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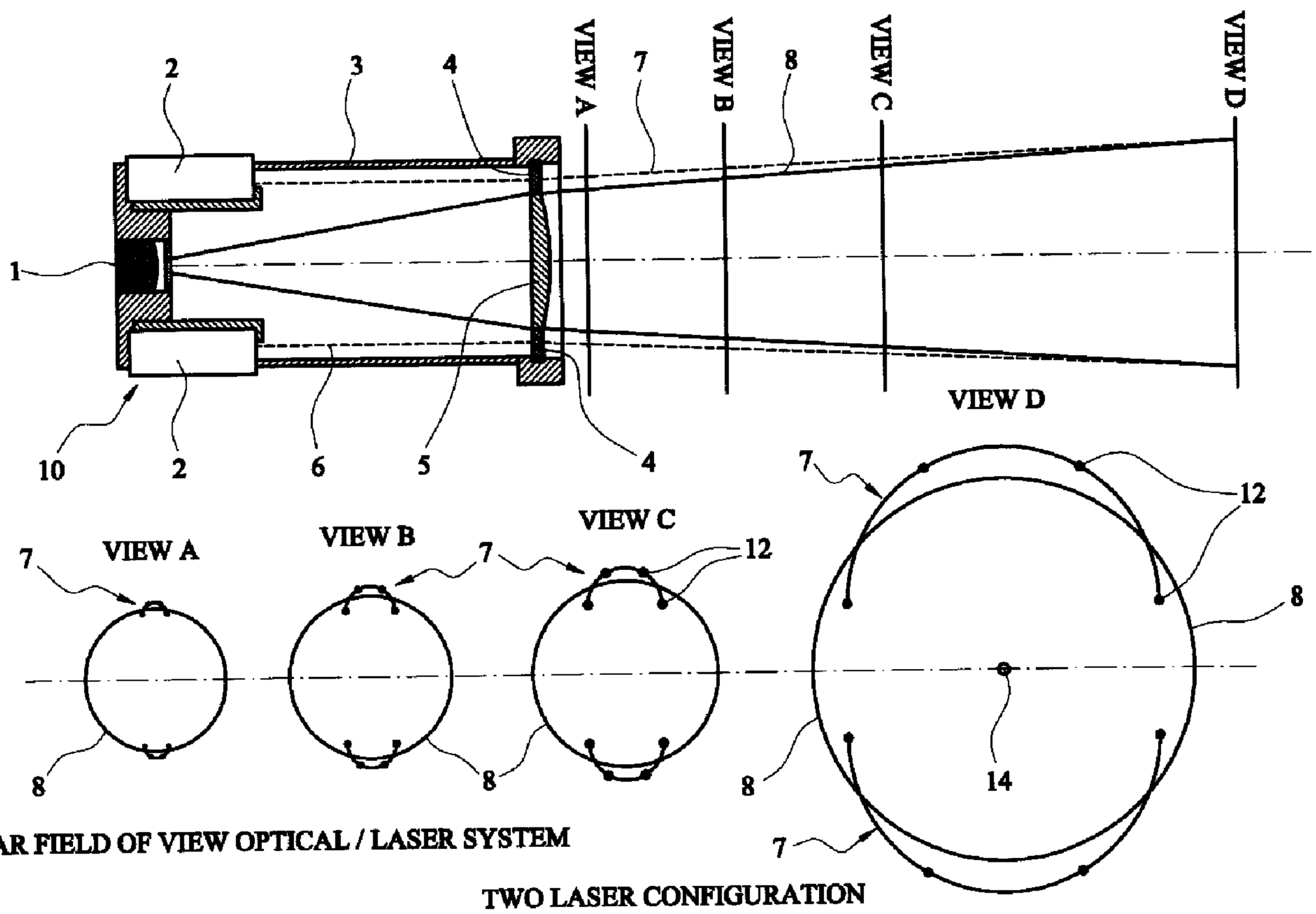

(57) Abrégé/Abstract:
An infra-red measurement device is disclosed having at least two laser emitters (2) which between them define a sighting area (7,7',7''). In one embodiment of the invention, two lasers are provided and these are each preferably split into a number of beams

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(57) Abrégé(suite)/Abstract(continued):
by means of, for example, a diffraction grating lens (4). The fact that there are two laser emitting devices, means that effectively twice the power can be utilised since the limit is per laser emitting device, and thus twice the brightness of a conventional device attained. In another embodiment of the invention, four laser emitters (2) are employed and the beams (6) can be split by a diffraction grating as before. The laser emitters in the device can be operated simultaneously, sequentially, or can be pulsed. Having greater brightness than conventional devices, the detectors of the invention are excellent for use in dark or smoky conditions, for example for obtaining the temperatures of car engines, furnaces and the like,

ABSTRACT

An infra-red measurement device is disclosed having at least two laser emitters (2) which between them define a sighting area (7,7',7''). In one embodiment of the invention, two lasers are provided and these are each preferably split into a number of beams by means of, for example, a diffraction grating lens (4). The fact that there are two laser emitting devices, means that effectively twice the power can be utilised since the limit is per laser emitting device, and thus twice the brightness of a conventional device attained. In another embodiment of the invention, four laser emitters (2) are employed and the beams (6) can be split by a diffraction grating as before. The laser emitters in the device can be operated simultaneously, sequentially, or can be pulsed. Having greater brightness than conventional devices, the detectors of the invention are excellent for use in dark or smoky conditions, for example for obtaining the temperatures of car engines, furnaces and the like.

LASER SYSTEM

This invention concerns a laser system and in particular a laser system suitable for use with an infra-red measurement device.

Infra-red measurement devices, for example, non-contact infra-red temperature measurement devices, comprise an infra-red detector and an optical system to focus the infra-red radiation from the object whose temperature is being measured onto the detector. Many of these devices are portable or hand-held and it is therefore important that the operator is able to point the device at exactly the right place so that the correct temperature is being measured. To this end, some such devices are provided with a laser emitter with which the device as a whole can be aimed. The laser beam may appear as a "spot" at the centre of the optical field, or may be split, e. g. by diffraction device, to produce a number of spots to define the measurement area in the optical field.

However, for safety reasons, there is an upper limit on the power of the laser beam which can be employed with such a device. This means that the efficiency of some of the conventional devices, when used in smoky or dark conditions, or at greater distances from the object being measured, is less than satisfactory.

The invention seeks to provide an infra-red measurement device incorporating a laser system improved in the above respects.

According to the present invention, there is provided an infra-red measurement device having a laser emitter for sighting purposes, characterised in that there are at least two laser emitters which define a sighting area.

In one embodiment of the invention, two lasers are provided and these are each preferably split into a number of beams by means of, for example, a diffraction grating, diffraction lens, prism, or other beam splitting device. The fact that there are two laser emitting devices, means that effectively twice the power can be utilised since the safety limit is per laser emitting device, and thus twice the brightness of a conventional device attained.

Each beam can be split more than once, e.g. sequentially, if desired to produce more complex patterns.

In another embodiment of the invention, four laser emitters are employed and at least some of the beams can be split by diffraction grating as before.

The laser emitters in the device of the present invention can be operated simultaneously, sequentially, or can be pulsed. Having greater brightness than conventional devices, the devices of the invention are excellent for use in dark or smoky conditions, for example for obtaining the temperatures of car engines, furnaces and the like. Moreover, the greater power allows the device to be used at greater distances from the object being measured than hitherto. The devices are preferably hand-held and may conveniently be battery powered.

A preferred example of the best mode of carrying out the invention is a construction array mounted with an infra red detector on a hand held device including a plurality of individual lasers of maximum safe power linked with on-off and/or power control switching wherein, at a first switch position, power supply to the lasers is cut off; in a second switch position, all the lasers are powered on, including an unmodified beam from one or more of the lasers directed to a position at or near the centre of the detector field of view; in a third switch position at least one laser is split by a diffraction element to produce a pattern of light intensity distribution spots on the measurement area surface to indicate to the user the edge of the field of view of the infra red detector together with a central spot from another un-split beam of a different laser.

In a further example, at least three lasers are provided, one defining a central or near central un-split spot, and the others each defining one or more spots each at or near the edges of the detector's field of view.

According to an embodiment of the present disclosure there is provided a hand-held infra red measurement device having a construction array mounted with an infra red detector having a field of view and at least two individual laser emitters for sighting purposes which define a sighting area and are linked with power control switching wherein, at a first switch position, power supply to the laser emitters is cut off; in a second switch position, all the laser

emitters are powered on, including an unmodified beam from one or more of the of the laser emitters directed to a position at or near the centre of the detector field of view; in a third switch position at least one laser beam is split by a diffraction element to produce a pattern of light intensity distribution spots on the measurement area surface to indicate to the user the edge of the detector field of view together with a central spot from another un-split beam of a different laser emitter.

According to an embodiment of the present disclosure there is provided a method of sighting an infra red detector which comprised providing two or more laser emitters and focusing the resultant laser beams into laser envelopes matching the optical field of view, wherein the laser emitters are of maximum safe power linked with on-off and/or power control switching wherein, at a first switch position, power supply to the laser emitters is cut off; in a second switch position, all the laser emitters are powered on, including an unmodified beam from one or more of the laser emitters directed to a position at or near the centre of the detector field of view; in a third switch position at least one laser beam is split by a diffraction element to produce a pattern of light intensity distribution spots on the measurement area surface to indicate to the user the edge of the detector field of view together with a central spot from another un-split beam of a different laser emitter.

According to an embodiment of the present disclosure there is provided an infra red laser system measurement device having a detector and at least two separate laser sighting emitters which display a light pattern on a measurement surface and in which the detector optical field of view is selectably switchable between either a far field or a close field of view.

According to an embodiment of the present disclosure there is provided an apparatus for remote temperature detection from a measurement spot on a target surface comprising: an infra red optical system, comprising an infra red detector and an infra red lens having an optical field of view angle, for imaging electromagnetic radiation onto said detector; and a visible light sighting system, incorporated into said optical system, comprising separate sighting modules, each having an independent light source directed onto a separate lens, to form a visible light pattern on said surface to identify and to coincide with the optical field of view of said detector and infra red lens, so that angles of light from said separate lenses

match the optical field of view angle; and a far field of view and a close field of view are arranged by separate sighting light sources of said apparatus.

According to an embodiment of the present disclosure there is provided a field-variable infra red thermometer with a visible targeting device comprising the combination of: an infra red detector; a field-variable optical system for producing a detector image on a target surface at a close field of view and at a far field of view, and for delivering infra red radiation from the target surface to the infra red detector; and visible light source means adapted to produce a light source image having an identifiable pattern on the target surface, said light source image being coincident with the detector image, wherein said identifiable pattern corresponds to the detector field of view.

According to an embodiment of the present disclosure there is provided a non-contact infra red temperature measurement device having an infra red detector, and an optical system to focus infra red radiation from an object energy zone whose temperature is to be measured onto the detector, comprising a laser sighting system including at least two laser emitters for sighting purposes, each of the at least two laser emitters emitting a laser beam for defining a sighting area of the object energy zone, wherein the optical and laser system can be set up differently to provide either a far field of view or a close field of view, wherein the laser beams from the laser emitters are each focused into visible laser patterns to identify an optical field of view of the infra red detector.

According to an embodiment of the present disclosure there is provided a method of sighting an infra red detector which comprises providing two or more laser emitters for sighting purposes and focusing the resultant laser beams for defining a sighting area, wherein the laser emitters are set up in a first configuration to provide a far field of view and are set up in a second configuration to provide a close field of view by focusing the laser beams from the laser emitters into visible laser patterns to identify an optical field of view of the infra red detector.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view of an infra-red temperature detector having two laser emitters in accordance with the invention;

Figure 2 is a similar view to Figure 1, wherein the device is configured for close field of view;

Figure 3 comprises diagrammatic representations of the field of view where four laser beams are employed in two configurations; and

Figure 4 is a similar view to Figure 3 showing two further laser field of view configurations.

Referring to the drawings, and in particular Figures 1 and 2, Figure 1 illustrates a far field of view optical and laser system for an infra-red heat detection device generally designated (10). The device (10) comprises an infra-red detector (1) on which is focused infra-red radiation by means of an optical infra-red lens (5). The lens (5) is held in a lens housing (3) within which are located two laser modules (2) each producing a laser beam (6) which illuminate and pass through diffraction lenses (4).

The diffraction grating lenses (4) split each of the beams (6) into a series of dots (12) which, to the eye, form a laser envelope in the form of a semi-circle (7). The optical field of view of the detector (1) is defined by a field of view envelope (8), and it will be seen that the set up of the diffraction grating lenses is such that the laser envelope (7) matches the optical field of view envelope (8) at essentially all points along the operating range of the system as shown by the various views A, B, C and D. It will be appreciated that the optical envelope (8) is not, in practice, visible to the naked eye, whereas the laser envelopes (7) are.

In Figure 2, the device is set up differently to give a close field of view set up where the lens (5) causes the optical field of view to take the configuration illustrated. In this case, each diffraction grating lens (4) is set up so that the semi-circular laser envelopes (7) are inverted close to the device (10) (views A and B) but progressively move towards the pattern shown in Figure 1 at greater distances (views C and D). In each case, the operator is able to

locate the centre of the optical field equidistant between the (visible) laser envelopes (7) and can thus sight the device accurately.

Referring now to Figure 3, the device (10) (not shown) incorporates four laser modules (2) producing four laser beams which are split by the diffraction grating lenses (4) into four semi-circular laser envelopes (7), or by selection of a different diffraction grating or lens, angular laser patterns (7'). The field of view configurations in Figure 3 are in respect of the far field of optical view system. In Figure 4, in contrast, a close field of view optical system is illustrated with four laser beams (6) producing four sets of laser envelopes (7) which can be semi-circular as before, or linear (7") by selecting the correct configuration of diffraction grating lens (4).

In an alternative embodiment, one of the modules (2) may be focussed so as to produce a spot (14) (Figure 1) at or near the centre of the optical field of view (8). If a single (un-split) spot (14) is produced this will be brighter than the split envelopes (7) and will be visible at a substantial distance away.

The use of four laser emitters (2) quadruples the permissible power, and therefore the brightness, of the laser envelope and is especially useful in dark or smoky conditions or at greater distances from the object being measured.

It will be appreciated that configurations other than semi-circles, angles, lines, and the like may be used to identify the optical field of view according to requirements. The detector of the invention provides a simple solution to the problem of brightness of the laser envelope in conditions of poor visibility or at greater distances from the object being measured.

What is claimed is:

1. A hand-held infra red measurement device having a construction array mounted with an infra red detector having a field of view and at least two individual laser emitters for sighting purposes which define a sighting area and are linked with power control switching wherein, at a first switch position, power supply to the laser emitters is cut off; in a second switch position, all the laser emitters are powered on, including an unmodified beam from one or more of the of the laser emitters directed to a position at or near the centre of the detector field of view; in a third switch position at least one laser beam is split by a diffraction element to produce a pattern of light intensity distribution spots on the measurement area surface to indicate to the user the edge of the detector field of view together with a central spot from another un-split beam of a different laser emitter.

2. A device as claimed in claim 1 wherein two lasers are provided.

3. A device as claimed in claim 1 wherein four lasers are provided.

4. A device as claimed in any one of claims 1 to 3 wherein at least one laser beam is split into a number of beams by means of a diffraction grating, diffraction lens, prism or beam splitter.

5. A device as claimed in claim 4 wherein the laser beam is split into a semi circular array of spots.

6. A device as claimed in claim 4 wherein the laser beam is split into an angled array of spots.

7. A device as claimed in claim 4 wherein the laser beam is split into a linear array of spots.

8. A device as claimed in any one of claims 1 to 7 wherein the sighting area matches the optical field of view.

9. A device as claimed in any one of claims 1 to 8 wherein each laser beam is split more than once.

10. A device as claimed in claim 1 wherein at least three laser emitters are provided, one defining a central or near central un-split spot, and the other two defining one or more spots each at or near the edges of the detector field of view.

11. A device as claimed in any one of claims 1 to 10 wherein the laser emitters are of a maximum safe power.

12. A device as claimed in any one of claims 1 to 11 wherein the power control switching includes on-off switching.

13. A method of sighting an infra red detector which comprised providing two or more laser emitters and focusing the resultant laser beams into laser envelopes matching the optical field of view, wherein the laser emitters are of maximum safe power linked with on-off and/or power control switching wherein, at a first switch position, power supply to the laser emitters is cut off; in a second switch position, all the laser emitters are powered on, including an unmodified beam from one or more of the laser emitters directed to a position at or near the centre of the detector field of view; in a third switch position at least one laser beam is split by a diffraction element to produce a pattern of light intensity distribution spots on the measurement area surface to indicate to the user the edge of the detector field of view together with a central spot from another un-split beam of a different laser emitter.

14. A method as claimed in claim 13 wherein the laser emitters are operated simultaneously, sequentially, or are pulsed.

15. An infra red laser system measurement device having a dctector and at least two separate laser sighting emitters which display a light pattern on a measurement surface and in which the detector optical field of view is selectably switchable between either a far field or a close field of view.

16. Apparatus for remote temperature detection from a measurement spot on a target surface comprising: an infra red optical system, comprising an infra red detector and an infra red lens having an optical field of view angle, for imaging electromagnetic radiation onto said detector; and a visible light sighting system, incorporated into said optical system, comprising separate sighting modules, each having an independent light source directed onto a separate lens, to form a visible light pattern on said surface to identify and to coincide with the optical field of view of said detector and infra red lens, so that angles of light from said separate lenses match the optical field of view angle; and a far field of view and a close field of view are arranged by separate sighting light sources of said apparatus.

17. Apparatus according to claim 16, wherein each light source is a laser.

18. Apparatus according to claim 16, wherein angles of light from said modules are divergent.

19. Apparatus according to claim 16, wherein the optical imaging system defines a field of view from said detector including a measurement spot on a target surface, the field of view being arranged with respect to the detector from a close field of view near position to a far field of view distant position and from a far field of view distant position to a close field of view near position; and a sighting device for marking the position and/or the size of the measuremcnt spot on the target surface, and sighting device comprising at least two light sources that each provides a respective sighting ray; and wherein at least one of said respective sighting rays is dedicated to close field of view short range marking and at least one other of said respective sighting rays of the sighting device is dedicated to far field of view long range marking, and wherein said sighting device is arranged for close field of view marking and for far field of view marking upon the apparatus being arranged from the near position to the distant position.

20. Apparatus according to claim 19, wherein at least two of the sighting rays are provided for visualization of the measurement spot at the close field of view near position and at least two other sighting rays are provided for visualization of the measurement spot at the far field of view distant position.

21. Apparatus according to claim 16, wherein each of the light sources comprises a respective laser diode.

22. Apparatus according to claim 16, wherein each of the light sources conprises a respective laser, and wherein the angular position of the lasers is arranged relative to one another in said sighting device.

23. Apparatus according to claim 16, wherein said sighting system comprises at least two light sources that each provides a respective sighting system and in which said system is arranged between short range and long range focusing.

24. A field-variable infra red thermometer with a visible targeting device comprising the combination of: an infra red detector; a field-variable optical system for producing a detector image on a target surface at a close field of view and at a far field of view, and for delivering infra red radiation from the target surface to the infra red detector; and visible light source means adapted to produce a light source image having an identifiable pattern on the target surface, said light source image being coincident with the detector image, wherein said identifiable pattern corresponds to the detector field of view.

25. A non-contact infra red temperature measurement device having an infra red detector, and an optical system to focus infra red radiation from an object energy zone whose temperature is to be measured onto the detector, comprising a laser sighting system including at least two laser emitters for sighting purposes, each of the at least two laser emitters emitting a laser beam for defining a sighting area of the object energy zone, wherein the optical and laser system can be set up differently to provide either a far field of view or a close field of view, wherein the laser beams from the laser emitters are each focused into visible laser patterns to identify an optical field of view of the infra red detector.

26. The device as claimed in claim 25, wherein the sighting area matches the optical field of view of the infra red detector.

27. The device as claimed in any one of claims 25 or 26, wherein optical elements direct the laser beams to the center and/or to the edges of the sighting area.

28. The device as claimed in any one of claims 25 to 27, wherein the laser emitters are operated sequentially.

29. The device as claimed in any one of claims 25 to 28, wherein the device is a hand-held device and a laser array is mounted with the infra red detector on the hand-held device.

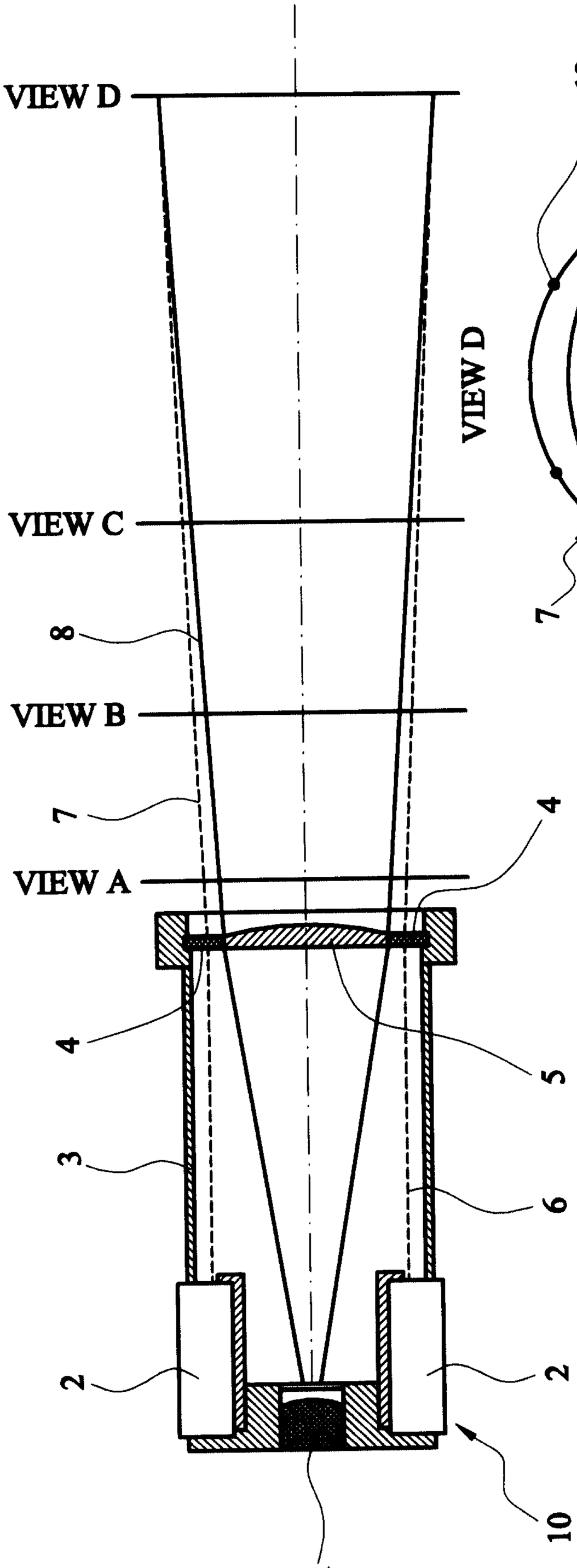
30. The device as claimed in any one of claims 25 to 29, wherein the device is a hand-held device having a multiple laser array mounted together with the infra red detector.

31. The device as claimed in any of claims 25 to 30, wherein the device is battery powered.

32. The device as claimed in claim 28, wherein four lasers are provided.

33. A method of sighting an infra red detector which comprises providing two or more laser emitters for sighting purposes and focusing the resultant laser beams for defining a sighting area, wherein the laser emitters are set up in a first configuration to provide a far field of view and are set up in a second configuration to provide a close field of view by focusing the laser beams from the laser emitters into visible laser patterns to identify an optical field of view of the infra red detector.

34. A method as claimed in claim 33, wherein the laser emitters are operated simultaneously, sequentially, or are pulsed.



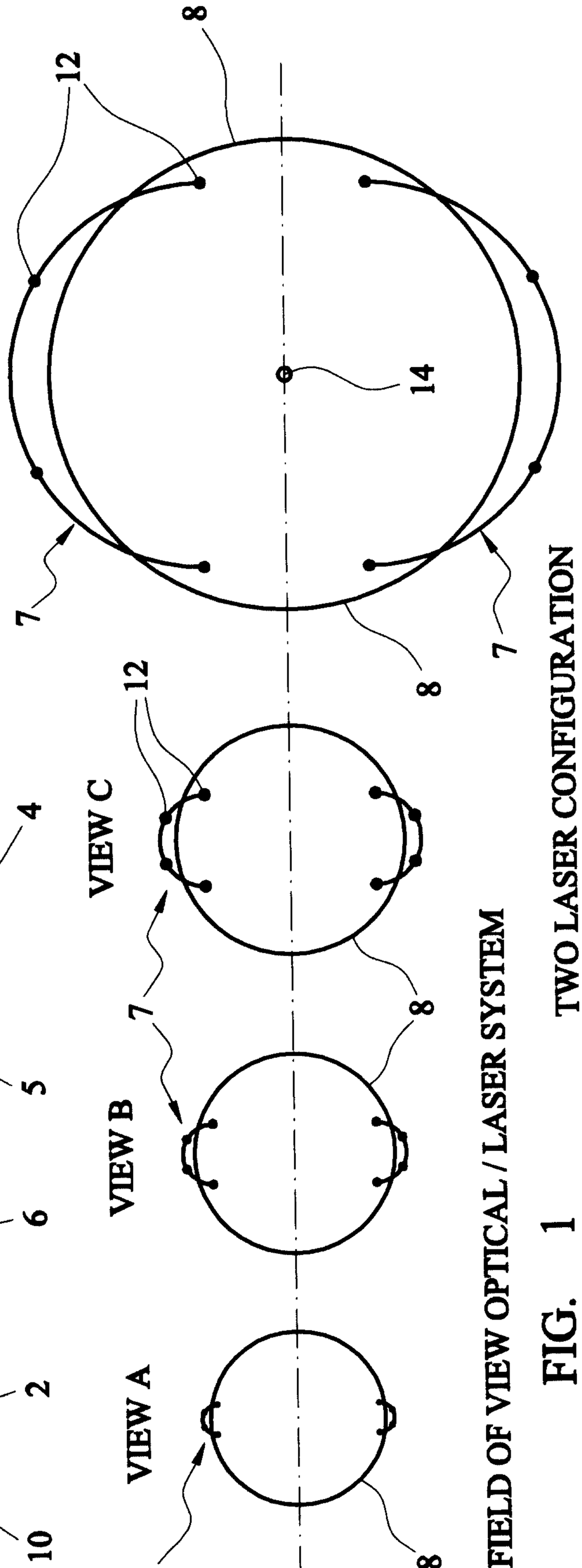
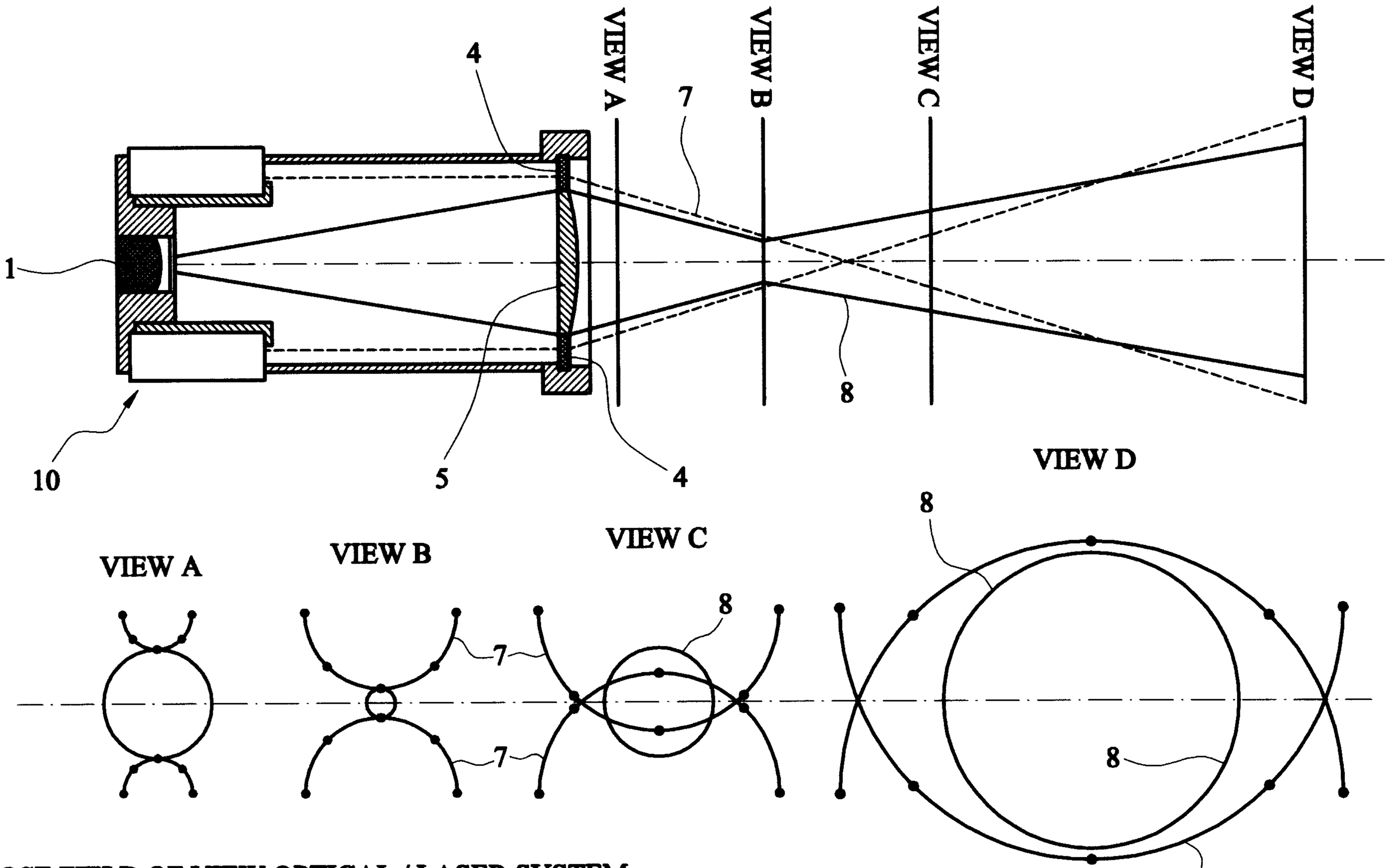


FIG. 1

TWO LASER CONFIGURATION

FAR FIELD OF VIEW OPTICAL / LASER SYSTEM



CLOSE FIELD OF VIEW OPTICAL / LASER SYSTEM

FIG. 2

TWO LASER CONFIGURATION

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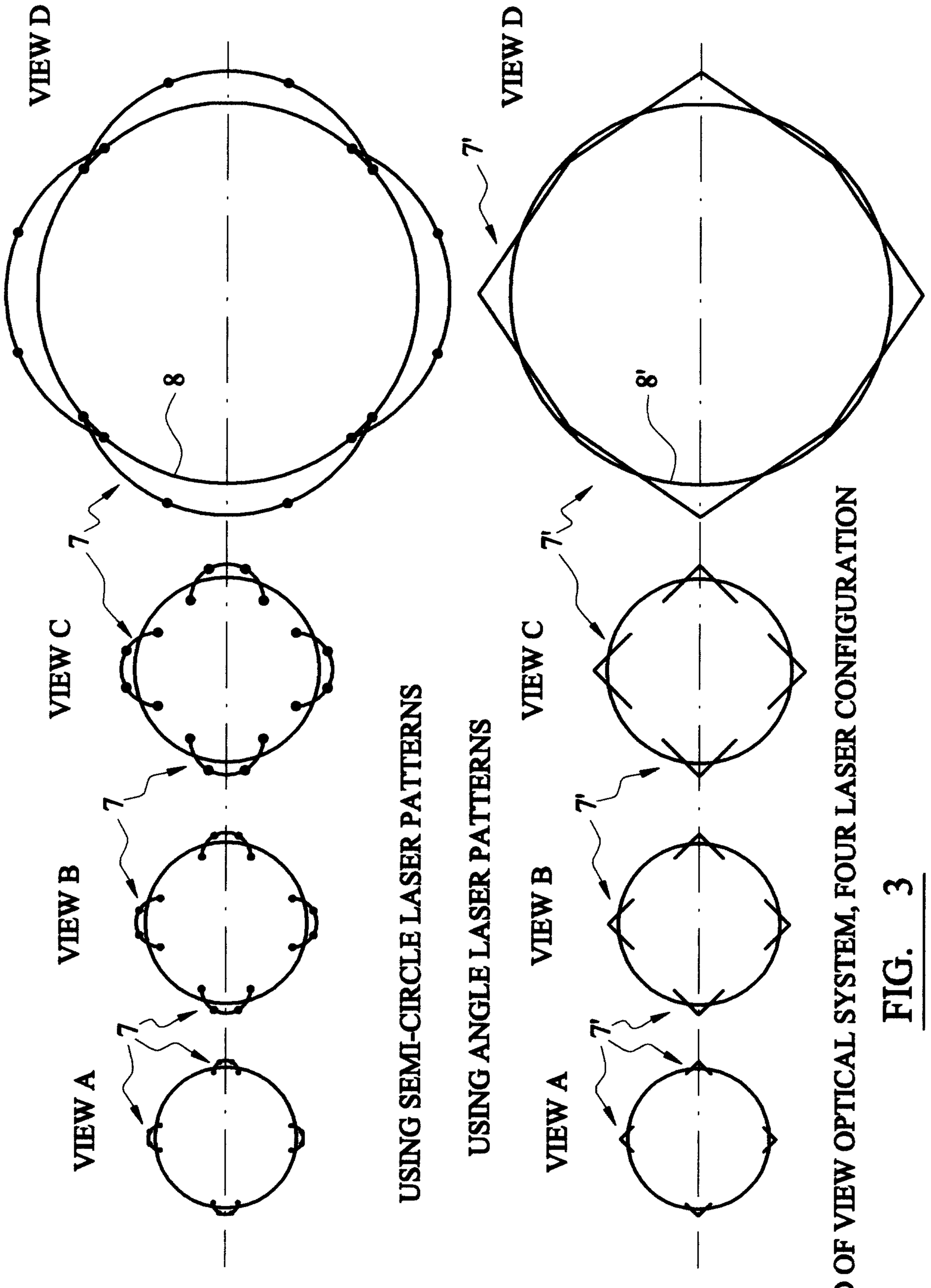

VIEW D
8
7
VIEW C
VIEW B
VIEW A
USING SEMI-CIRCLE LASER PATTERNS
VIEW D
7'
8'
7'
VIEW C
VIEW B
VIEW A
USING ANGLE LASER PATTERNS
FAR FIELD OF VIEW OPTICAL SYSTEM, FOUR LASER CONFIGURATION

FIG. 3

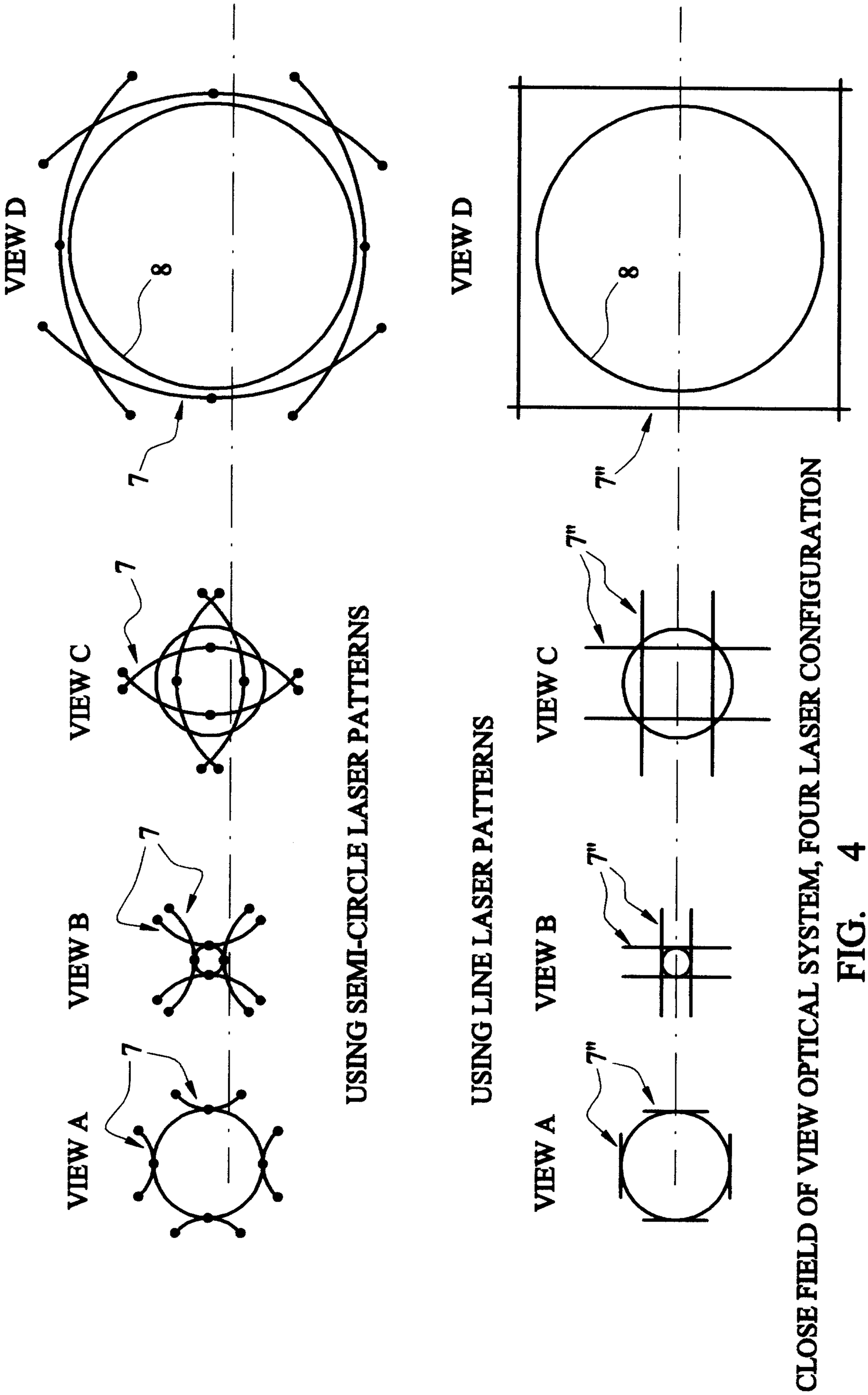
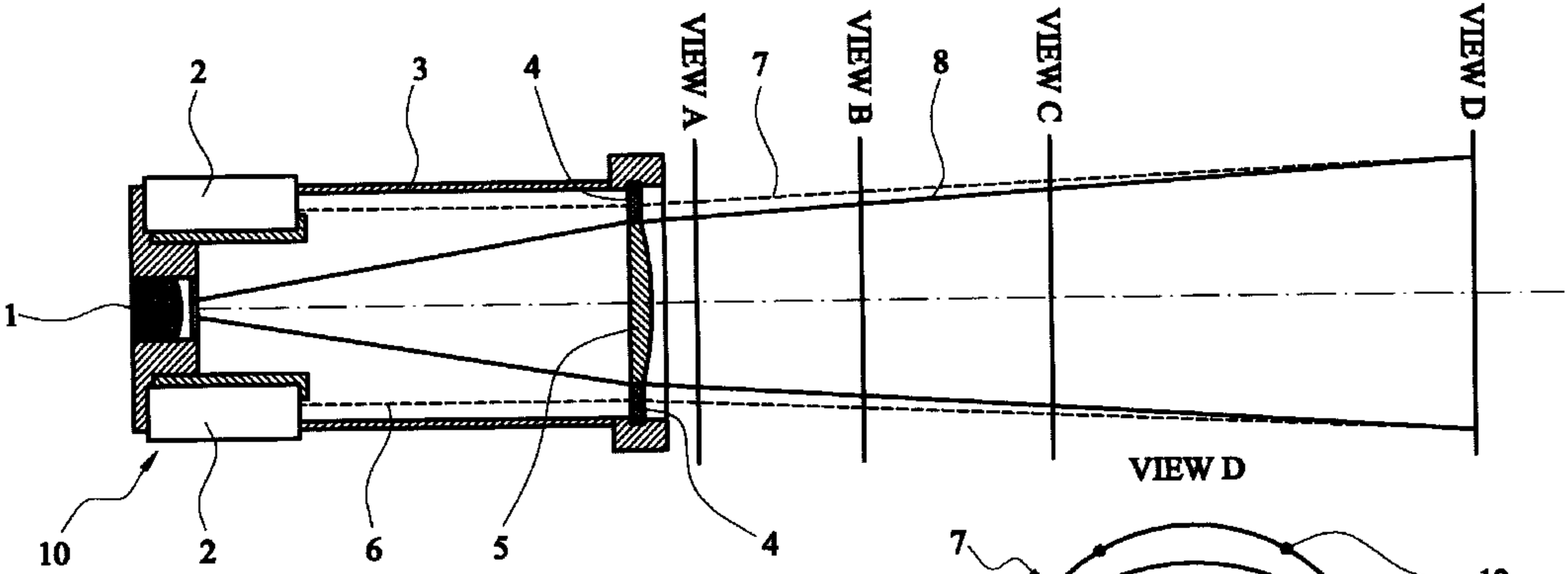
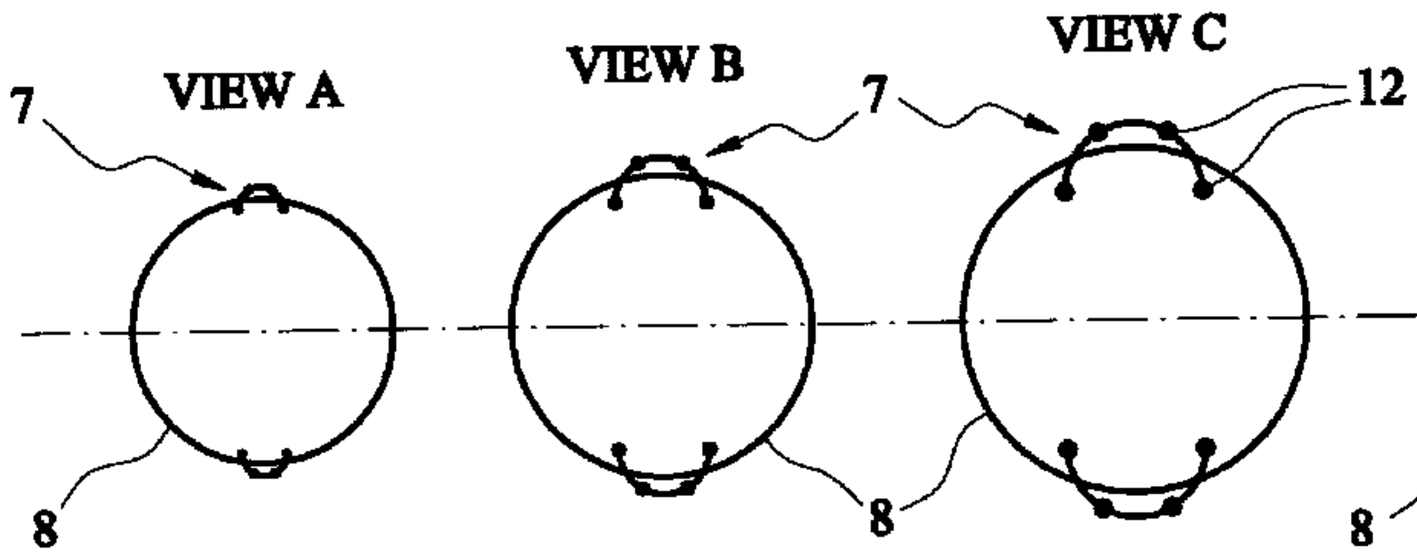
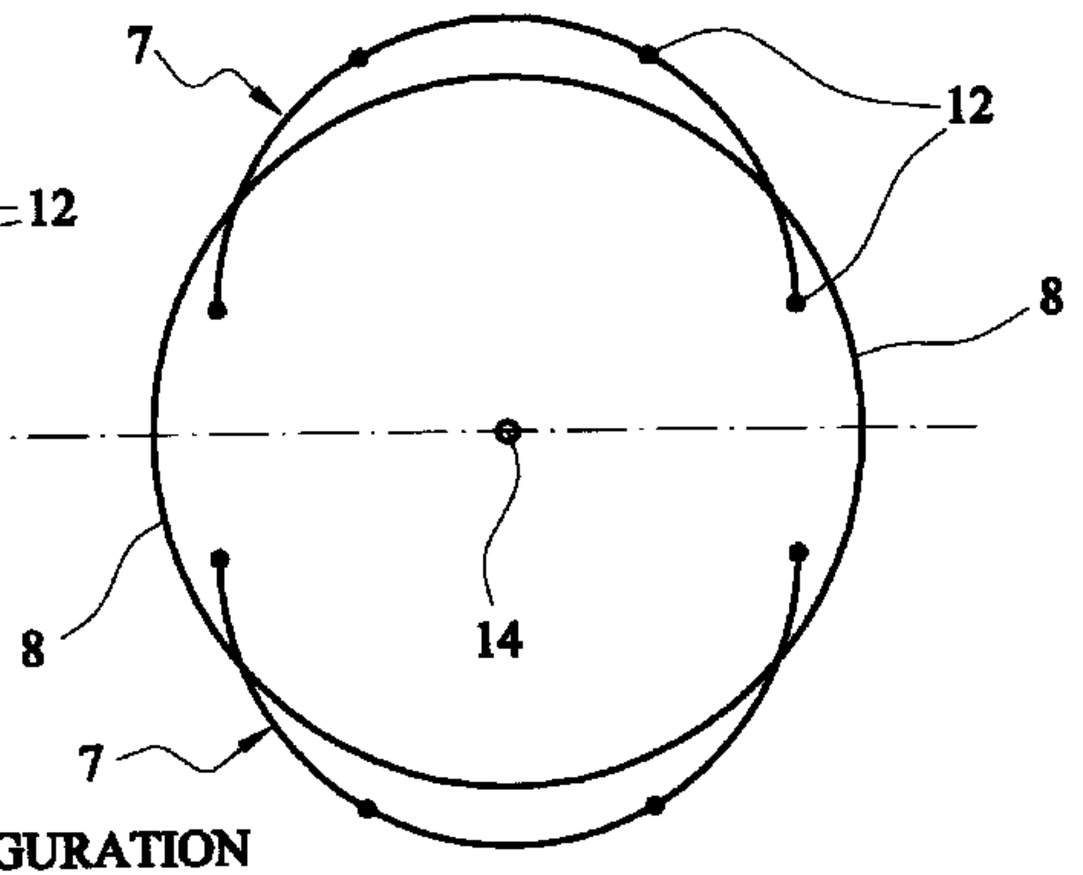

USING SEMI-CIRCLE LASER PATTERNS
VIEW A
VIEW B
VIEW C
VIEW D
7
8
USING LINE LASER PATTERNS
VIEW A
VIEW B
VIEW C
VIEW D
7"
8
CLOSE FIELD OF VIEW OPTICAL SYSTEM, FOUR LASER CONFIGURATION

FIG. 4





FAR FIELD OF VIEW OPTICAL / LASER SYSTEM



TWO LASER CONFIGURATION