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(54) **ASSEMBLY AND METHOD FOR USE IN TERMINATING AN OPTICAL FIBER OR FIBERS**

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(52) **U.S. Cl.** **385/80**; 385/86

(58) **Field of Classification Search** 385/80, 385/86, 59, 55
See application file for complete search history.

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(57) **ABSTRACT**

An optical fiber terminating assembly has an outer body (**10**), a first member (**11**) locatable in the outer body (**10**) and which carries a protruding length of optical fiber (**36**) which locates an alignment structure (**44**, **45**) and a housing (**12**) locatable in alignment with the first member (**11**). The housing (**12**) has an access opening for receiving an optical fiber (**52**, **53**) to be terminated so that the fiber can be located in the alignment structure in abutment with the optical fiber length (**35**). The housing has a compartment (**47**) which receives a heat responsive adhesive element (**57**), a saddle (**58**) and a resistor (**59**). When a current is passed through the resistor, the heat generated is transmitted by the saddle to the adhesive which melts and flows around the optical fiber (**52**, **53**) to secure it in position in abutment with the optical fiber length (**35**).

30 Claims, 7 Drawing Sheets

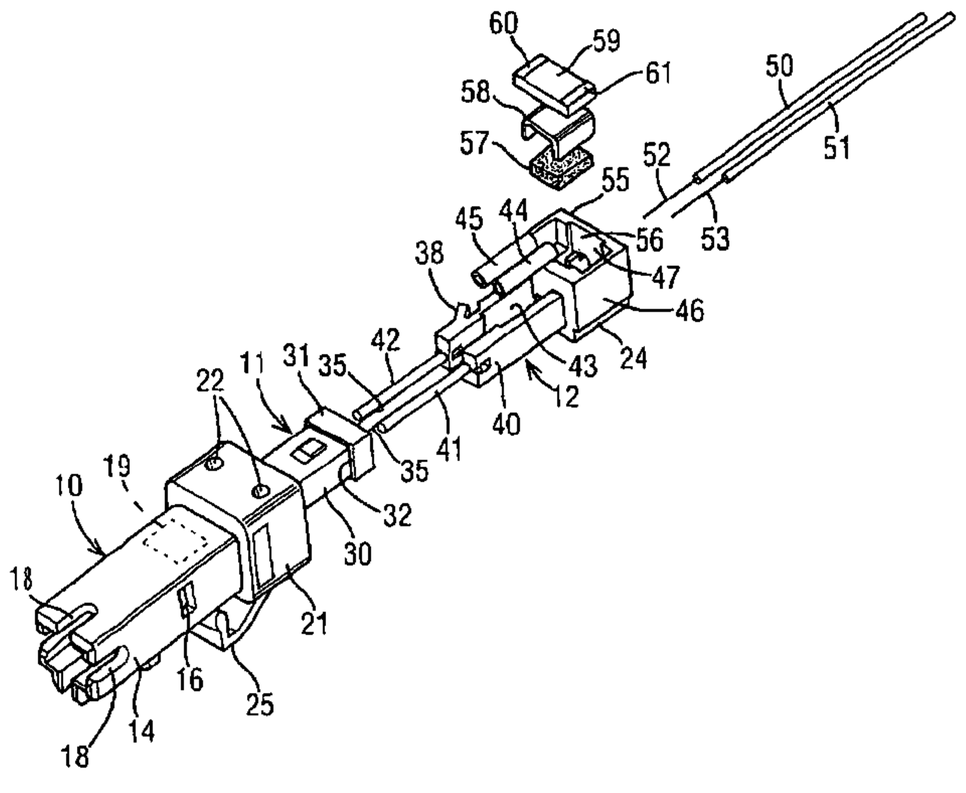

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FIG. 1

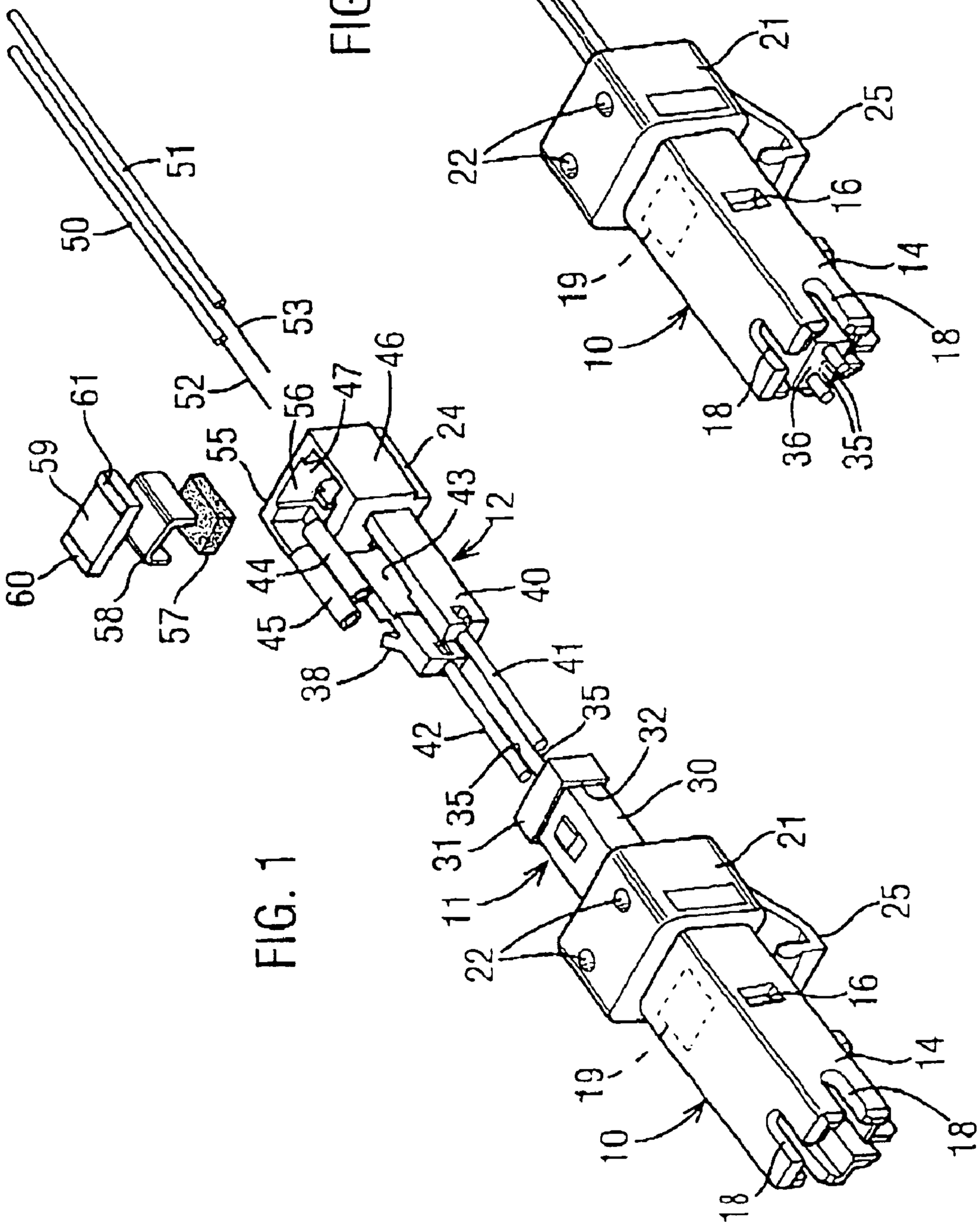
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FIG. 2

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FIG. 3

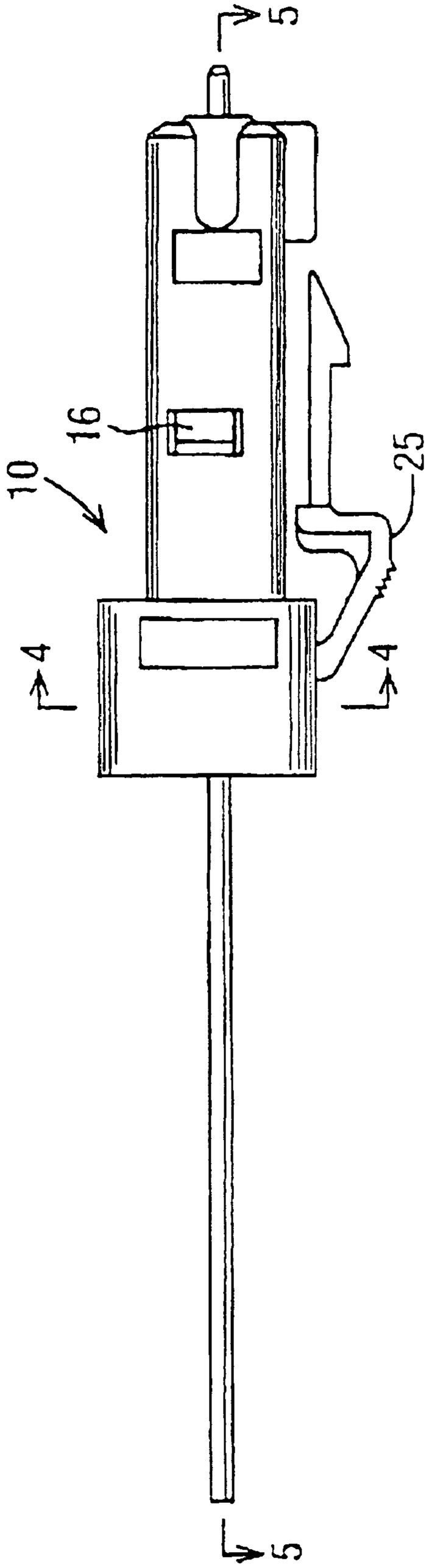


FIG. 4

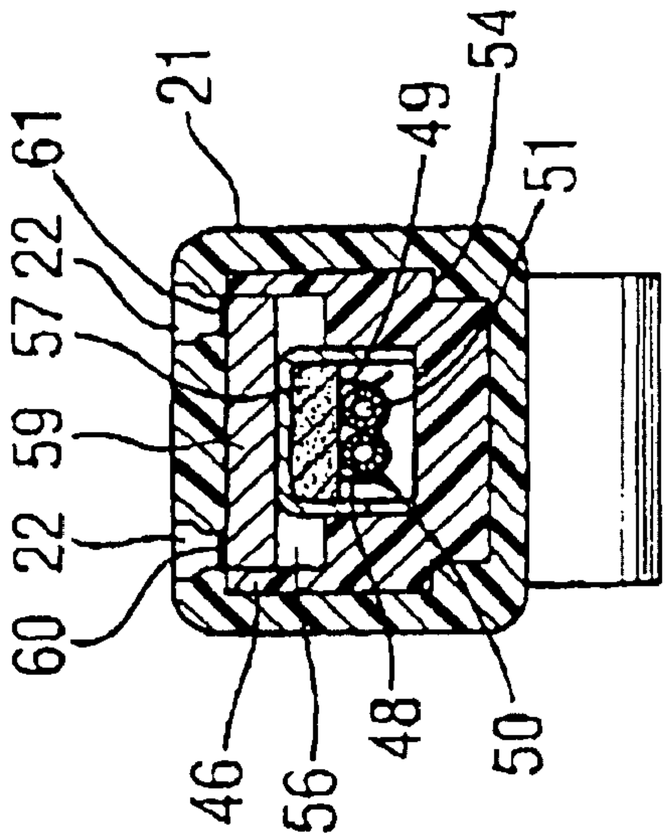


FIG. 5

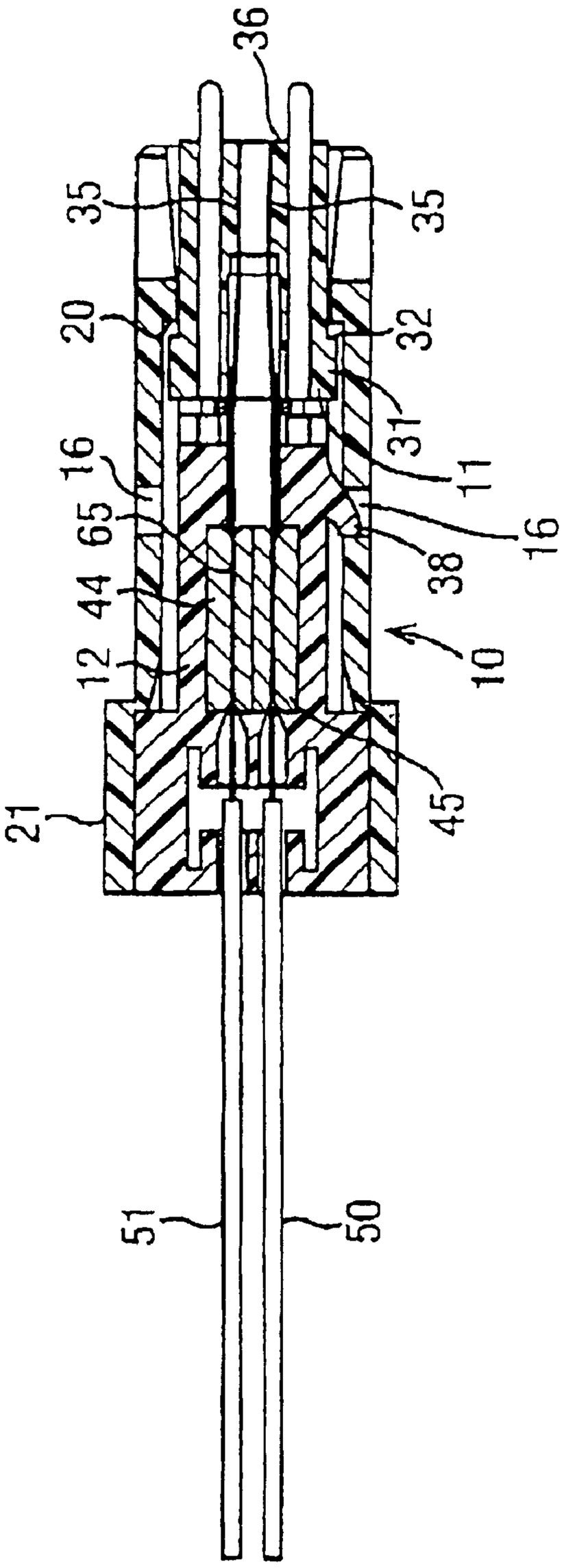


FIG. 6

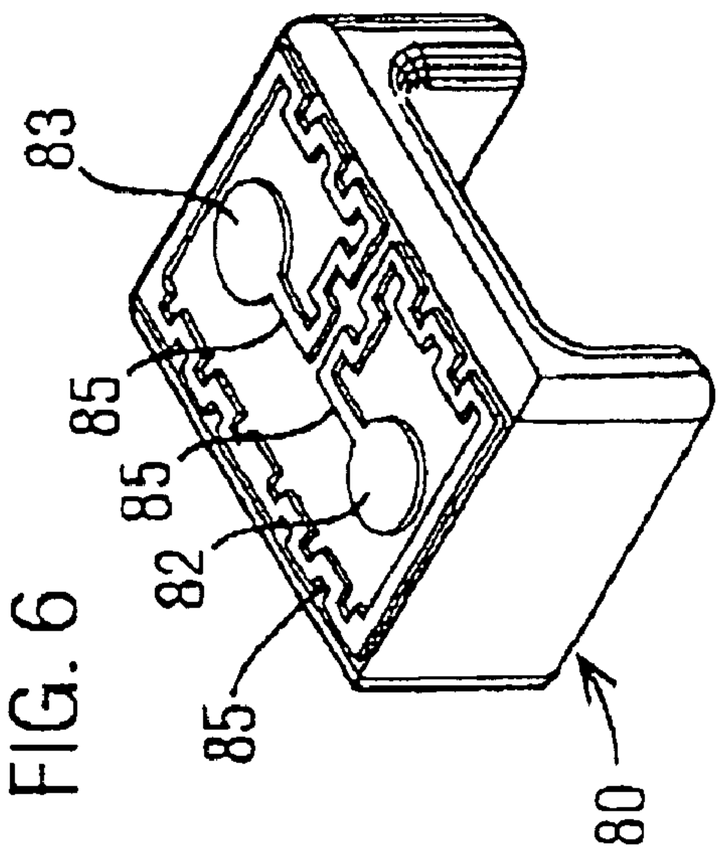


FIG. 7

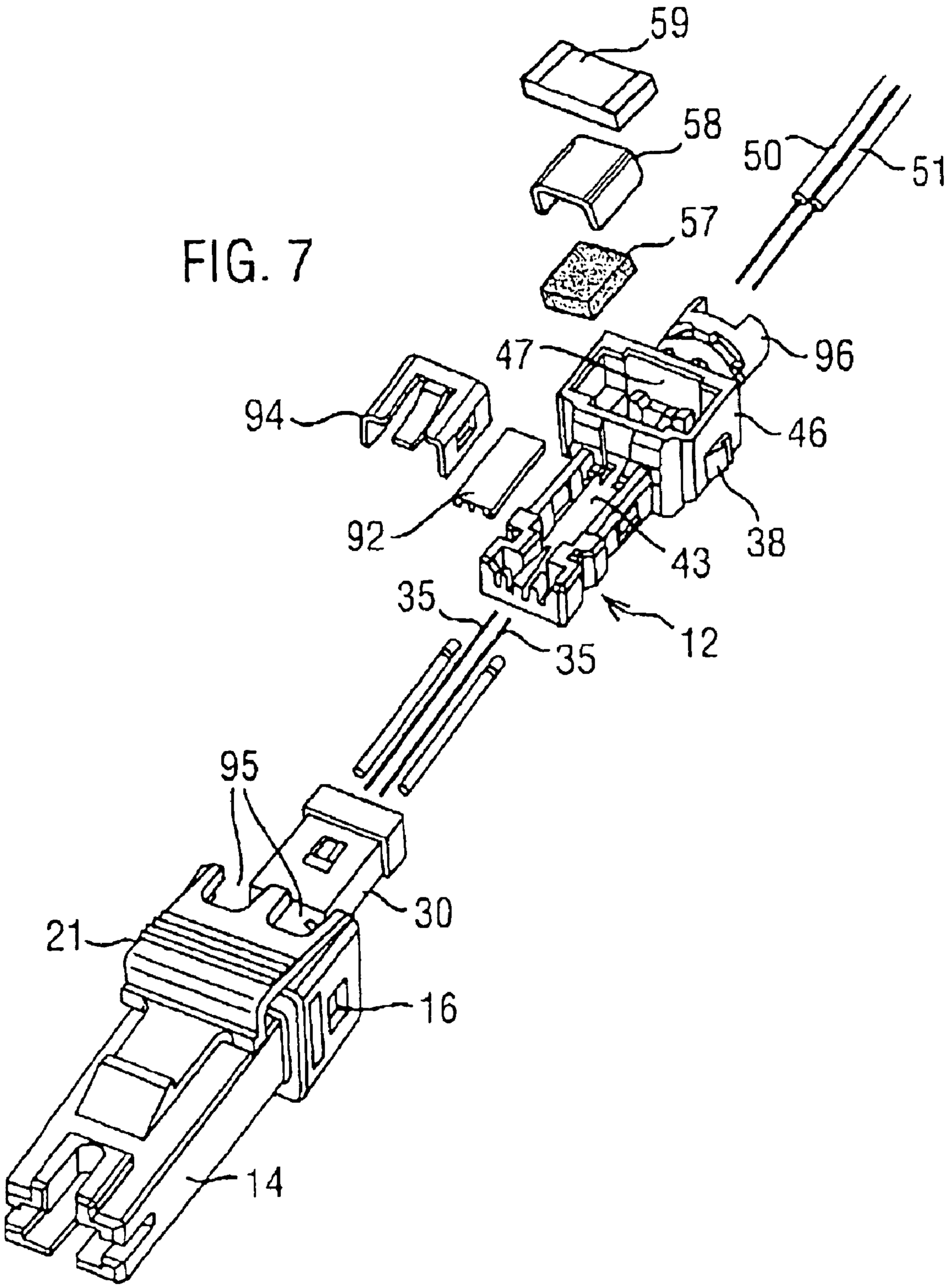


FIG. 8

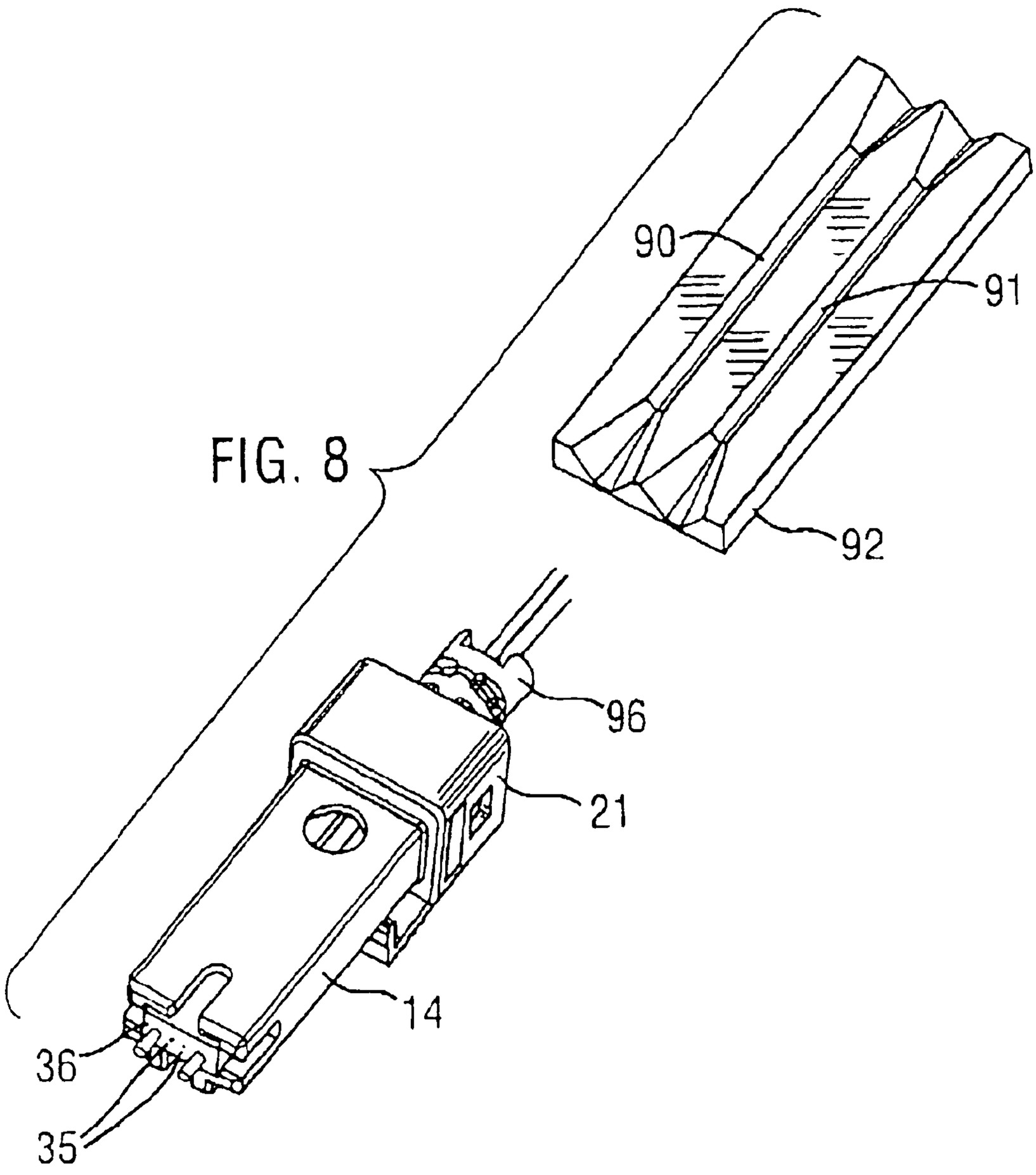


FIG. 9

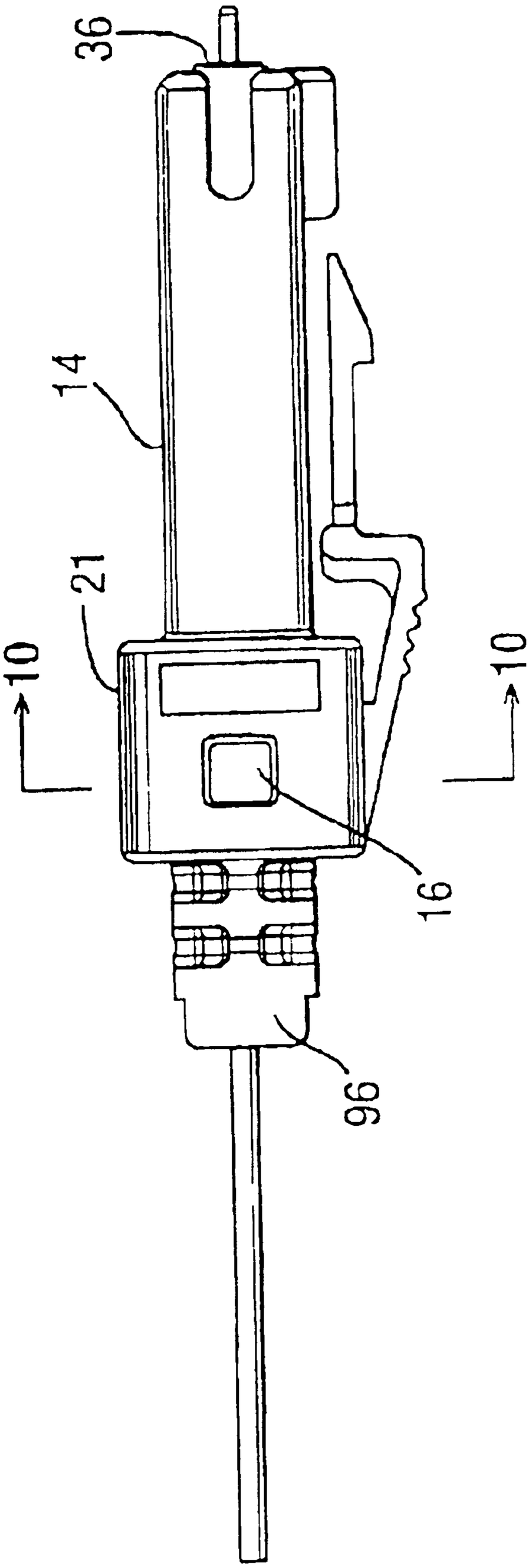


FIG. 10

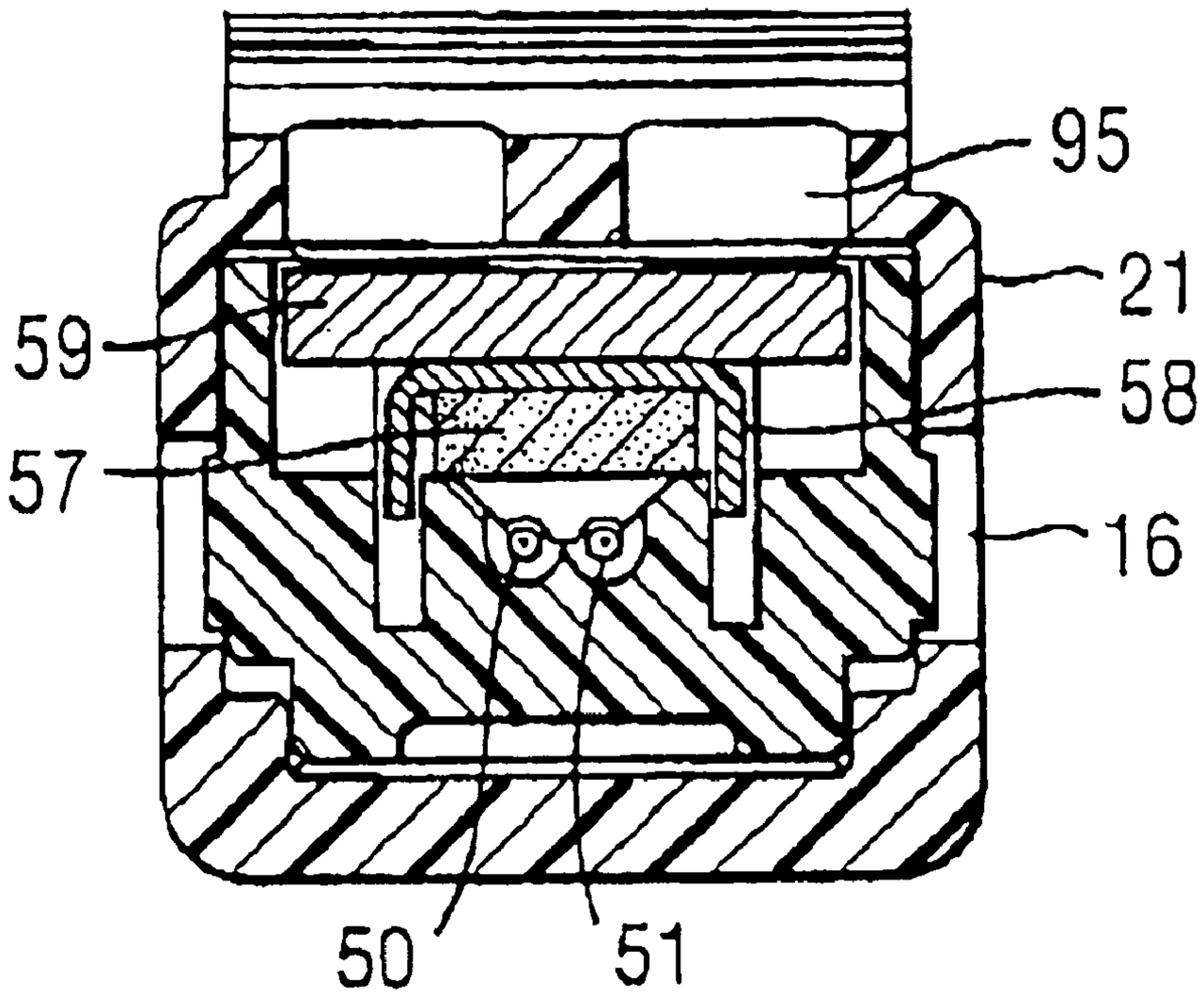
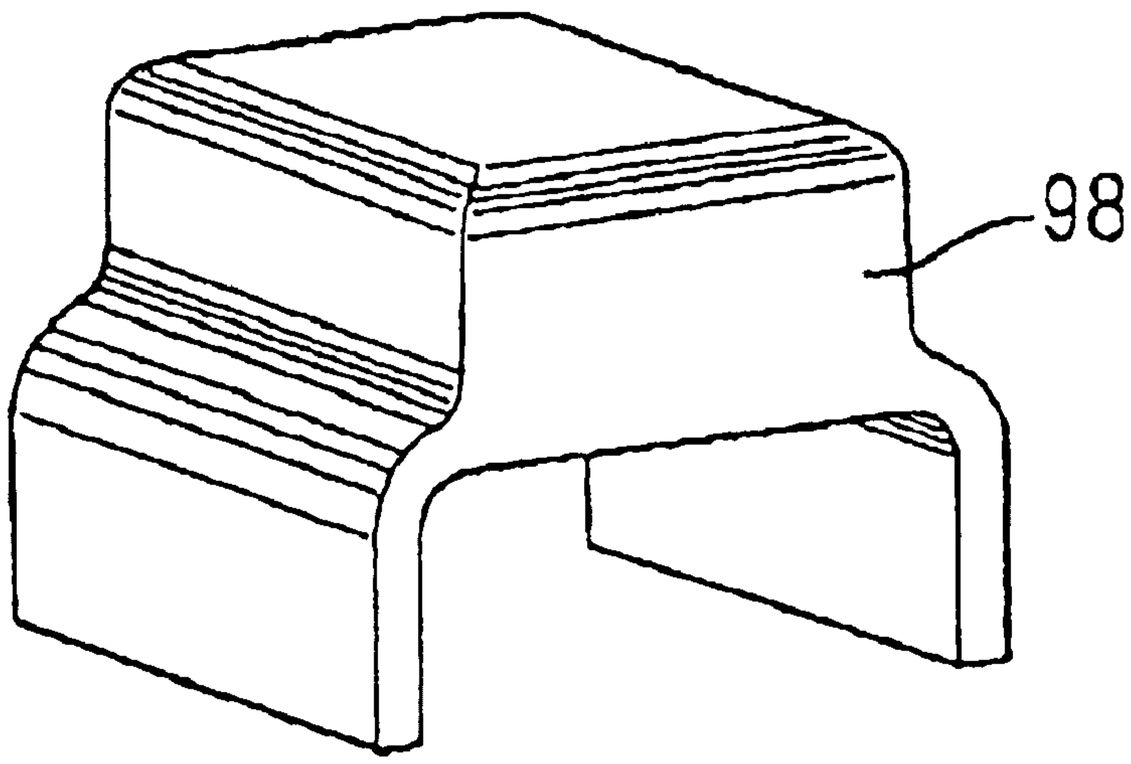


FIG. 11



ASSEMBLY AND METHOD FOR USE IN TERMINATING AN OPTICAL FIBER OR FIBERS

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

FIELD OF THE INVENTION

This invention relates to an assembly for use in terminating an optical fiber or optical fibers.

BACKGROUND OF THE INVENTION

The use of optical fibers as a signal-carrying medium for communications is now extremely widespread and continues to increase. Optical fibers are used not only in cables which interconnect geographically separated locations, but also within buildings themselves. As such there is a need for an optical fiber termination which can be used in the field in order to terminate an optical fiber or fibers.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided an assembly for use in terminating an optical fiber comprising a housing which can receive the optical fiber to be terminated so that it is located in alignment with a length of another optical fiber, or an optoelectronic device, the housing including a compartment through which the optical fiber to be terminated can extend, the compartment being designed to receive a heat responsive adhesive element and a thermally conductive element, which can be coupled to a source of energy so that heat in the thermally conductive element causes the adhesive to melt and flow around the optical fiber to secure it in position.

According to a second aspect of the present invention there is provided an assembly for use in terminating an optical fiber comprising an outer body member, a first member locatable within the body member, the first member carrying a length of optical fiber which protrudes therefrom, a housing locatable in alignment with the first member, an optical fiber alignment means for receiving the end of the length of optical fiber which protrudes from the first member, the housing having an access opening for receiving an optical fiber to be terminated so that such fiber can be located in the alignment means so as to be aligned and abutted with the optical fiber length, the housing including a compartment through which the optical fiber to be terminated extends, the compartment being designed to receive a heat responsive adhesive element and a thermally conductive element, which can be coupled to a source of energy so that heat in the thermally conductive element causes the adhesive to melt and flow around the optical fiber to secure it in position. By heat responsive adhesive is meant a material which in the presence of heat can assume a condition in which it can flow or be caused to flow and subsequently harden again on cooling in order to secure an optical fiber in position.

The compartment may accommodate the heat responsive adhesive, the thermally conductive element, and an electrically conductive element.

The compartment may accommodate the heat responsive adhesive and the thermally conductive element, with access

to the compartment being provided for a heat source. The electrically conductive element may be a resistor.

The thermally conductive element may be a metallic element. The thermally conductive element may be a saddle which straddles the adhesive element.

The outer body member may include one or more openings so located as to allow connection of an electrical power source to the electrically conductive element or thermal contact to an external heat source.

The plug assembly may be used to terminate more than one optical fiber. The assembly may include a plurality of optical fiber alignment elements. The alignment element or elements may comprise a sleeve or sleeves, a V groove or grooves, ceramic or metal ferrules, glass capillary triple rod aligners or a combination of these.

A third aspect of the present invention provides a method of terminating an optical fiber or fibers using an assembly such as described, which comprises positioning the end of an optical fiber to be terminated in the housing so it is in alignment with the length of the other optical fiber, or optoelectronic device, heating the thermally conductive element such that the adhesive assumes the state in which it can flow around the optical fiber to be terminated and secured in position in alignment with the optical fiber length.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference is made to the accompanying drawings and descriptive matter in which preferred embodiments of the invention are illustrated.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is an exploded view of an assembly in the form of a plug assembly in accordance with an embodiment of the present invention;

FIG. **2** is a perspective view of the plug assembly;

FIG. **3** is a side elevation of the plug assembly;

FIG. **4** is a section taken on the line **4-4** of FIG. **3**;

FIG. **5** is a sectional view taken on the line **5-5** of FIG. **3**;

FIG. **6** is a perspective view showing a modification of a component in the plug assembly of FIG. **1**;

FIG. **7** is an exploded view of a modification of the embodiment of FIG. **1**;

FIG. **8** is a perspective view of the modification according to FIG. **7**;

FIG. **9** is a side view of the modification according to FIG. **7**;

FIG. **10** is a sectional view taken on the line **10-10** of FIG. **9**; and

FIG. **11** shows a modified form of saddle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in particular, FIGS. **1** to **5** shows a plug assembly for use in terminating an optical fiber or optical fibers comprises an outer body member **10**, a first member part **11** and a housing part **12**. These parts can all be molded from suitable plastics materials.

The outer body member has a body portion **14** which defines therein a space of generally rectangular cross-section which can receive the first member **11**. Two opposite side walls of the body portion **14** each have an aperture **16** formed therein at a generally central location. The open end of the

body portion **14** has four longitudinally extending slots identified by reference number **18**, the slots **18** being arranged so that one slot **18** is formed in each of the walls of the body portion **14**.

The internal surface of the body portion **14** is formed with a step **20** which is illustrated in FIG. **5** of the drawings. The top wall of the body portion **14** can have a transparent section **19**.

The other end of the outer body member **10** has an enlarged portion **21** which is formed integrally with the body portion **14**. In the top wall of the enlarged portion **21** are formed two spaced through holes **22**. Internally, as shown in FIG. **4**, opposite side walls of the body **10** portion **21** have steps shown at **54**. The lower wall of the portion **21** has an integrally formed resilient catch element **25** which can be used to secure the plug assembly in another part of an optical fiber connector in a manner which will be apparent to those skilled in the art.

The first member **11** comprises a main body portion **30** of generally rectangular cross-section and an end portion **31** whose dimensions are slightly greater than the body portion **30** so that a step **32** is formed around their junction. The first member **11** has secured therein a pair of optical fiber lengths **35** which at one end are substantially flush with an end face **36** of the first member and at the other end protrude from the end portion **31** as illustrated in FIG. **1**. Also the first member **11** has two longitudinally extending bores formed therein, these extending for the full length of the body. The housing part **12** has a first generally channel-shaped section **40** from one end of which projects a pair of spaced pins **41**, **42**. The channel section **40** defines a compartment **43** which can receive a pair of optical fiber alignment elements in the form of a pair of guide sleeves **44**,**45** which preferably are optically transparent. Each guide sleeve has a through bore with a diameter corresponding to that of an optical fiber. The ends of each bore are widened to facilitate insertion of an optical fiber. One side wall of the channel-shaped section has an outwardly extending projection **38**.

The housing part **12** also includes an end housing part **46** which is formed integrally with the channel-shaped section **40**. The end part **46** defines a compartment **47**. The lower surface of the compartment **47** defines two side-by-side grooves **48**, **49** in which can be located the protective outer sleeves **50**, **51** of two optical fibers **52**, **53**, which are to be terminated. The outer surface of opposite side walls of the end part **46** are stepped at **24**. The end wall **55** of the end part **46** has formed therein an aperture **56**. The compartment **47** can accommodate above the optical fibers **52**, **53** and sleeves **50**, **51** a heat responsive adhesive in the form of a glue pellet **57** which is straddled by a thermally conductive saddle **58** on top of which is located an electrical resistor **59** which has conductive pads **60**, **61**. The saddle may be formed from aluminum or other suitable thermally conductive material.

In order to assemble the plug assembly the pins **41**, **42** on the housing part **12** are located within the longitudinally extending bores formed in the first member **11**, the housing part **12** is moved towards the first member **11** and the protruding parts of the optical fibers **35** locate into one end of the sleeves **44**, **45**, which sit within the compartment **43** of the housing part **12**.

The assembly of the glue pellet **57**, the saddle **58**, and the resistor **59** are located in the compartment **47** as shown in FIG. **4** of the drawings. The first member **11** and housing part **12** are moved into the outer body member **10** so that they assume the position shown in FIG. **5** of the drawings. It will be noted that this movement is arrested when the step **32** on the first member **11** comes into contact with the step **20** formed on the interior surface of the outer body member **10**. Also at this point the projection **38** on the channel-shaped section **40** locates within the opening **16** to secure the body parts in position. The step **24** on the outer surface of the end part **46** sits on the step **54** on the interior of the body portion **21**.

In use the optical fibers to be terminated are fed through the aperture **56** in the end wall **55** into the compartment **47** so that the outer sleeves **50**, **51** of the fibers sit within the grooves **48**, **49** at the base of that compartment. The optical fibers **52**, **53** which protrude from the sleeves **50**, **51** are fed into the end of the sleeves **44**, **45** until they meet and abut with the optical fiber lengths at a position shown at **65** in FIG. **5**.

Optical radiation is then passed through the optical fibers **52**, **53** and the junction of the fibers **52**, **53** with the optical fiber lengths **35** is detected through the transparent section **19** of the body member **10**. If radiation is detectable, this is an indication that the fibers **52**, **53** and optical fiber lengths **35** are not aligned and/or abutted correctly. They are then manipulated until the radiation is substantially extinguished indicating correct abutment and/or alignment. At this point an electrical power source is connected to the pads **60**, **61** of the resistor by passing electrical conductive terminals of the power source through the apertures **22** formed in the portion **20** of the outer body member **10** so that they contact the pads **60**, **61**. Electrical current is passed through the resistor **59** which heats up the glue pellet **57** by way of the thermally conducting saddle **58**. The power source is in the form of a tool which can be used to apply pressure to the resistor and hence the adhesive in order to cause it to flow around the fibers. The adhesive melts and flows around the optical fibers **52**, **53**. The thermally conducting saddle has a good thermal conductive bond with the resistor **59**. When the current is interrupted the adhesive then resets to secure the fibers **52**, **53** in their correct position in alignment and abutment with the optical fiber lengths **35**.

It will be appreciated that the above described plug assembly represents a very convenient way of terminating optical fibers in the field since it is relatively simple to use.

The plug assembly as described above is used to terminate a pair of optical fibers. It will be appreciated that the assembly can be used to terminate one or several optical fibers. Also the assembly as described includes a single compartment **47** for receiving the adhesive pellet. It will be appreciated that assemblies can be constructed which have more than one compartment.

Also the assembly as described is used to terminate optical fibers so that they are aligned with optical fiber lengths **35**. It will be appreciated that the basic principle of activating a heat responsive adhesive by heating it using an electrically conductive element can be applied generally to many different types of optical fiber splice or connector and not just that described in the above embodiment.

An alternative form of saddle and resistive heating element is shown in FIG. **6** of the drawings. In this arrangement the resistor and saddle are effectively combined into a single element.

The arrangement shown in FIG. **6** comprises a U-shaped member **80** which is formed from ceramic material and which, in use, straddles the glue pellet **57** in much the same way as the saddle **58** of FIG. **1**.

A pair of conductive contacts **82**, **83** are formed on the upper surface of the U-shaped member **80** and a resistive element **85** extends around the upper surface between the contacts **82**, **83**.

In use the arrangement operates in a manner similar to that described for FIGS. **1** to **5**. Electrically conductive terminals of a power source are passed through the apertures **22** of the portion **21** so that they contact the contacts **82**, **83** on the

U-shaped member **80**. Electrical current from the power source is then passed through the resistive element **85** and the heat generated is conducted through the U-shaped member **80** and melts the glue pellet which then flows around the fibers **52**, **53**.

In the embodiment described with reference to FIGS. **1** to **5** the alignment means for the fiber lengths **36** and the fibers **52**, **53** are sleeves **44**, **45**.

It will be appreciated that other alignment means can be employed. One example is a V-groove type arrangement which is employed in an alternative embodiment illustrated in FIGS. **7** to **10**. The connector shown in these Figures is similar to that of FIGS. **1** to **5**, but the alignment is achieved using a pair of V-grooves **90**, **91** formed in a component **92**. The component **92** is located over the fiber ends to be aligned and abutted which are located on the base of the compartment **43**. Each pair of fibers extends along one of the grooves **90**, **91** in a manner which will be apparent to those skilled in the art. The component **92** is retained in position in the channel-shaped section **40** by a clip **94**.

Other differences with respect to the first embodiment are the location of the aperture **16** and cooperating projection **38**, the provision of slots **95** rather than holes **22** for the terminals or electrodes of the power source, and the provision of a cable clamp **96**.

In the arrangements described above the resistor is accommodated in the compartment **47**. It is possible to produce an embodiment in which the resistor is external to the compartment. One example is illustrated in FIG. **11**. In this arrangement the saddle is formed with a thicker upper part **98** so that when located in the compartment **47**, its upper surface is substantially flush with the upper edges of the walls of the compartment **47**. In this example the body part **21** will have a rectangular opening corresponding in shape to the top surface of the saddle, instead of the holes **22**.

In use an external resistor, which will be part of the power source, is located in that rectangular opening so that it rests against the upper surface of the saddle. When a current is passed through the resistor the adhesive is heated substantially as described before.

Alternatively the power source can be provided with a coil which can be located against or near the saddle to heat the saddle inductively.

It will be appreciated that the embodiments described are MTRJ type connectors. The basic principle of using a heat responsive adhesive in conjunction with a thermally conductive element such as saddle **58** to can be employed in other types of connector such as SC, LC, ST, LX5, MU, MTP, E200 connectors.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. An optical fiber terminating assembly comprising: a housing which can receive an optical fiber to be terminated so that it is located in alignment with a length of another optical fiber, or an optoelectronic device, the housing including a compartment through which the optical fiber to be terminated can extend; a heat responsive adhesive element; and a thermally conductive element, said compartment for receiving said heat responsive adhesive element and said thermally conductive element, said thermally conductive element being coupleable to a source of energy so that heat in the thermally conductive element causes the adhesive to melt and flow around the optical fiber to secure it in position.

2. The assembly according to claim **1**, wherein said compartment accommodates said heat responsive adhesive, said thermally conductive element, and an electrically conductive element, said electrically conductive element being mounted such that when an electrical current is passed through the electrically conductive element the heat in the thermally conductive element melts the adhesive.

3. The assembly according to claim **1**, wherein said compartment accommodates said heat responsive adhesive and said thermally conductive element, said compartment having access for a heat source to be coupled with the thermally conductive element.

4. The assembly according to claim **2**, wherein said electrically conductive element is a resistor.

5. The assembly according to claim **1**, wherein the thermally conductive element is a metallic element.

6. The assembly according to claim **1**, wherein said thermally conductive element is a saddle which straddles the adhesive element.

7. The assembly according to claim **1**, wherein the thermally conductive element is a ceramic saddle provided with resistive portions to which an electrical current can be applied.

8. The assembly according to claim **1**, wherein the housing is formed to terminate more than one optical fiber.

9. The assembly according to claim **1**, wherein the optical fiber includes a sleeve, said compartment is configured to receive a portion of the sleeve, so that the heat in said thermally conductive element causes the adhesive to melt and flow around the sleeve to secure it in position.

10. The assembly according to claim **9**, wherein said compartment includes at least one groove configured to receive the portion of the sleeve of the optical fiber.

11. An optical fiber terminating assembly comprising an outer body member, a first member locatable within said body member, said first member carrying a length of optical fiber which protrudes therefrom, a housing locatable in alignment with the first member, an optical fiber alignment means for receiving the end of the length of optical fiber which protrudes from the first member, said housing having an access opening for receiving an optical fiber to be terminated so that said fiber can be located in the alignment means so as to be aligned and abutted with the optical fiber length, said housing including a compartment through which the optical fiber to be terminated extends, said compartment being designed to receive a heat responsive adhesive element and a thermally conductive element, which can be coupled to a source of energy so that heat in the thermally conductive element causes the adhesive to melt and flow around the optical fiber to secure it in position.

12. The assembly according to claim **11**, wherein said compartment accommodates said heat responsive adhesive, said thermally conductive element, and an electrically conductive element, said electrically conductive element being mounted such that when an electrical current is passed through the electrically conductive element the heat in the thermally conductive element melts the adhesive.

13. The assembly according to claim **11**, wherein said compartment accommodates said heat responsive adhesive and said thermally conductive element, said compartment having access for a heat source to be coupled with the thermally conductive element.

14. The assembly according to claim **12**, wherein said electrically conductive element is a resistor.

15. The assembly according to claim **12**, wherein the thermally conductive element is a metallic element.

16. The assembly according to claim **11**, wherein said thermally conductive element is a saddle which straddles the adhesive element.

17. The assembly according to claim **11**, wherein the thermally conductive element is a ceramic saddle provided with resistive portions to which an electrical current can be applied.

18. The assembly according to claim **11**, wherein the outer body member includes one or more openings located to allow either connection of an electrical power source to said electrically conductive element, or the application of an external energy source.

19. The assembly according to claim **11**, wherein the housing is formed to terminate more than one optical fiber.

20. A method of terminating an optical fiber or fibers using an assembly with a housing which can receive the optical fiber to be terminated in alignment with a length of another optical fiber, or an optoelectronic device, the housing including a compartment through which the optical fiber to be terminated can extend, a heat responsive adhesive element and a thermally conductive element, the method comprising:

positioning an end of the optical fiber to be terminated in the housing so it is in alignment with the length of the other optical fiber, or optoelectronic device;

heating said thermally conductive element such that the adhesive assumes the state in which it can flow around the optical fiber to be terminated and secured in position in alignment with the optical fiber length, wherein the compartment accommodates the heat responsive adhesive element and the thermally conductive element.

21. The method according to claim **20**, including sensing alignment of the optical fiber to be terminated with the optical fiber length by passing radiation along the fibers and observing the level of radiation detectable at the junction of the optical fiber and the optical fiber length.

22. The method according to claim **20**, further comprising positioning a portion of a sleeve of the optical fiber in the compartment so that the step of heating causes the adhesive to flow around the sleeve to secure it in position.

23. The method according to claim **22**, wherein the compartment includes at least one groove configured to receive the portion of the sleeve of the optical fiber.

24. A fiber optic device comprising:

a plug assembly including a first end positioned opposite from a second end, the first end of the plug assembly being adapted to receive a first optical fiber;

the plug assembly including a first member through which a second optical fiber extends, the first member having an end face located at the second end of the plug assembly, the second optical fiber having a first end and a second end, the first end of the of the second optical fiber being substantially flush with the end face of the first member;

the plug assembly including a housing part positioned between the first and second ends of the plug assembly, the housing part defining one or more internal compartments, the one or more internal compartments including a first compartment and a second compartment;

an alignment component positioned within the second compartment, the alignment component for use in aligning the first and second optical fibers such that the second end of the second optical fiber abuts with an end of the first optical fiber;

an adhesive positioned within the first compartment; and

a flow-causing element carried by the plug assembly, the flow-causing element having at least a portion located within the first compartment, the first and second compartments being in fluid communication with one another such that the flow-causing element can selectively cause the adhesive to flow from the first compartment to the second compartment to secure the first and second optical fibers together within the alignment component.

25. The fiber optic device of claim 24, wherein the alignment component defines a v-groove, the v-groove having a cross-sectional shape that enlarges at opposite ends of the v-groove to form funnels.

26. The fiber optic device of claim 24, wherein the plug assembly includes an outer body into which the housing part and the first member can be inserted, the outer body including a resilient catch.

27. The fiber optic device of claim 24, wherein the flow-causing element is a thermally conductive element.

28. The fiber optic device of claim 27, wherein the thermally conductive element is in contact with a resistor.

29. An optical fiber terminating assembly comprising:

a housing which can receive an optical fiber to be terminated so that it is located in alignment with a length of another optical fiber, or an optoelectronic device, the housing including a compartment through which the optical fiber to be terminated can extend; an adhesive element; and a flow-causing element, said compartment for receiving said adhesive element and said flow-causing element, said flow-causing element causing the adhesive element to flow around the optical fiber to be terminated to secure it in position.

30. An optical fiber terminating assembly comprising:

an outer body member, a first member locatable within said body member, said first member carrying a length of optical fiber which protrudes therefrom, a housing locatable in alignment with the first member, an optical fiber alignment means for receiving the end of the length of optical fiber which protrudes from the first member, said housing having an access opening for receiving an optical fiber to be terminated so that said optical fiber can be located in the alignment means so as to be aligned and abutted with the optical fiber length, said housing including a compartment through which the optical fiber to be terminated extends, said compartment being designed to receive an adhesive element and a flow-causing element which causes the adhesive to flow around the optical fiber to be terminated to secure it in position.

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