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CA 2117907 C 2002/07/02

(11)(21) 2 117 907

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 1993/04/07
(87) Date publication PCT/PCT Publication Date: 1993/10/28
(45) Date de délivrance/Issue Date: 2002/07/02
(85) Entrée phase nationale/National Entry: 1994/10/11
(86) N° demande PCT/PCT Application No.: FI 1993/000150
(87) N° publication PCT/PCT Publication No.: 1993/021548
(30) Priorité/Priority: 1992/04/08 (921564) FI

(51) Cl.Int.^{5}/Int.Cl.^{5} G02B 5/00, G02B 5/18, G02B 27/10, G02B 5/04
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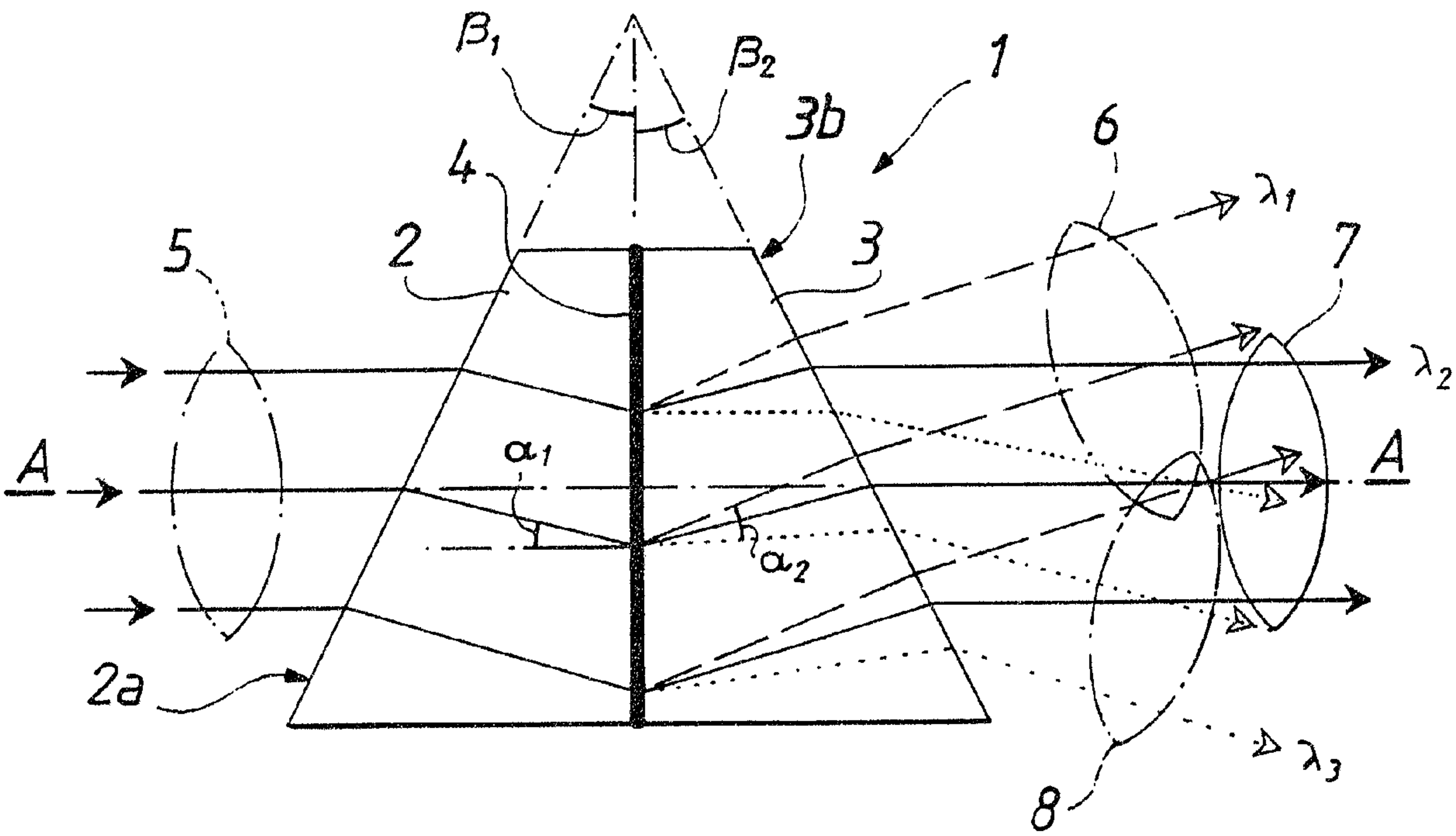
(54) Titre : DISPOSITIF OPTIQUE COMPORTANT DES PRISMES ET UN RESEAU
(54) Title: OPTICAL COMPONENT COMPRISING PRISMS AND A GRATING



(57) Abrégé/Abstract:
An optical component is provided herein comprising a first prism having a transmission grating on one face thereof. A second prism faces that transmission grating with one of its faces, so as to form a compact component having that transmission grating located between the first prism and the second prism.

ABSTRACT

An optical component is provided herein comprising a first prism having a transmission grating on one face thereof. A second prism faces that transmission grating with one of its faces, so as to form a compact component having that transmission grating located between the first prism and the second prism.

(a) TITLE OF THE INVENTION

OPTICAL COMPONENT COMPRISING PRISMS AND A GRATING

(b) TECHNICAL FIELD TO WHICH THE INVENTION RELATES

The invention relates to an optical component.

(c) BACKGROUND ART

According to the prior art, optical components, e.g., a lens, a prism, a grating, etc., are known, with which optical radiation, e.g., radiation in the visible wavelength range and in the near infrared range can be processed, e.g., directed, collated and/or diffused into spectral parts. From these basic optical components it is known to assemble optical devices for processing radiation.

A drawback of using separate components, e.g., prisms and gratings, and arranging them into lens systems, is that carrying out the desired function requires an exact optomechanical implementation and also assembling and adjusting the apparatus. That is why the assembling of optical apparatuses from separate components in the mentioned way is very slow and expensive.

(d) DESCRIPTION OF THE INVENTION

An object of one broad aspect of the present invention is to achieve a novel optical component, which substantially obviates the mentioned drawbacks.

It is an object of a particular aspect of the invention to achieve a novel component which can be used in several different apparatuses for processing optical radiation.

By one broad aspect of this invention, an optical component is provided comprising a first prism having a transmission grating on one face thereof; and a second prism facing the transmission grating with one of its faces. This forms a compact component having the transmission grating located between the first prism and the second prism.

By one variant thereof, the transmission grating is a transmission grating of the volume type.

By another variant thereof, and/or the first variant, the first prism and the second prisms are identical.

Thus, according to one broad aspect of the invention, the optical component comprises a combination of one or more prisms and a transmission grating, which is formed as a compact component. The radiation is directed with the prism or prisms and the radiation dispersion is achieved by means of the transmission grating to direct the desired radiation wavelengths into one or more desired directions.

By virtue of the combined components of aspects of the invention, radiation is processed such that it can be diffused into wavelength components of the radiation directed into desired directions, or conversely the radiation components coming from several sources can be collated into one compact radiation beam.

According to an embodiment of an aspect of the invention, the optical component comprises two prisms and an intermediate transmission grating. This configuration is the minimum configuration of the optical apparatus to achieve the desired features.

According to another embodiment of an aspect of the invention, the transmission grating is a holographic transmission grating of the volume type.

This invention in its broad aspects has the following advantages. The main advantage of the optical component of a main aspect of this invention is that, by means of this component, large optomechanical configurations can be constructed, in which, among other things, the optical and the mechanical axis of symmetry coincide. The optical component straightens the optical axis in the spectrograph. This gives advantages, especially in picturing spectroscophy. Previously, only prism configurations of "direct vision" type had been utilized for implementing a spectrograph, but these have not been commonly utilized in measuring instruments, because the spectrum of these is too non-linear.

Still another advantage of an aspect of the present invention is that the radiation is directed with one or more prisms and this gives a direct optical structure.

Still a further advantage of an aspect of the present invention is that combining an intermediate dispersion element, e.g., transmission grating into the prisms, gives the radiation passing through the optical component a large dispersion, which can be utilized in different applications.

Still yet another advantage of an aspect of the present invention is that the radiation spectrum can be arranged normal to the optical and the mechanical axis. Then the detector does not have to be inclined and thus the angle does not require exact controlling.

Still yet another advantage is that the present invention as such can be realized as a compact construction. This still facilitates the utilization of small size optical apparatuses.

(e) DESCRIPTION OF THE FIGURES

In the accompanying drawings:

Fig. 1 presents schematically one optical component according to one embodiment of an aspect of the invention as a cross-sectional view.

Fig. 2 presents an apparatus for registering several spectra.

Fig. 3 presents picturing spectroscophy.

Fig. 4 presents a monochromator.

Fig. 5 presents a wavelength multiplexer and -demultiplexer.

Fig. 6 presents a spectrograph apparatus.

(f) AT LEAST ONE MODE FOR CARRYING OUT THE INVENTION

The optical component 1 in Figure 1 comprises two prisms 2, 3 and a holographic transmission grating of the volume type. The first prism 2 and the second prism 3 are identical and they have been arranged symmetrically on both sides of the grating 4. Thus the top angles $beta_1$, $beta_2$ of the prisms 2, 3 are equal, the thicknesses of the prisms are the same and they have been fabricated of the same material. The prisms 2, 3 and the grating 4 have been connected by their faces to a compact entity. The optical axis A-A of the optical component 1 passes symmetrically through the component normal to the grating 4.

The optical component 1 functions principally in the following way. The optical radiation is passed essentially as a collimated radiation beam 5 to the first face 2a of the first prism 2, where the radiation is refracted according to Snell's law against the transmission grating 4 of the volume type. The incidence angle, $alpha_1$, of the grating 4 is such that the desired wavelength part, $lambda_2$, passes into a desired direction, $alpha_2$, after the grating. In the case of Figure 1, the middle wavelength $lambda_2$ of the spectrum of the incidence radiation passes relatively to the optical axis A-A to the leaving face 3b of the second prism 3 and is directed outwardly from the component as a leaving radiation beam 6 marked by a dashed line. Because the prisms 2, 3 are identical, the deflection of the radiation on the leaving face 3b of the second prism 3 relatively to the face 3b is symmetrical to the deflection of the radiation on the incident face 2b of the first prism 2. The leaving radiation beam 7 of this wavelength, $lambda_2$, returns to a radiation beam radiating in the same direction as the original optical axis A-A.

By means of the grating 4, the relation between the propagation angle of the wavelengths, $lambda_1$ and $lambda_2$, of the spectrum of the incident radiation 5 and the propagation angle of the middle wavelength, $lambda_2$, is defined. The spectral part with the shortest wavelength, $lambda_3$, which belongs to the incident radiation beam 5, deflects the most in the optical component according to this, and forms a leaving radiation beam 8, as can be seen from Figure 1, the dashed line.

The optical component of Figure 1 can be altered, e.g., so that the top angles, $beta_1$, $beta_2$, of the prisms are different in size. Differing thicknesses and/or different materials may be used in the prisms so as to change their refraction properties.

In Figure 2 is presented an apparatus for registering several spectra simultaneously. Radiation is passed to this optical apparatus through photoconductors, e.g., a row of fibres 9, from several sources. The lens system 10 makes the radiation parallel so as to suit the optical component 1 of an aspect of the invention. This optical component contains the same parts as in Figure 1 and the same reference numerals have been used. Following the optical component 1, there is another lens system 11 in the propagation direction of the radiation. With this lens system 11, the radiation from the optical component 1 is directed towards the detector 12, which, in this case, is a matrix detector, e.g., a CCD matrix detector. The optical radiation can be passed to the apparatus of Figure 2 through one or more photoconductors and the radiation spectra are registered with the matrix detector 12. This apparatus is suitable for registering one or more spectra.

The picturing spectroscopical apparatus, which utilizes the optical component according to an aspect of this invention, has been presented schematically in Figure 3. This apparatus comprises an objective 13 and a slot 14, through which the radiation to be examined is passed to the first lens system 15 for making it parallel for the optical component 1 of an aspect of the invention. Once again, the optical component 1 is principally the same as in Figure 1, and the same reference numerals have been used. The radiation leaving the optical component 1 is collated by means of the second lens system 16 and directed towards the detector, especially the matrix detector 17. The incident radiation can also be passed through other means to the first lens system 15 instead of the objective 13 and the slot 14.

A monochromator, which utilizes the optical component of an aspect of the invention, has been presented in Figure 4. A light source 18 has been formed through adjacent light source components, e.g., LEDs arrayed in a row. The radiation leaving the light source 18 is collated by the first lens system 19 and is directed in a relatively-small opening angle to the optical component 1 of an aspect of the invention. Even in this case, the optical component is a component according to Figure 1, and the same reference numerals have been used. The radiation leaving the optical component 1 is collated with the second lens system 20, the desired part is filtered away by means of the filter 31 and the remaining radiation is focussed to the photoconductor 21, e.g., an optical fibre. Instead of the optical fibre 21, different mirror- and/or volume lens systems can be used for directing the radiation to the wanted site. Essential in the apparatus of Figure 4 is that the light source 18 consists of several light source components, the radiation of which is collated by means of an optical component according to an aspect of the invention to an essentially-compact radiation beam.

The wavelength multiplexer of an aspect of this invention is presented in Figure 5. Optical radiation information from several sources is passed to this wavelength multiplexer through parallel photoconductors 23, e.g. a fibre row. Radiation of a different wavelength range can be brought through each photoconductor 22. The radiation from the photoconductor 22 is collated by a first lens system 23 and directed to an optical component 1 according to an aspect of the invention. The optical component 1 is once again the same as in Figure 1, and the same reference numerals have been used. The radiation from the optical component 1 is treated with the filter 32, another lens system 24 and is directed to one photoconductor, e.g., a fibre 25. Alternatively, it can also be directed to a photoconductor, a light channel, etc. Further it is possible to process the radiation with other optical components, e.g., lenses, mirrors, etc. to reach the goal.

A wavelength multiplexer of this type can be used in the opposite direction relatively to the mentioned propagation of the radiation. Then it functions as a demultiplexer according to an aspect of this invention. The optical radiation is passed through the photoconductor 25 to the apparatus and it is directed in a desired way to the photoconductor 22.

A small module type spectrograph apparatus of an aspect of this invention is presented in Figure 6. The radiation to be examined is in this case brought to the apparatus through the photoconductor 26. The photoconductor can, e.g., be a multiform fibre, which is connected to the apparatus through a FC-connector. The radiation from the photoconductor 26 is collimated with the first lens system 27, after which it is passed to a high pass filter 28. Then the radiation is brought to travel through an optical component 1 according to an aspect of this invention. This optical component is principally the same as that one which was presented in Figure 1, and the same reference numerals have been used. Following the optical component 1, the radiation is collated by another lens system 29, and is directed to a detector 30. A spectrograph apparatus of this type works, e.g., on a wavelength range of 750 to 1065 nm and has a resolution of, e.g., 20 nm. The high pass filter 28 prevents all wavelengths under 650 nm from travelling into the apparatus. The detector 30 can be a row detector, which is a known semiconductor detector. This consists, e.g., of 16 elements. A spectrum is formed on this element from the incident radiation and is registered.

Claims

1. An optical component comprising a first prism having a transmission grating on one face thereof; and a second prism facing said transmission grating with one of its faces; so as to form a compact component having said transmission grating located between said first prism and said second prism.

2. The optical component according to claim 1, wherein said transmission grating is a transmission grating of the volume type.

3. The optical component according to claim 1 or claim 2, wherein said first prism and said second prisms are identical.

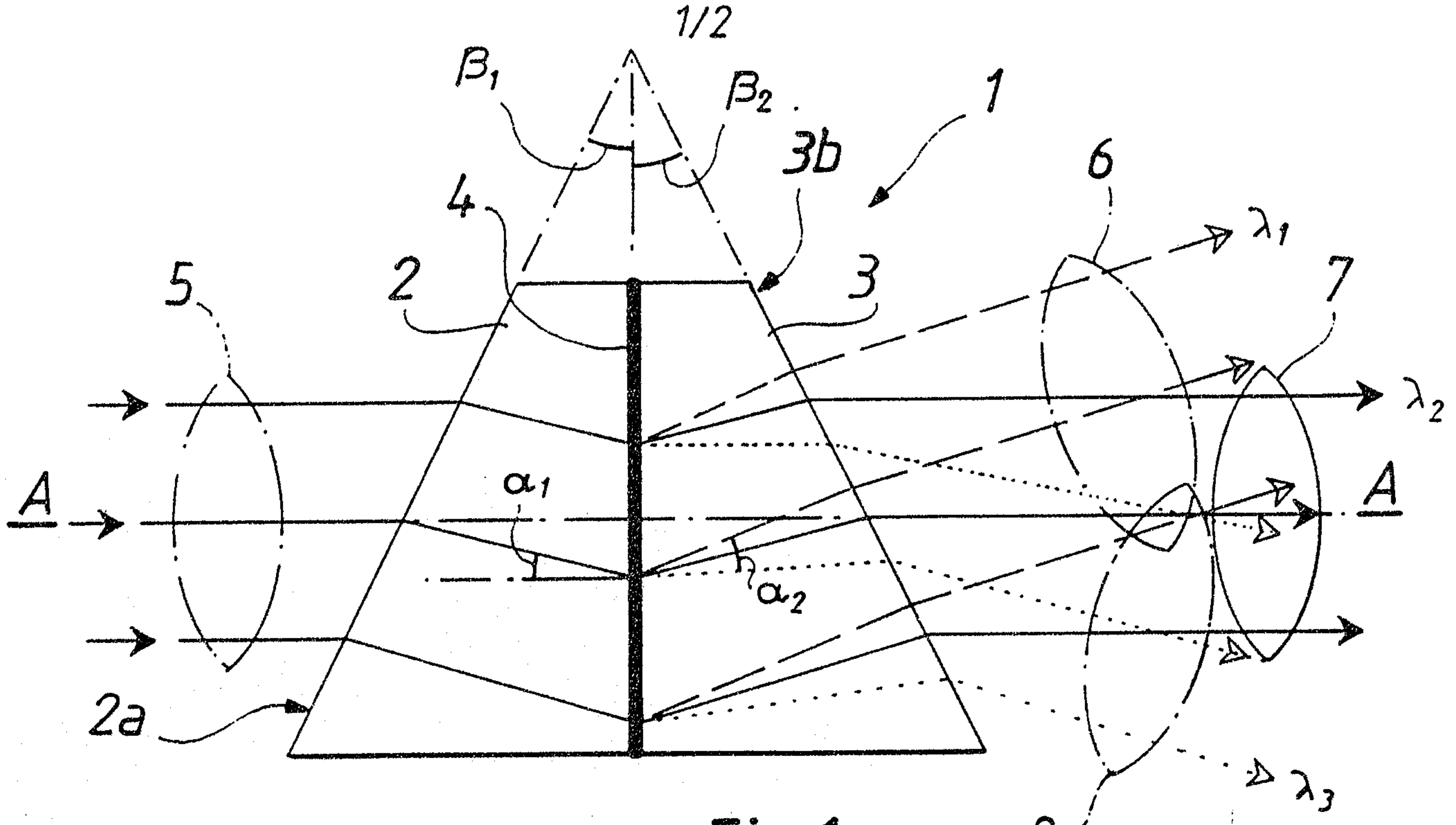


Fig. 1

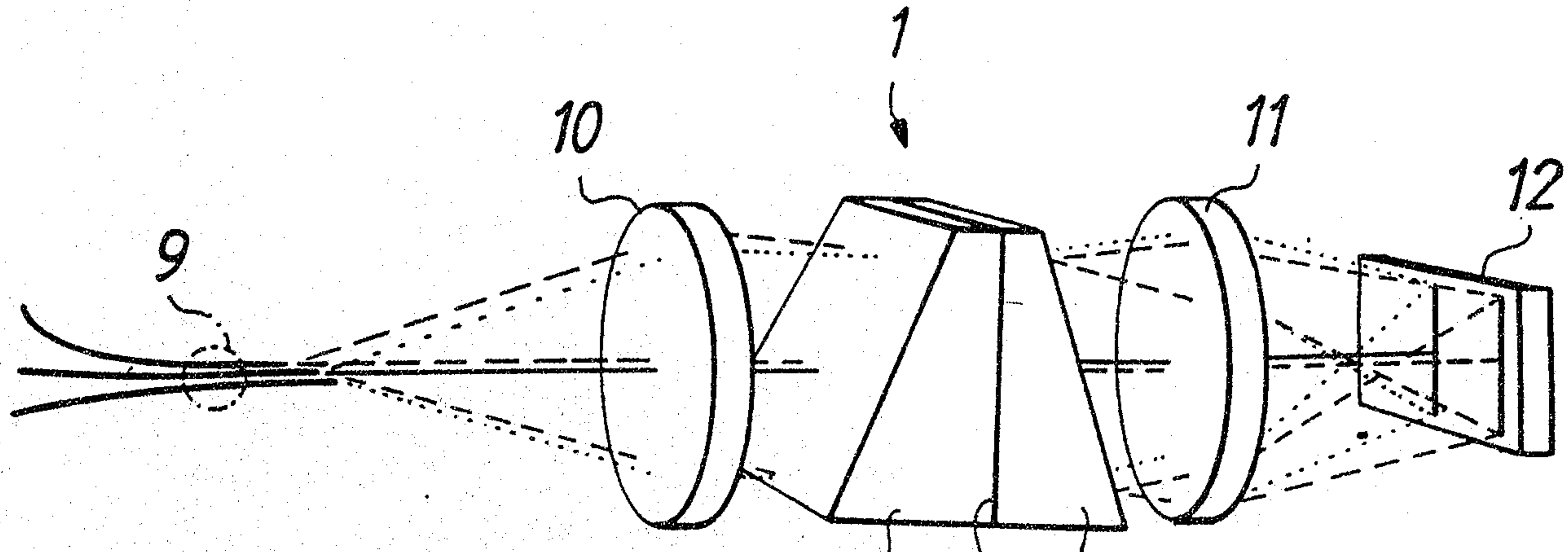


Fig. 2

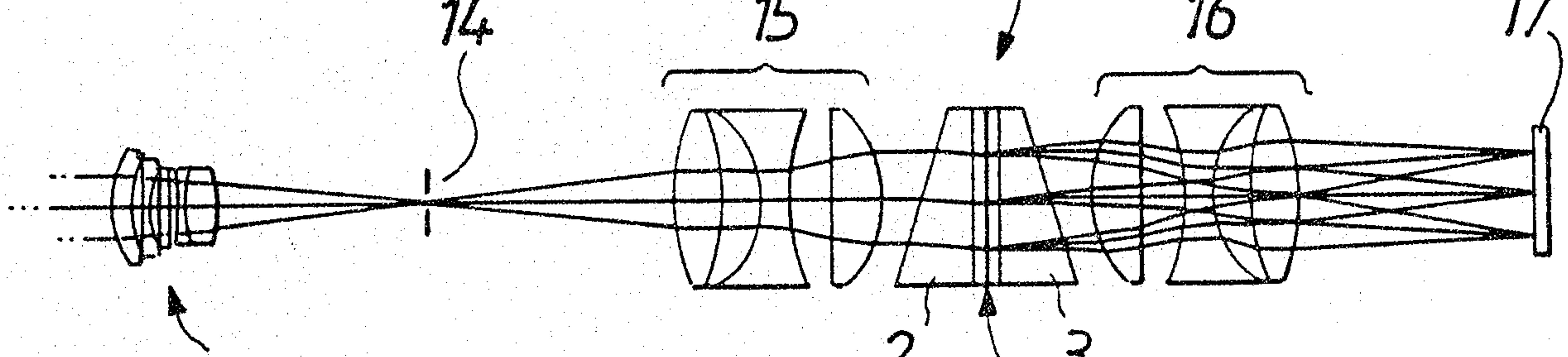


Fig. 3

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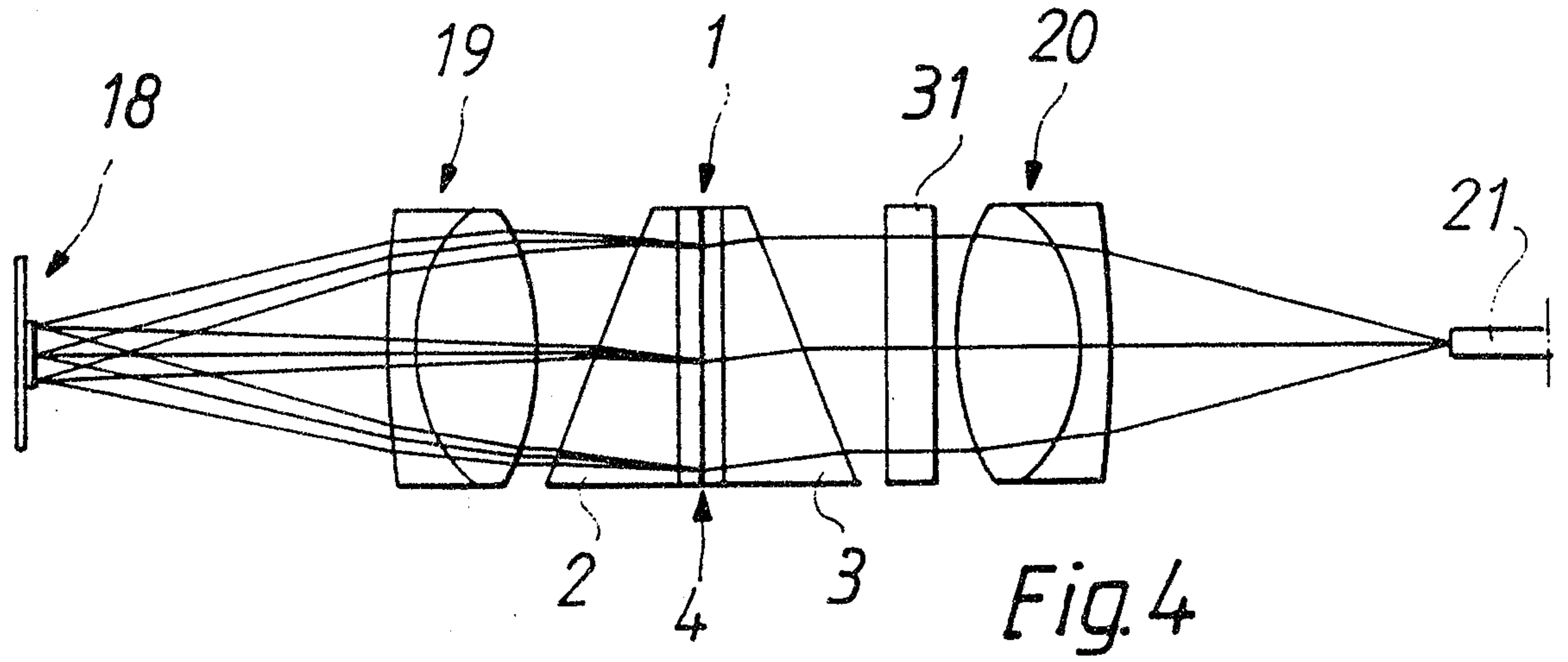

Fig.4

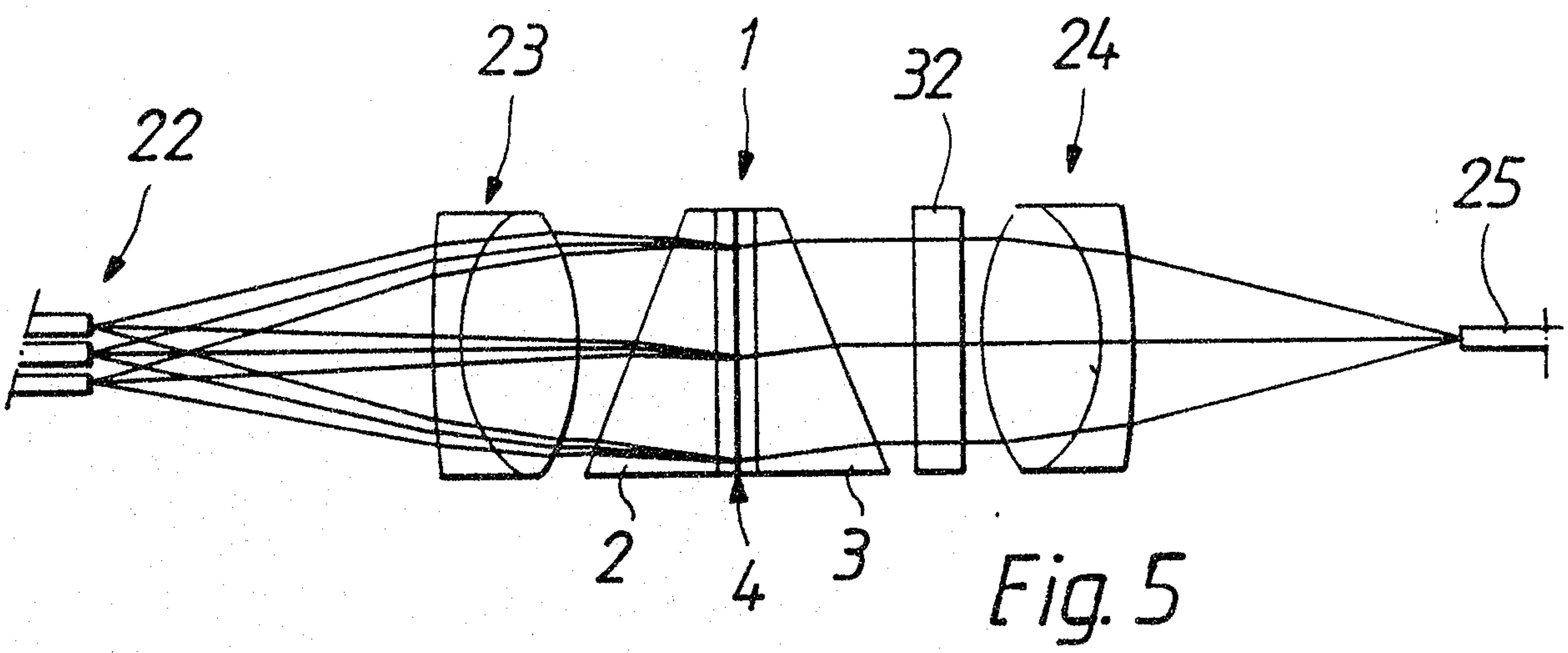

Fig. 5

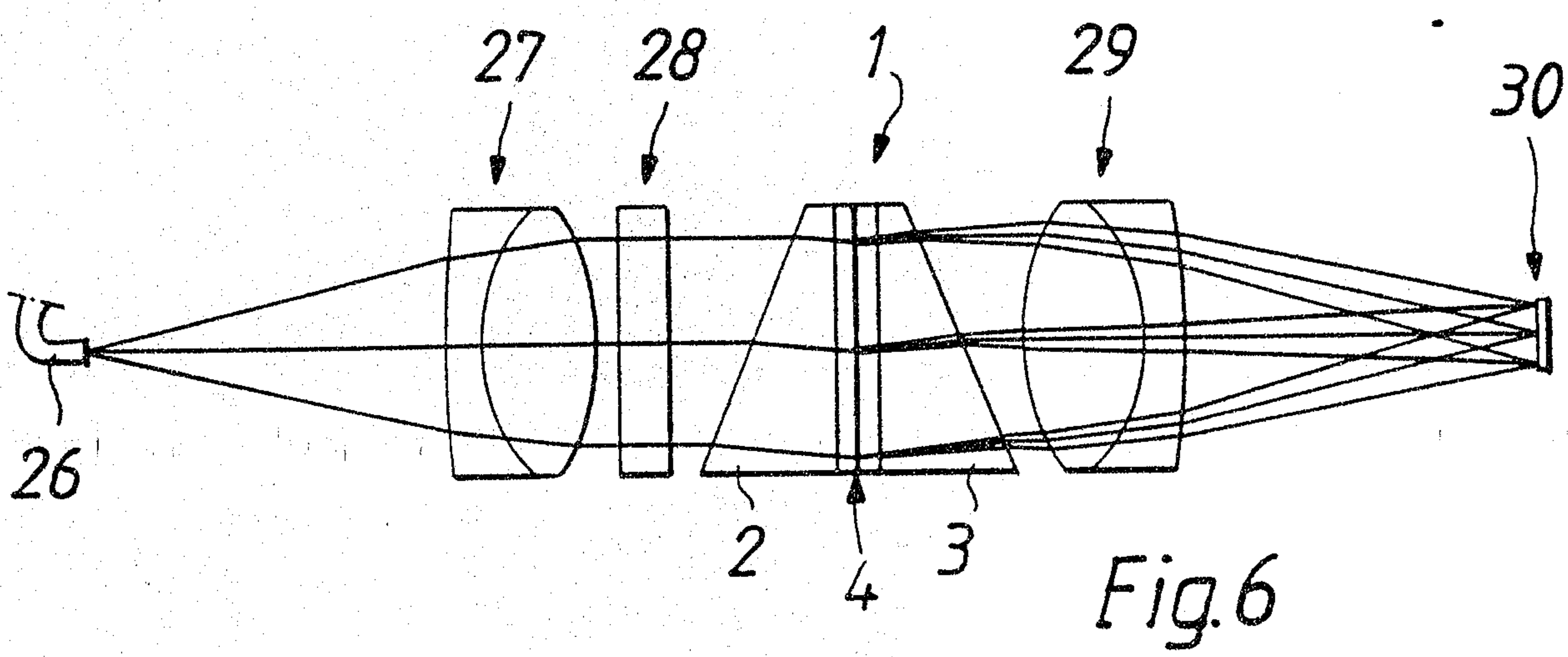

Fig.6

β1
β2
1
3b
6
4
λ1
2
3
7
5
λ2
A
α1
A
α2
2a
λ3
8