A protective element for covering the light exit surface on an optical component, in particular on an optical plug.
Abstract

The protective element, for example the protective cap (4) on an optical plug part (1) consists of a plastic material which is enriched with a black filler absorbing the light irradiation. With this it may be the case for example of carbon fibres. Such a protective element forms a reliable blockage against exiting light, which behaves roughly similar to a protective element of similar dimensions of metal.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A protective element for covering the light exit surface on an optical component, in particular on an optical plug, consisting of a plastic material, characterised in that the plastic material is enriched with a preferably black filler absorbing the irradiation.

2. A protective element according to claim 1, characterised in that the filler consists of carbon, in particular of carbon fibres.

3. A protective element according to claim 2, characterised in that the plastic material is a polyphenylene sulphide (PPS) with a proportion of polytetrafluor ethylene.

4. A protective element according to claim 3, characterised in that the plastic material comprises a volume proportion of 25 to 35% carbon fibres and from 10 to 20% polytetrafluor ethylene.

5. A protective element according to one of claims 1 to 4, characterised in that the inner wall (22) proximal to the light exit surface runs at an angle which is inclined to a plane running perpendicularly through the optical axis (21).

6. An optical plug with a plug housing, in which there is held at least one fibre optic and with a protective cap (4) for covering the end-face side of the fibre optic, wherein the protective cap is movably mounted on the plug housing (2) between an opening position (14) and a closure position.
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INVENTION TITLE:

A protective element for covering the light exit surface on an optical component, in particular on an optical plug

The following statement is a full description of this invention, including the best method of performing it known to me/us:-
The invention relates to a protective element for covering the light exit surface on an optical component, in particular on an optical plug, according to the preamble of claim 1. On the one hand the elements have the object of protecting the exit surface, thus for example the end-face side of a plug pin, from mechanical effects and from dust and dirt. Another important function however also lies in preventing the exit of light with an activated optical component. Thus for example energy-rich laser beams may damage the unprotected retina of the human eye.

In practice various types of protective elements are known. By way of DE-A-44 25 821 or by way of EP-A-770 892 there are known protective caps of plastic material which can be placed onto the end-face side of an optical plug and which are not, or only loosely connected to the plug housing. With a second category of protective elements it is the case of protective caps which form a portion of the plug housing and which with the insertion procedure are automatically brought from a closure position into an opening position. A typical protective element of this type is for example shown and described in EP-A-823 649.

A disadvantage of the known protective elements of plastic lies in the fact that the material density of the commonly used plastics is insufficient so that a complete light blockage may not be achieved. Since as a rule a certain material elasticity is yet also desired, known protective elements are commonly formed of polyoxymethylene (POM). In order to achieve an optimal light blockage one has already progressed to manufacturing the protective elements of metal and or mirroring these on the surface. With this however there are entailed high manufacturing costs
and protective elements of metal furthermore have the disad-

vantage that with a mechanical cooperation with other components  
they effect a high wear. With a mirroring one must always take  
care that no reflecting light is thrown back into the fibre op-
tic, which makes necessary a certain geometric arrangement of  
the mirror surface.

It is therefore the object of the invention to provide a protec-
tive element of the previously mentioned type which forms an op-
timal light blockage, can be inexpensively and easily manufac-
tured and furthermore has excellent mechanical properties. This 
object is achieved by a protective element which comprises the 
features of claim 1.

The plastic material which is enriched with a preferably black  
filler absorbs the light beams practically completely so that  
with a small wall thickness a complete light blockage is  
achieved. However the reflection behaviour is also optimal since  
on the surface practically no light is thrown back. The filler  
may be admixed to the plastic materials already as a raw mate-
rial and a processing is therefore possible without problem with  
conventional machines.

The filler consists advantageously of carbon, in particular of  
carbon fibres. Carbon fibre reinforced plastics are already  
known and commonplace in technology on account of their strength  
properties. In place of fibres the carbon may also be admixed in  
ball form. But also other black fillers such as e.g. black pig-
ments in the form of pigment rust or aniline black would be  
theoretically conceivable. The filler also does not necessarily  
need to be black, since according to the case of application  
also with other fillers or mixtures of fillers good results may  
be achieved.
A plastic material of a polyphenylene sulphide (PPS) has been proven to be particularly advantageous, which apart from the carbon as a filler has a proportion of polytetrafluoroethylene (PTFE). The carbon may with this make up a volume proportion of 25 to 35% and the polytetrafluoroethylene that of 10 to 20%. A PPS plastic material with 30% carbon fibres and 15% PTFE (PPS 30% CF, 15% PTFE) has proven to be particularly advantageous. The PTFE material with this creates particularly good sliding properties, which with mechanically moved protective caps is particularly desirable. This material is for example obtainable from the RTP company, Winona, MN 55987, USA.

Further individual features and advantages of the invention result from the subsequent description of embodiment examples and from the drawings. There are shown:

Figure 1 a perspective representation of an optical plug and socket connection with two plug parts and with a socket part;

Figure 2 a cross section through a plug part according to Figure 1 and

Figure 3 a plan view of a plug part with a separate protective cap.

Figure 1 shows a plug and socket connection consisting of the two plug parts 1, 1' and of a socket part 10. The plug parts have a plug housing 2 in which is held a plug pin 3 and in this in turn there is held a fibre optic. As a protective element on the end-face side of the plug housing a protective cap is joint-
edly and displaceably mounted. For this the protective cap has
at its disposal inner lying joint cams 9 which engage in a guide
path 5 on the plug housing.

The fibre optic runs on an optical axis on which at the end-face
side of the plug pin 3 there exits light. The inner wall 22 of
the protective cap runs at an angle $\alpha$ which is inclined to a
plane running perpendicularly through the optical axis. By way
of this it is ensured that residual light reflected at the sur-
face is not thrown back onto the light exit surface.

The removed plug is biased by a compression spring 6 into a clo-
sure position 15. For this purpose a plunger 7 engages on a
lever arm 8 in order to produce a closure torque about the axis
of the joint cam 9.

On inserting the plug part 1 into the socket part 10 the protec-
tive cap 4 is pivoted open and displaced back, against the clos-
ing force of the compression spring 6 by way of means not de-
scribed in more detail here, until the protective cap has
reached the opening position 14.

The socket part 10 has a socket housing 11 in which the actual
plug socket 12 is arranged. This ensures that the plug pins of
plugs inserted on both sides are centered to one another. So
that in the case on a plug removed on one side no light may exit
from the socket part, on each side of the socket 12 there is ar-
ranged a resilient diaphragm which on inserting a plug is
pressed downwards. With this diaphragm it is likewise the case
of a protective element which is to absorb where possible all
light beams.
The plug and socket connection according to Figure 1 and 2 is described in more detail in the mentioned EP-A-823 649. The protective cap 4 and where appropriate also the diaphragm 13 consist of a carbon fibre reinforced plastic material of the type PPS. By way of a proportion of PTFE material the sliding properties are considerably improved which makes itself felt particularly on the friction surfaces on the lever arm 8 and on the joint cam 9. The effect as a light blocker with a proportion of 30% carbon fibres is practically the same as with a protective cap of metal. By way of a particular forming of the inner side of the protective cap (surface roughness, oblique position, etc.) it may be achieved that reflected residual light does not beam back into the fibre optic but is laterally reflected.

In a trial arrangement in each case a protective cap according to Figure 2 of POM and carbon fibre reinforced PPS were impinged with light. The wavelength was 1550 nm and the light power 0.5 mW. With identical dimensions the POM protective cap let through more than 80% light, whilst the PPS carbon fibre protective cap also at 250 mW still did not let through any light.

Figure 3 shows a plug 16 which is not equipped with an integrated protective cap. In the removed condition a protective cap 17 may be stuck onto the plug end-face side. This cap is provided as one piece with a retaining tape 18 on whose end there is arranged a loop 19. The fibre optic cable 20 is guided through this loop so that the protective cap 17 given an inserted plug is unloseably held on the cable. This protective cap too consists of plastic material which is enriched with a preferably black plastic material. Particularly good sliding properties are here however rather undesired since the protective cap in the stuck-on condition should have a secure hold.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A protective element for covering the light exit surface on an optical component, in particular on an optical plug, consisting of a plastic material, characterised in that the plastic material is enriched with a preferably black filler absorbing the irradiation.

2. A protective element according to claim 1, characterised in that the filler consists of carbon, in particular of carbon fibres.

3. A protective element according to claim 2, characterised in that the plastic material is a polyphenylene sulphide (PPS) with a proportion of polytetrafluoroethylene.

4. A protective element according to claim 3, characterised in that the plastic material comprises a volume proportion of 25 to 35% carbon fibres and from 10 to 20% polytetrafluoroethylene.

5. A protective element according to one of claims 1 to 4, characterised in that the inner wall (22) proximal to the light exit surface runs at an angle which is inclined to a plane running perpendicularly through the optical axis (21).

6. An optical plug with a plug housing, in which there is held at least one fibre optic and with a protective cap (4) for covering the end-face side of the fibre optic, wherein the protective cap is movably mounted on the plug housing (2) between an opening position (14) and a closure position.
(15) and forms a protective element according to one of the claims 1 to 5.

7. A plug according to claim 6, characterised in that the protective cap (4) is pivotably and/or displaceably mounted on the plug housing (2) and is biased under spring biasing into the closure position.
8. A protective element and/or optical plug substantially as hereinbefore described with reference to the drawings.

9. An optical component including a protective element according to any one of claims 1 to 5 and 8.

10. The steps, features, compositions and compounds disclosed herein or referred to or indicated in the specification and/or claims of this application, individually or collectively, and any and all combinations of any two or more of said steps or features.

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