output stage elements 8 is arranged on the airborne part 12b. Each of the output stage elements 8 is connected to an (additional) beam coupling unit 20 using an optical fiber 9 or an optical free beam 9. The individual beam portions of the individual output stage elements 8 are then combined in the beam coupling unit 20 and are forwarded via an optical fiber 9 or an additional optical free beam 9 to a beam optics element 10 for emitting the active beam 22. One embodiment of Figure 4 shows, in particular, a scalable system, since a desired and/or required output power can be achieved through a corresponding adjustment of the number of individual modules.

Figure 3 shows an example of a division of the components of an airborne laser weapon system according to the invention into the ground-based part 12a and the airborne part 12b. In particular, the relatively heavy components of the laser weapon system, such as the generator, cooling elements with cooling fluid, accumulators, pump diodes, beam couplers and the control station for an operator are concentrated and/or arranged in the ground-based part 12a. The relatively lightweight components and/or those that are ultimately necessary for the quality of the laser beam, such as active laser element(s), in particular the output stage(s) thereof, the focusing drive, the telescope, and the necessary sensors can be provided on the airborne platform 12b and can be attached by means of a relatively long, e.g. several kilometers, optical waveguide 18 to the ground-based part 12a. The optical waveguide 18 in this case transmits energy from the ground platform 12a to the air platform 12b and transmits command and control data between base platform 12a and air platform 12b. Those components that are responsible for the ultimate beam quality are preferably provided on the air platform 12b.

However, in the end, the suitability of a laser source that is suitable for a laser weapon system is determined substantially by the mode quality and/or beam divergence, the spectral properties and the optical power thereof. For this reason, in this connection, with 10 kW optical power, for example, the freely available fiber

length is currently less than 2.5 m. It would appear to be difficult to implement a concept for beam transmission according to the concept of an optical waveguide of such short free length that is towed behind an airborne platform.

To avoid the problems presented above, it is proposed to design the structure of a laser weapon system such that only one output stage, which is at the end of the amplification chain of a laser source and ultimately determines the mode quality and/or beam divergence, spectral properties and optical power of the radiation emitted by the laser source, optionally an oscillator which likewise determines the beam properties, and an assigned beam focusing system, which focuses the laser beam that has been generated in this manner onto a target, is arranged offset from the remaining components of the laser weapon system, particularly from the diode pump sources, the ancillary units and the energy storage devices, on the airborne platform that belongs to this weapon system.

With an unmanned airborne platform, the assigned support generally involves a ground-based platform, regardless of whether it is a platform that is located or anchored on land or a vehicle. However, this naturally also does not exclude the possibility of the support being a watercraft, ship or submarine. The output stage described can particularly be a fiber laser, wherein the output stage either again ends in a fiber output of short length or ultimately a free beam is emitted therefrom. However, it is also conceivable for the described output stage to involve a different type of optically pumped laser source, in which the medium is designed as a rod-, slab- or disk laser, or as a number or combination of such geometries, wherein in this case, a free beam is preferably likewise ultimately emitted. In any case, the actual high-powered, high-quality beam that is required for the operation is first generated on board the airborne platform.

It is not absolutely essential for the output stage to contribute substantially to the optical output power of the laser source, that is, to have a power amplification of significantly greater than 1. Rather, an output stage is also conceivable which

largely passively compensates for only the deterioration of beam properties in terms of mode quality and/or beam divergence or the spectral or time-dependent properties of the beam which are caused/occur during transmission from the stages upstream.

It is further noted that the concept is not necessarily limited to the use of a beam source or pump source, and can instead also be transferred to the principle of beam coupling of a plurality of laser sources or pump sources. In this case, a plurality of output stages or a plurality of pump sources are used, which are connected in an equivalent manner via (a plurality of) optical waveguides to the airborne platform.

Applied to a current fiber laser design, an embodiment example is shown in Fig. 4, which can be designed such that the above-described output stage consists of the specified active fiber, with the interfaces consisting of the points specified as B, C and D, which are also characterized in that, in contrast to a classic concept in which the interface consists of the point identified as A, said interfaces are not simultaneously subject to high powers and stringent requirements in terms of transmission behavior. In the present case, an optical waveguide of suitable design and suitable length, e.g. multiple kilometers, may be spliced in at point D, and the base connected to the aerial vehicle in order to reach the intended goal.

Figure 4 shows the schematic structure of active beam generation of a beam focusing unit 4 according to the invention. A seed laser unit 14, which is substantially known from the prior art, has two pump laser diodes in Figure 4, by way of example, and generates with the active fiber and/or the master oscillator a laser beam with the input power for the fiber amplifier downstream and/or an optically pumped fiber 16b. Arranged upstream and downstream of the active fiber of the seed laser unit 14 are fiber Bragg gratings as wavelength-selective fiber reflectors of the fiber-coupled pump laser diodes.

Claims

1. A laser weapon system (2), comprising
at least one laser generating unit (6);
at least one output stage element (8);
a beam optics element (10); and
a ground-based part (12a) and an air-based part (12b);
wherein the ground-based part (12a) is designed at least for generating energy for the laser weapon system (2);
wherein the air-based part (12b) is configured for target acquisition in the laser weapon system (2);
wherein the beam optics element (10) and the at least one output stage element (8) are arranged on the air-based, fully movable part (12b),
wherein an optical fiber (18) provides energy transmission from the ground-based part (12a) to the air-based part (12b) and a communications connection between the ground-based part (12a) and the air-based part (12b),
wherein the output stage element (8) has
a fiber amplifying unit (16b);
wherein a seed laser unit (14) and at least one pump laser unit (16a) is connected to the output stage element (8) by means of at least one optical fiber (18).

2. The laser weapon system (2) according to claim 1, wherein the at least one output stage element (8) is configured to perform at least one function from the group consisting of amplifying the optical output power, conditioning the output beam, and compensating and/or improving mode quality, beam divergence, and spectral and/or time-dependent properties of the output beam.

3. The laser weapon system (2) according to any of the preceding claims, wherein the laser generating unit (6) is designed as a fiber laser.

4. The laser weapon system (2) according to any of the preceding claims, wherein the laser generating unit (6) has

at least one seed laser unit (14);

at least one pump laser unit (16a); and/or

at least one fiber amplifying unit (16b);

wherein the laser generating unit (6) is connected to the output stage element (8) by means of an optical fiber (18).

5. The laser weapon system (2) according to any of the claims 1 to 4, comprising

a plurality of pump laser units (16a);

wherein the plurality of pump laser units (16a) are connected to a beam coupler unit (20); and

wherein the beam coupler unit (20) is connected to the output stage element (8).

6. The laser weapon system (2) according to the preceding claim, comprising

a plurality of pump laser units (16a);

wherein the plurality of pump laser units (16a) is connected to the output stage element (8),

wherein the output stage element (8) has a beam coupler unit (20).

7. The laser weapon system (2) according to any of the preceding claims,

wherein the laser weapon system (2) is designed for aligning an active beam (22) substantially within a half-space; and/or

wherein the dynamic properties of the air-based, fully movable part (12b) of the target acquisition and/or target tracking of the beam optics element (10) of the laser weapon system have

a focusing speed of > 0.1 rad/s, in particular > 0.5 rad/s, more particularly > 1 rad/s, more particularly > 1.5 rad/s, more particularly 2 rad/s; and/or

a focusing acceleration of > 0.1 rad/s^2, in particular > 0.5 rad/s^2, more particularly > 1 rad/s^2, more particularly > 1.5 rad/s^2, more particularly 2 rad/s^2; and/or

a focusing precision of < 20 µrad, in particular < 15 µrad, more particularly < 10 µrad, more particularly < 5 µrad, more particularly < 2 µrad.

8. A laser weapon system (2) according to any of the preceding claims, wherein the connection between output stage element (8) and beam optics element (10) is achieved by means of an optical fiber (9) or an optical free beam (9), wherein the length of the optical fiber or of the optical free beam is < 2.5 m, in particular < 2 m, more particularly < 1.5 m, more particularly < 1 m, more particularly < 0.5 m.

9. The laser weapon system (2) according to any of the preceding claims 1 to 7, wherein the optical fiber (18) has a length of up to 8 km, in particular, up to 7 km, more particularly up to 6 km, more particularly up to 5 km, more particularly up to 4 km, more particularly up to 4 km, more particularly up to 3 km, more particularly up to 2 km, more particularly up to 1 km.