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(56) Documents cited
**GB A 2097145** **GB 1423257** **GB 1417176**
**GB 1534766**

(58) Field of search
**H4D**
**H4F**
**G2J**

# (54) Optical-mechanical scanning system switched between two inputs

(57) The mechanism comprises a target observation channel 2 and a missile location channel 3, the target observation channel 2 and missile location equipment 3, each has its own input optical system (4, 5, Fig. 1 not shown) having different fields of vision. Both these fields of vision are raster scanned in elevation and azimuth by means of a rotating polygonal drum ray switch in the ray paths 13a, 13b of the two channels 2, 3 switch 17, which periodically deflects the light from the two channels, onto a common thermal image receiver 20. The ray switch 17 preferably has deflectors 18a, 18b along its periphery which are inclined atternatingly relative to the radius direction. Scanning in the perpendicular mirrors is by means of rotatable mirrors 11a, 11b.

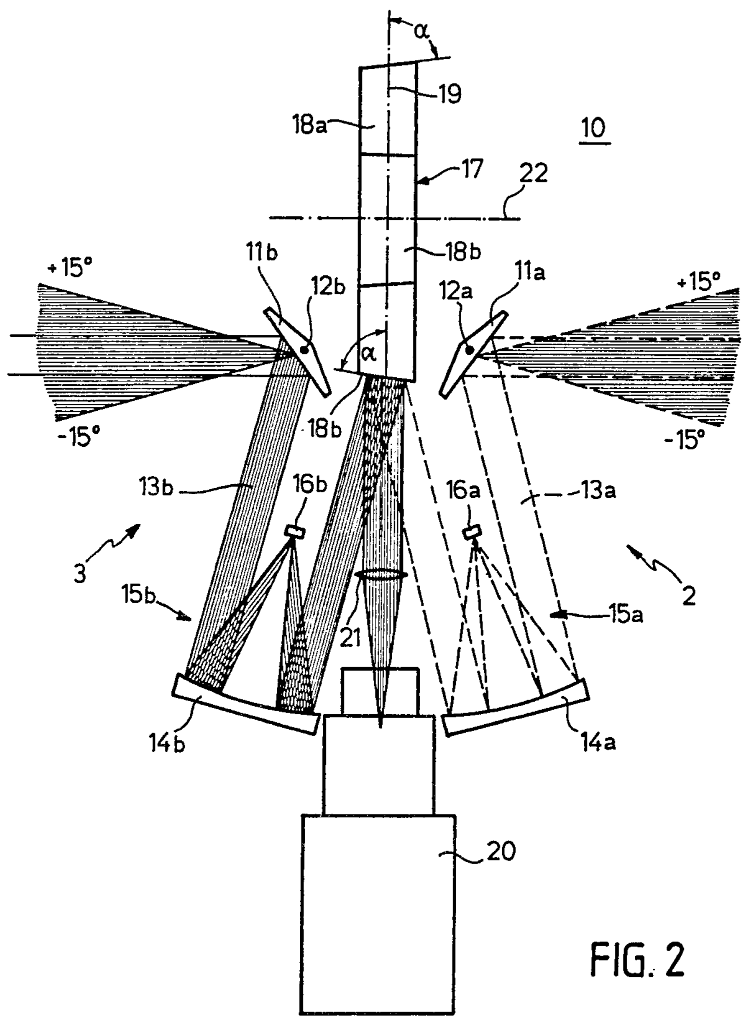


FIG. 2

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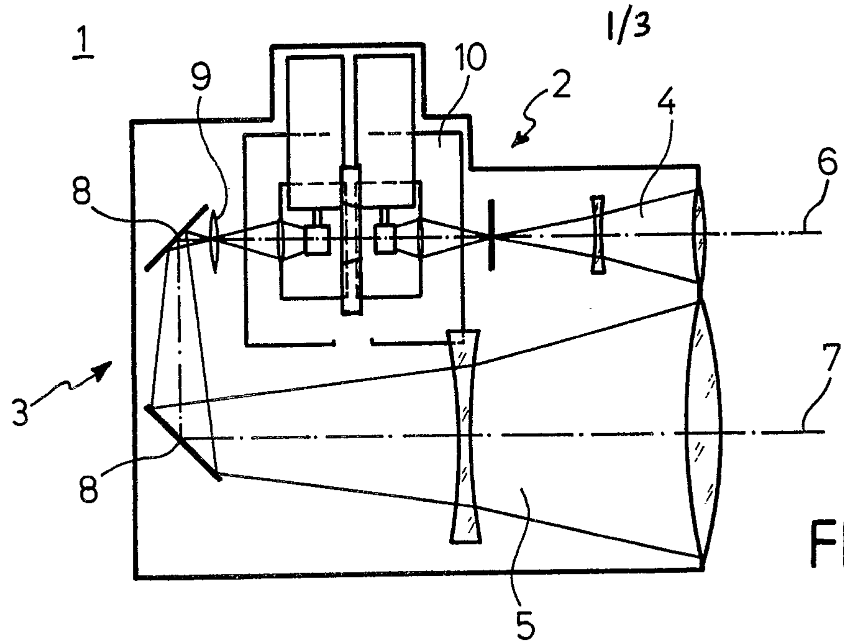


FIG. 1

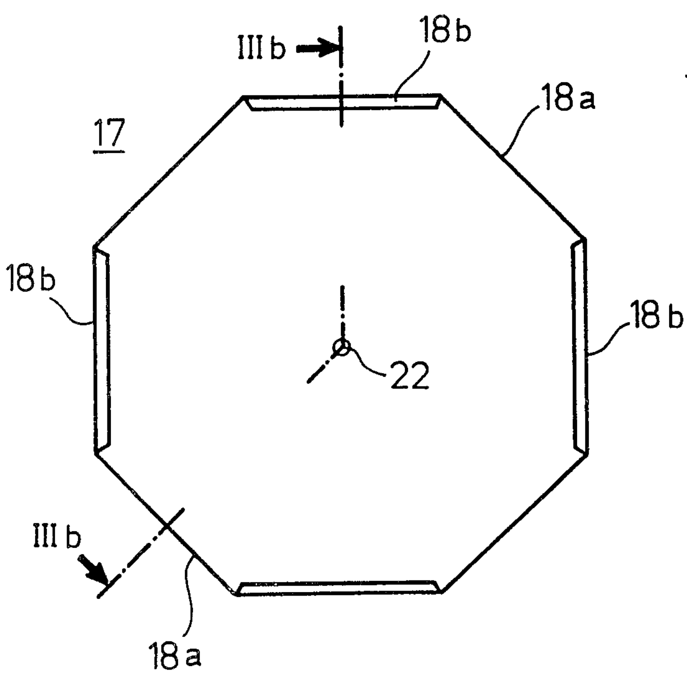


FIG. 3a

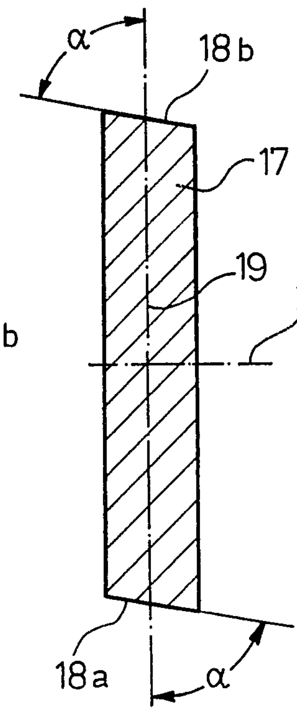


FIG. 3b

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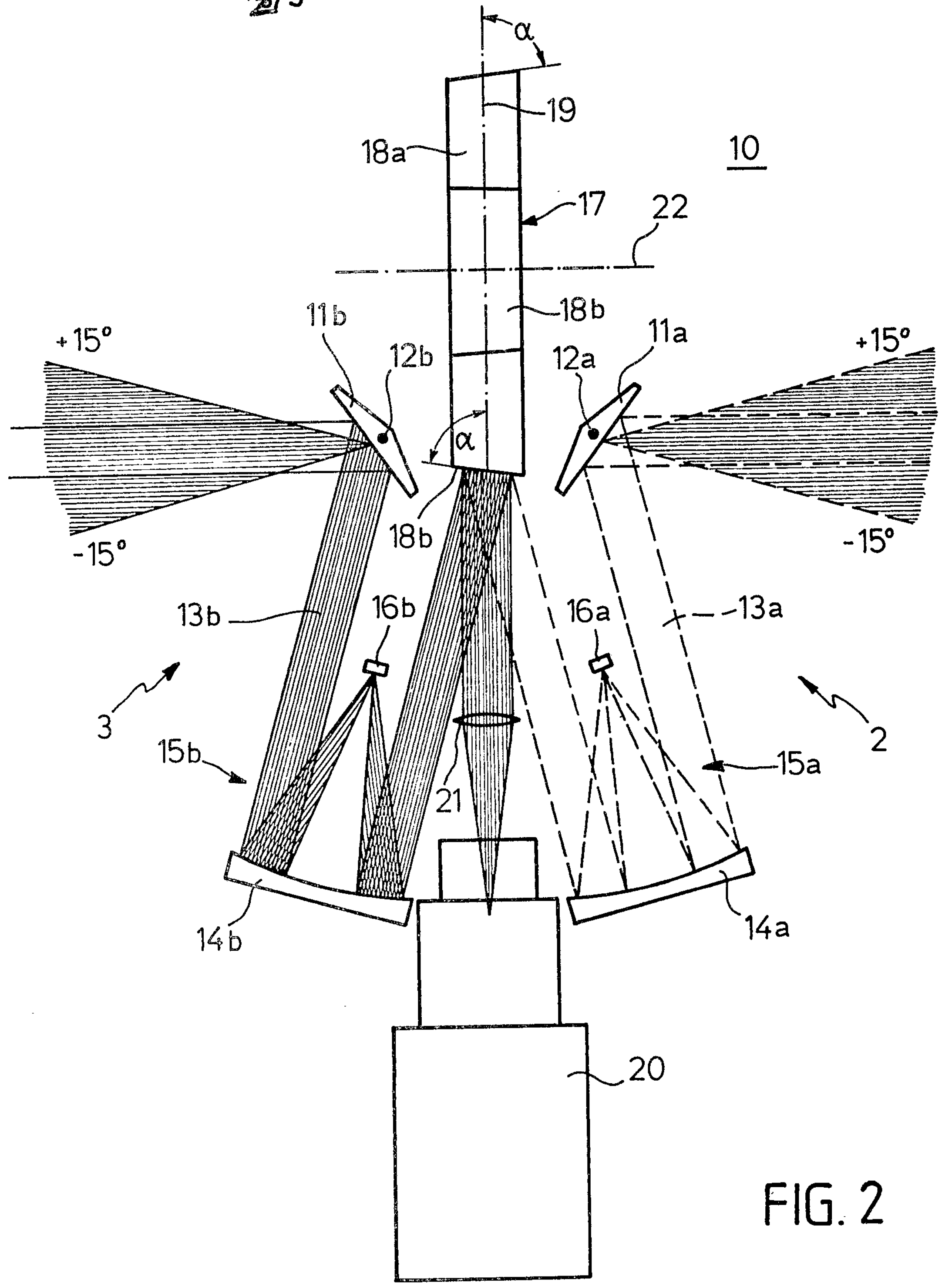


FIG. 2

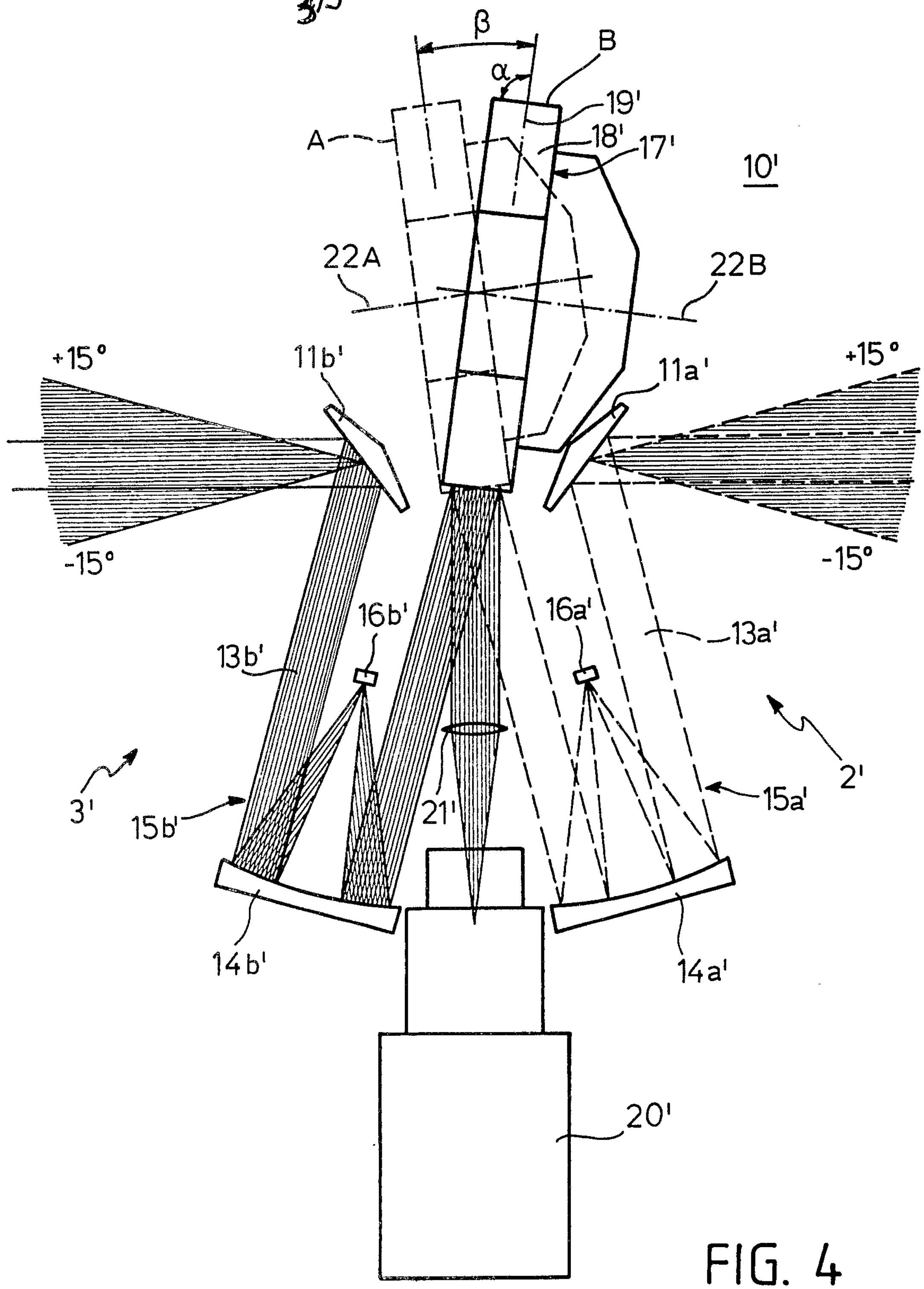
β
α
B
19'
18'
17'
A
10'
22A
22B
+15°
11b'
11a'
+15°
-15°
-15°
16b'
16a'
13a'
13b'
2'
3'
15b'
21'
15a'
14b'
14a'
20'

FIG. 4

SPECIFICATION

**Mechanism for guiding a flying body into a target**

This invention concerns a mechanism for guiding a flying body into a target, having observation equipment for target observation and possibly target tracking within a first field of vision as well as a position finder and guiding equipment, for the flying body, which determines a second field of vision and which communicates with the flying body by way of a signal connection for transmission of guidance signals, in which the observation equipment as well as the position finder and guiding equipment are combined in a guidance station.

Such mechanisms, for guiding flying bodies into targets normally have, in a guidance station, as observation equipment, a directive periscope with which a gunner aims at a target and keeps it in the line of sight by following-up with the periscope. The flying body carries, on its tail, a pyrotechnical illuminating composition or the like which emits radiation in the optical or in the infra-red range. The infra-red radiation of the illuminating composition is perceived by a goniometer, serving as location or position finder and guidance equipment, in the guidance station. Guidance signals are developed in the goniometer, from the displacement of the flying body from the line of sight of the periscope, which signals are transmitted to the flying body for example by way of a guidance wire connection. The flying body is guided by the guidance signals onto the line of sight of the periscope and held on this, so that the target is always hit when the gunner keeps the target in the line of sight. Such guidance procedures are generally designated as being semi-automatic.

Such mechanisms are substantially suitable only for use by day, since target observation and target tracking with the periscope is effected in the range of visible light. In order to make night time use possible, it is known to use, in the guidance station, additional image intensifiers or thermal image equipment as observation equipment.

The problem underlying the invention is to simplify, for such an arrangement, the mechanisms, necessary in the the guidance station, for target observation, target tracking and for guiding the flying body and to provide a sturdy mechanism for guiding the flying body into the target.

In accordance with the invention this problem is solved by providing for the observation equipment as well as the location and guidance equipment to be conducted into a thermal image equipment having two optical channels which are associated with the observation equipment or the location and guidance equipment, each optical channel having scanning elements for line-form scanning of the fields of vision, associated with the observation equipment or the location and guidance equipment, in elevation and azimuth, and the scanning elements for the one scanning direction being arranged on a controlled ray switch which is common to both optical channels and which guides the ray paths from the observation equipment as well as the location and guidance equipment linewise alternately onto a common thermal image receiver.

In such arrangement, for the target observation, target tracking and for guiding the flying body, a common thermal image equipment is used which has, however, for the observation equipment as well as for the location and guidance equipment, two separate optical channels which can be switched, with the aid of a periodically switchable beam switch, onto the common receiver. The representation systems for the observation equipment as well as for the location and guidance equipment are in each case identically constructed, but the input optical system of the location and guidance equipment has a greater focal length, so that the field of vision of the location and guidance equipment.

With the mechanism in accordance with the invention it is possible to scan simultaneously two differently large fields of vision at the same time linewise, in which one line of the field of vision after one line of the other field of vision are provided at the common receiver. The two fields of vision, periodically nested or merged into one another, are scanned in this way. The two input optical systems have, as elevation scanning elements, respective rotating scanning mirrors, whilst the common ray switch is preferably designed as a rotating polygonal wheel, along the periphery of which deflectors, for deflection of the radiation of each optical channel and at the same time for line-form scanning, are provided, which deflectors are so placed or pitched relative to the radius direction of the polygonal wheel that the radiation of both optical channels is deflected onto the common receiver.

With the invention it is possible to integrate target observation, target tracking and guidance of the flying body in a compact sturdy unit inside the guidance station, whereby size, weight and mechanical expenditure can be reduced compared with known mechanisms.

Further developments and advantages of the invention will be appreciated from the sub-claims as well as from the following description, in which two exemplified embodiments are described in more detail with reference to the accompanying drawings. In the drawings:

*Figure 1* is a schematic partially-sectioned view of a first embodiment of the mechanism for guiding a flying body into a target in accordance with the invention, having observation equipment as well as location and guidance equipment;

*Figure 2* illustrates schematically and to an enlarged scale the construction of an observation equipment as well as of the location and guidance equipment of the mechanism of Fig. 1, having a rotating polygonal wheel for line scanning;

*Figure 3a* is a front view of the wheel of the mechanism of Figs. 1 and 2;

*Figure 3b* is a section taken along the III*b*–III*b* of Fig. 3*a* of the polygonal wheel of the arrangement of Figs. 1 and 2;

*Figure 4* illustrates schematically in a manner comparable with Fig. 2, the construction of an observation as well as location and guidance equipment, in accordance with a second exemplified embodiment of the invention.

Illustrated in Fig. 1 is a part of a guidance station 1 into which observation equipment 2 and location and guidance equipment 3 are integrated. The observation equipment comprises an input telescope 4, and the location and guidance equipment has an input telescope 5 having a greater focal length. Lines of sight 6 and 7 of the observation equipment or of the location and guidance equipment are parallel, so that, by means of the input telescope 5 of the location and guidance equipment, an enlarged segment of the field of vision perceived with the observation equipment 2 is supplied. The thermal radiation picked up by the input telescope 5 of the location and guidance equipment 3 is conducted, by way of two deflecting mirrors 8, and a graticular optical system 9, but the radiation picked up by the input telescope 4 of the observation equipment 2 is conducted directly into a scanning/reception block designated by the reference numeral 10.

This scanning/reception block is shown in more detail in Fig. 2. The optical reproduction systems for the observation equipment 2, as well as the location and guidance equipment 3, are identically constructed. Following on the input optical system, the radiation of each piece of equipment falls onto a respective elevation scanning mirror 11*a* or 11*b* which, in each case rotates about an axis 12*a*, 12*b* which is perpendicular to the ray or beam path. For clarity, the ray path of the location and guidance equipment is shown hatched and designated by the numeral 13*b*, whilst the ray path of the observation equipment is shown in broken lines at 13*a*. The ray path inside the scanning/reception block 10 will be explained with reference to the location and guidance equipment 3. From the elevation scanning mirror 11*b*, the radiation is guided onto a parabolic mirror 14*b* of an intermediate optical system 15*b*, in this case a so-called Bouwers optical system, and deflected from there onto a hyperbolic deflecting mirror 16*b* at the focal point of the parabolic mirror 14*b*. From there, the light is thrown back onto the parabolic mirror 14*b* and reflected from the latter parallel to the incident ray path in the direction of a ray switch 17.

This ray switch 17 is a rotating polygonal wheel, along the periphery of which flat deflectors 18*a* and 18*b* are arranged. As becomes apparent from Fig. 3, the polygonal wheel has eight such deflectors. The radiation of the location and guidance equipment 3 falls, in the case shown in Fig. 2 onto a deflector 18*b* which is pitched with an angle $\alpha$ towards the radius direction 19 of the polygonal wheel 17. The deflector 18*b* acts as a deflection element for the radiation 13*b* and guides this towards a thermal image receiver 20 onto the detector of which the radiation is focussed with the aid of a collecting optical system 21. If, with the elevation scanning mirror 11*b* halted the polygonal wheel 17 is rotated, then one line of the field of vision of the location and guidance equipment 3 is scanned by this deflector 18*b*.

The intermediate optical system 15*a*, is identical to the intermediate optical system 15*b*, having a parabolic mirror 14*a* and a deflecting mirror 16*a*, is arranged in the ray path 13*a*. In the position of the polygonal wheel 17 shown in Fig. 2 the radiation of the observation equipment similarly encounters the deflector 18*b*, but is not deflected by the latter onto the thermal image receiver 20. Only when the polygonal wheel 17 is further rotated, so that the following deflector 18*a* is located in the ray path, is the radiation of the observation equipment guided onto the thermal image receiver 20, so that a line of the field of vision of the observation equipment 2 is scanned. The radiation, incident onto this deflector 18*a*, of the location and guidance equipment 3 is guided past the thermal image receiver. Accordingly the deflectors 18*a* have, relative to the radius direction 19 of the polygonal wheel, the same angle of incidence $\alpha$, which lies however on the other side of the radius direction 19. The angles of incidence are accordingly oppositely identical. During the scanning of a line of the two fields of vision, the elevation scanning mirrors 11*a* and 11*b* remain in the same position and are only further swung when the respective radiation 13*a* or 13*b* respectively falls onto the respective next but one deflector 18*a* or 18*b* respectively of the polygonal wheel 17. In this way the two fields of vision of the observation equipment 2 or of the location and guidance equipment 3 are picked up, nested or integrated linewise one into the other, in the thermal image receiver 20. The images of the two fields of vision can be separated in accordance with conventional methods, so that, for example, the fields of vision of the two pieces of equipment are depicted on two different sightscreens or displays. Equally it is possible to depict the two fields of vision on a common sightscreen, in which case the image of the field of vision of the location and guidance equipment 3 can be switched selectively into the image of the observation equipment on the sightscreen.

In order to achieve a high image quality with the described scanning, the polygonal wheel 17 has to be driven about its axis of rotation 22, perpendicular to the radius direction, approximately twice as fast as upon the scanning of an individual image. The high centrifugal accelerations occurring as a result thereof can be mastered satisfactorily by appropriate materials of the polygonal wheel. One such material is, for example, that known under the Trade Name Zerodur.

The construction of the polygonal wheel 17 is shown in detail in Figs. 3*a* and 3*b*. Here it is evident that all the deflectors 18*a* and 18b have the same centre angle and accordingly have the same length along the periphery of the polygonal wheel 17. The size of the field of vision is therefore determined merely by the telescopes 4 or 5 respectively of the observation equipment 2 or of the location and guidance equipment 3.

Shown in Fig. 4 as a further exemplified embodiment of a mechanism for guiding a flying body into a target, is a respective scanning/reception block 10′. This scanning/reception block 10′ is constructed down to the beam switch 17′, substantially identically with the scanning/reception block 10 of Fig. 2. Identical or identically-acting elements are designated with the same reference numerals, but with a prime added.

For the observation equipment 2′, an elevation scanning mirror 11*a*′, an intermediate optical system 15*a*′ with a parabolic mirror 14*a*′ and a deflector mirror 16*a*′ are provided. For the location and guidance equipment 3′, likewise an elevation scanning mirror 11*b*′, an intermediate optical system 15*b*′ consisting of a parabolic mirror 14*b*′ and a deflecting mirror 16*b*′ are provided. Furthermore, a thermal image receiver 20′ and a collecting optical system 21′ for focussing the radiation incident onto the thermal image receiver 20′ is used.

The beam switch 17′ is likewise in the form of a polygonal wheel having, for example, likewise eight deflectors 18′. These deflectors 18′ all have, relative to the radius direction 19′ of the polygonal wheel, the same angle of incidence $\alpha'$. The polygonal wheel 17′ rotates about its central axis of rotation 22′. The polygonal wheel 17′ is swingable into two positions A and B, the polygonal wheel being shown in broken lines in the position A. The swivel angle $\beta$ corresponds to twice the angle of incidence $\alpha'$. Accordingly also the angular position of the axis of rotation changes; these two angular positions are designated in Fig. 4 by the numerals 22A and 22B.

In the position A of the polygonal wheel 17′, the radiation 13*a*′ of the observation equipment 2′ is guided onto the thermal image receiver 20′, so that during the rotation along a deflector 18′ the field of vision of the observation equipment 2′ is scanned in a line. Then the polygonal wheel is swung into the position B, so that now upon further rotation of the polygonal wheel about the new position 22B of the axis of rotation the radiation 13*b*′ of the location and guidance equipment 3′ is deflected by the following deflector 18′ into the thermal image receiver 20′.

In this mechanism, also, the two fields of vision of observation equipment 2, as well as the location and guidance equipment 3′, are scanned line for line, this line scanning being nested or interlineated one into the other. By controlled swinging of the elevation scanning mirrors 11*a*′ and 11*b*′, the two fields of vision are scanned as a whole.

At the output of the thermal image equipment there appear, in both exemplified embodiments, image signals which, in accordance with the positions of the individual deflection elements, can be associated with the observation phase or the location and guidance phase respectively. Of course it is possible also to use the image signals from the observation phase for the navigation or location and guidance of the flying body. For this, an electrical selection circuit (not shown) can be used. Such a use can be expedient when the flying body that is to be guided is not launched immediately in the vicinity of the guidance station. In this case it must be ensured that the flying body is picked up by the location and guidance equipment as soon as possible after firing.

As a result of the indicated electrical selection circuit, at the start of the flight phase the observation equipment with the larger aperture angle of the field of vision can be used to pick up the flying body and also to guide the flying body towards the line of sight.

CLAIMS

1. A mechanism, for guiding a flying body into a target having observation equipment for target observation and possibly target tracking within a first field of vision as well as with location equipment (or position finder) and guiding equipment for the flying body which determines a second field of vision and which communicates with the flying body by way of a signal connection for transmission of guidance signals, in which the observation equipment as well as the location equipment or position finder and guidance equipment are combined in a guidance station, characterised in that the observation equipment as well as the location and guidance equipment are combined into a thermal image equipment having two optical channels which are associated

with the observation equipment or the location and guidance equipment, in that each optical channel has scanning elements for line form scanning of the fields of vision, associated with the observation equipment or the location and guidance equipment, in elevation and azimuth, and in that the scanning elements for the one scanning direction are arranged on a controlled ray switch which is common to both optical channels and which guides the ray paths from the observation equipment as well as the location and guidance equipment linewise alternately onto a common thermal image receiver.

2. A mechanism as claimed in claim 1, characterised in that the ray switch has a rotating driven polygonal wheel along the periphery of which are arranged deflectors which serve as scanning elements for the one scanning direction, and are inclined towards the radius direction.

3. A mechanism as claimed in claim 2, characterised in that the deflectors of the polygonal wheel all have the same centre angle and the same angle of incidence ($\alpha$) towards the radius direction, and in that the angular position of the axis of rotation of the polygonal wheel is periodically variable, so that the ray paths from the observation equipment as well as the location and guidance equipment are guided linewise alternately onto the common thermal image receiver.

4. A mechanism as claimed in claim 2, characterised in that consecutive deflectors of the polygonal wheel all have the same centre angle, but towards the radius direction have, in each case, oppositely identical angles of incidence ($\alpha$), and in that the polygonal wheel is driven about a fixed axis of rotation which is perpendicular to the radius direction.

5. A mechanism as claimed in any preceding claim characterised in that the optical channels of the observation equipment as well as location and guidance equipment have respectively an input optical system (input telescopes 4, 5), an elevation scanning mirror as well as an intermediate optical system for guiding the associated ray path from the elevation scanning mirror onto the common beam switch.

6. A mechanism as claimed in claim 5, characterised in that the input optical systems of the observation equipment as well as the location and guidance equipment have different focal lengths.

7. A mechanism as claimed in any preceding claim, characterised in that the location and guidance equipment is connectable to the thermal image receiver in the observation phase when the optical channel of the observation equipment is switched onto the thermal image receiver.

8. A mechanism as claimed in any preceding claim characterised in that a sight screen connected to the thermal image receiver is provided for the observation equipment as well as the location and guidance equipment.

9. A mechanism for guiding a flying body into a target substantially as hereinbefore described with reference to and as illustrated in Figs. 1 to 3b or in Fig. 4 of the accompanying drawings.

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