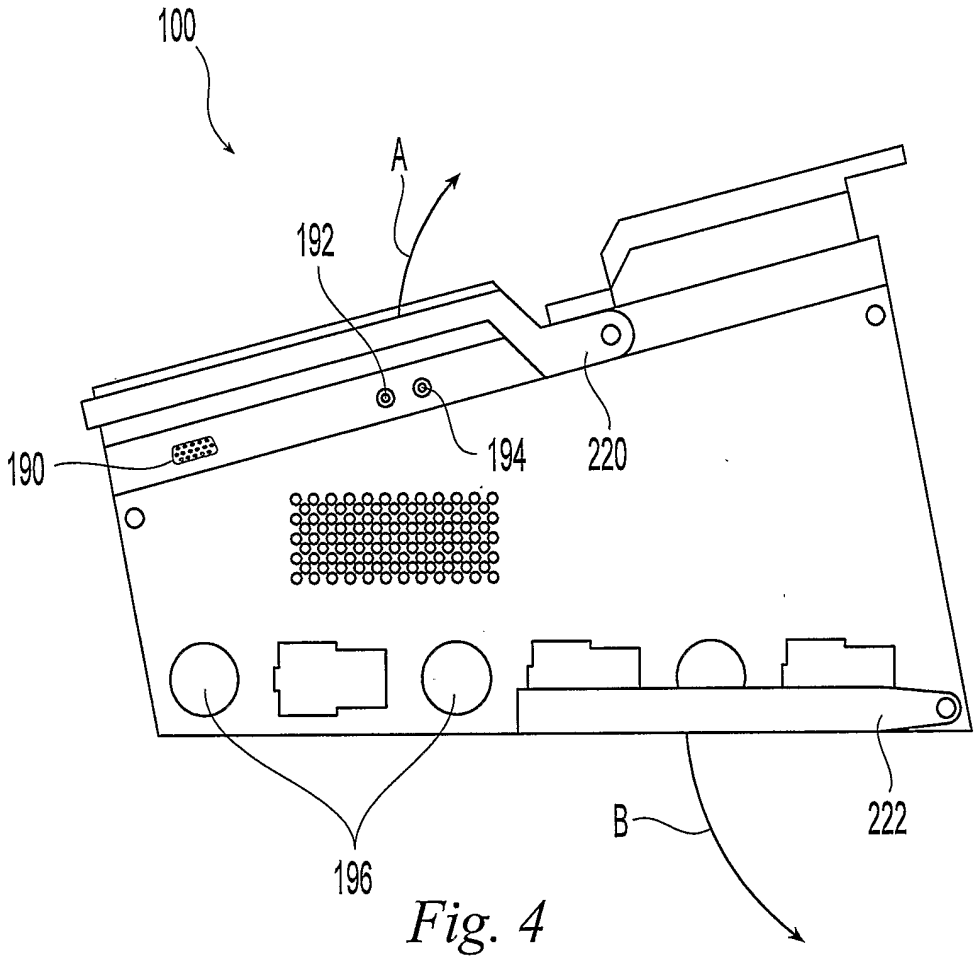

Fig. 4

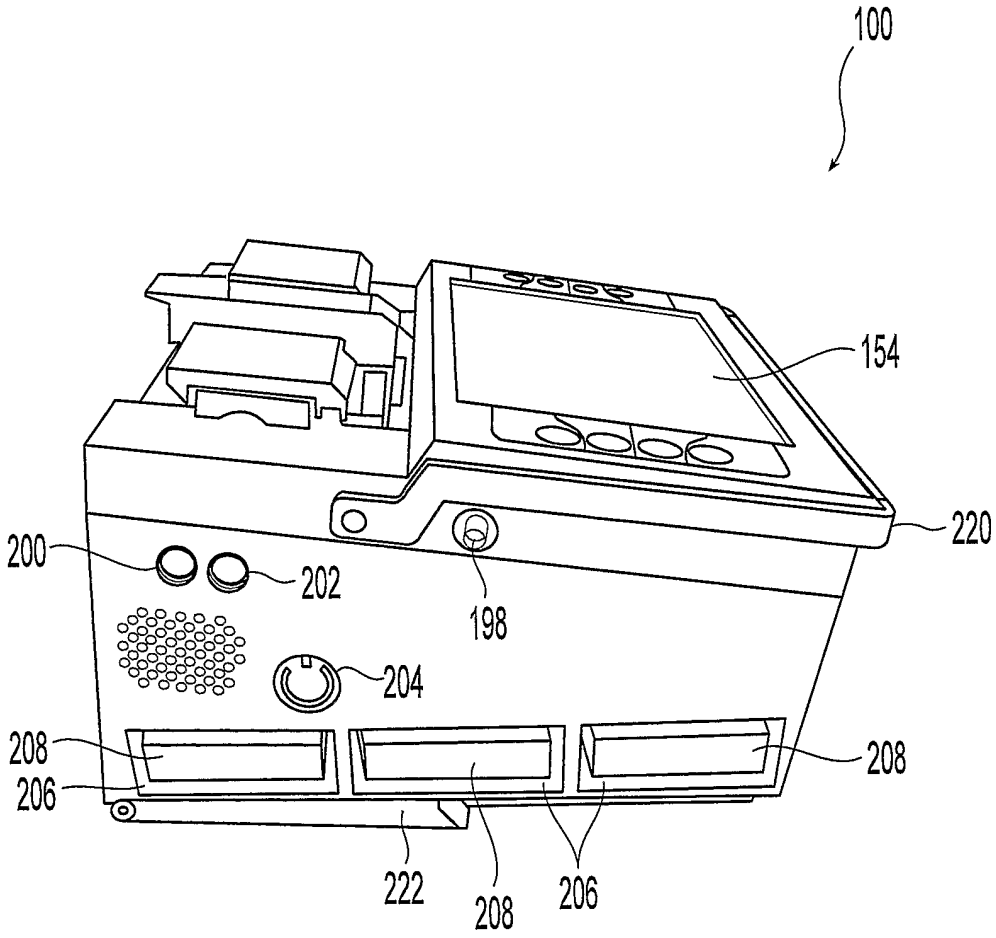

Fig. 5

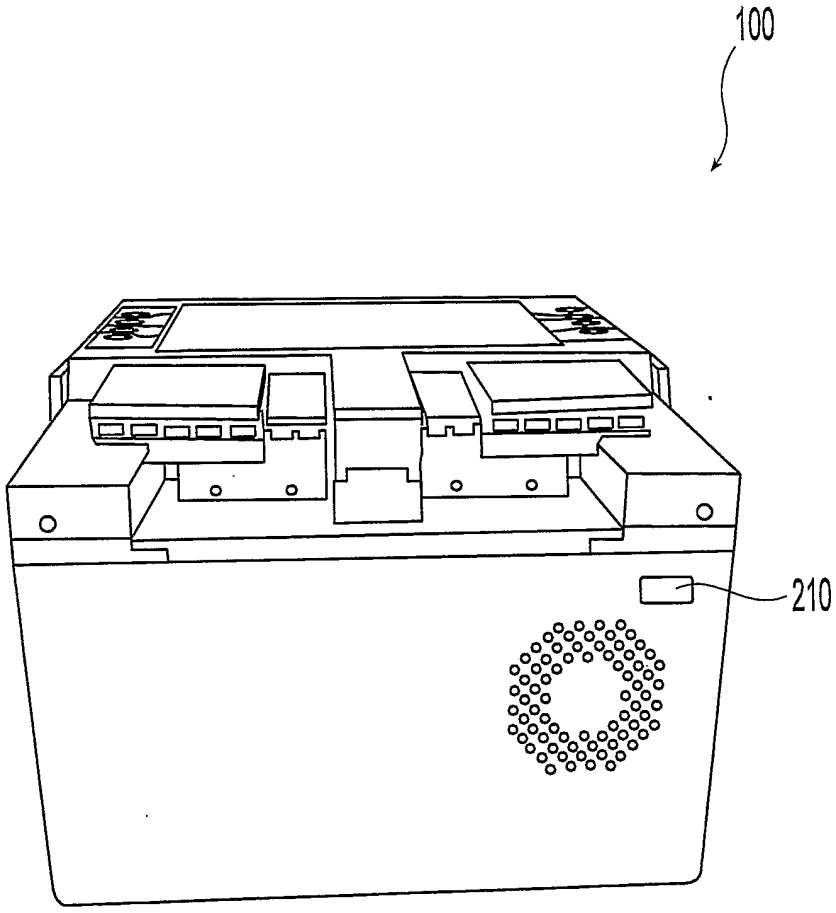

Fig. 6

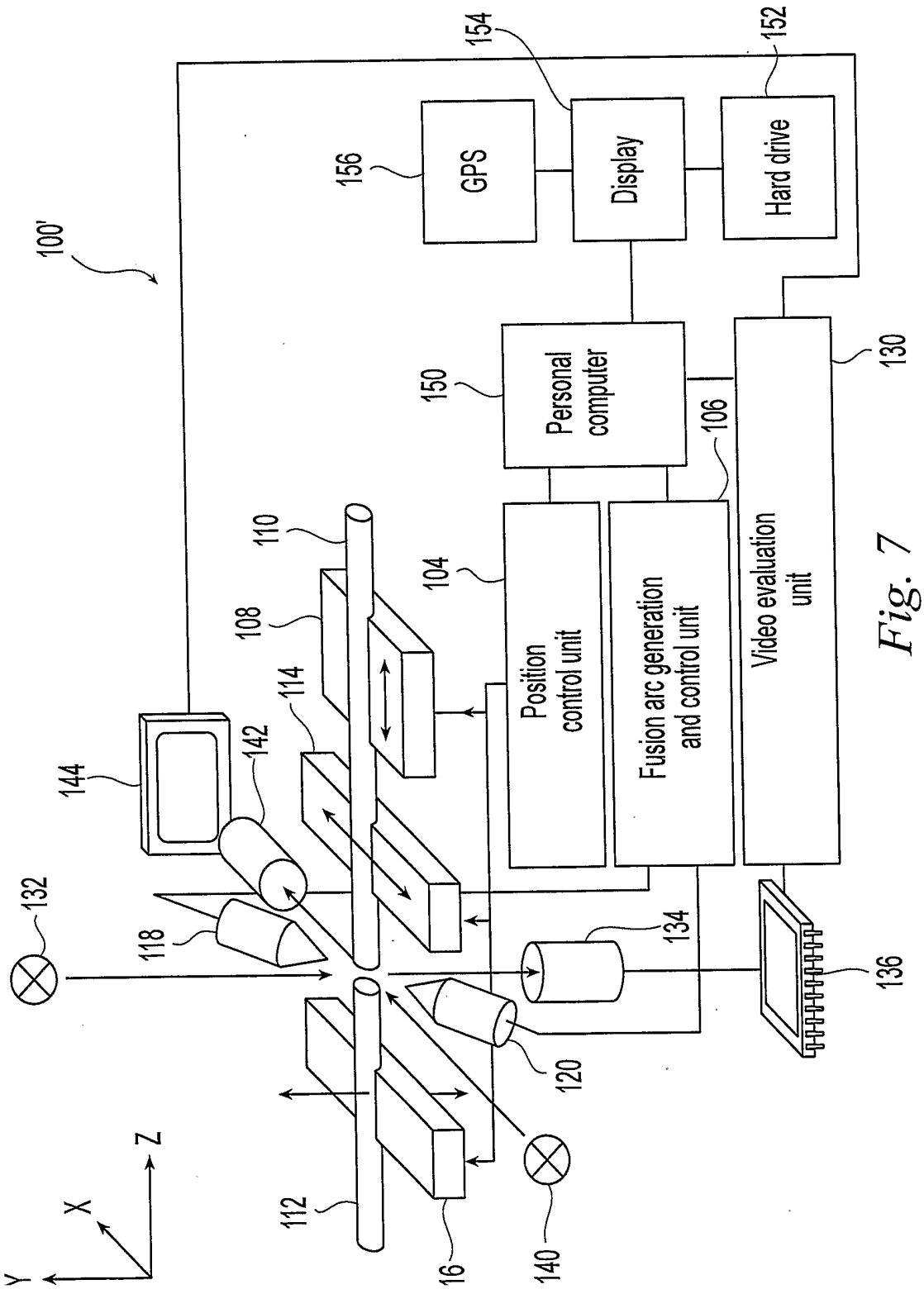
100'
154
152
156
GPS
Display
Hard drive
150
Personal computer
106
130
Video evaluation unit
110
104
Position control unit
108
Fusion arc generation and control unit
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Fig. 7

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US2005/013819

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/255

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 G02B

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ANONYMOUS: "Fusion Splicer" INTERNET ARTICLE, 'Online! 1 January 2004 (2004-01-01), XP002333103 Photonics Spectra, Innovative Products January 2004 Edition Retrieved from the Internet: URL:http://www.photonics.com/spectra/newprods/XQ/ASP/newprodidfo.6502/QX/read.htm> 'retrieved on 2005-06-22! the whole document	1,2, 17-19
X	EP 0 880 039 A (SUMITOMO ELECTRIC INDUSTRIES, LTD) 25 November 1998 (1998-11-25) column 1, line 31 - column 2, line 32	1,9-19
Y	column 5, line 2 - line 4 column 7, line 18 - line 49; figures 4,5	2,3

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 June 2005	22/08/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bourhis, J-F

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US2005/013819

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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X	WO 02/093215 A (CCS TECHNOLOGY, INC; MENEGOZZI, REGINA) 21 November 2002 (2002-11-21) page 1, line 6 - page 2, line 11 page 4, line 21 - line 25 page 7, line 6 - line 24 page 10, line 12 - line 32; figure 1	1,3-8,20
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P,X	ANONYMOUS: "OptiSplice Premier iLID Fusion Splicer" INTERNET ARTICLE, 'Online! November 2004 (2004-11), XP002333104 product specifications Retrieved from the Internet: URL:http://www.corningcablesystems.com/web /library/litindex.nsf/$all/LAN-611-EN/$fil e/LAN-611-EN.pdf> 'retrieved on 2005-06-22! the whole document	1-20

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INTERNATIONAL SEARCH REPORT

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