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directive] 光学精密工程 2012, 20(12) 2571-2598 ISSN: 1004-924X CN: 22-1198/TH

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现代应用光学

用于清除水面污染物的移动式气动CO₂激光器

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摘要： 本文介绍的工程项目在于研发一种激光技术来清除大面积海域和其他水面存在的油膜污染物。针对海面严重污染问题,研究了基于喷气发动机的可移动式气动CO₂激光器(100~250 kW)的设计方案及其在清除水面污染时的工程实现。提出的技术方案意在有效弥补传统的海面油膜处理方法只可处理块状油层而无法消除100 μm厚油膜的弊病。文中介绍了可移动式气动CO₂激光器的设计机理,研究了可执行该项工作的不同类型的激光器,证明了选用可移动式气动CO₂激光器执行该项工作的合理性。考虑了激光器系统的供气方案,选择了高质量的喷气发动机作气动CO₂激光器的动力设备并设置了该设备工作时需要的容量。最后,描述了该激光系统气动液压设备的设计方案,给出了相关设备、油箱、和操作控制单元的结构。目前,作者已经完成了用于处理水面油膜的气动CO₂激光器的概念设计,并制备了相应的激光系统。另外,研制了气动CO₂激光器系统的工作平台,通过用激光束扫描石油膜覆盖的水面,实验验证了利用该系统收集油膜和令油膜有效燃烧的可行性。

关键词： 气动CO₂激光器 喷气发动机 水面污染 环境保护

Jet engine based mobile gas dynamic CO₂ laser for water surface cleaning

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Abstract: The purpose of the project presented in the paper is to develop a laser technology to clean large areas of seas and other water surfaces from oil film contamination. It mainly aims development of technological scheme and engineering design of jet engine based mobile Gas Dynamic Lasers (GDLs) (100-250 kW) intended to solve this important problem of environment protection. This method and laser system proposed are expected to complement other traditional methods, which usually more successfully treat bulk layer oil pollution but do not match to eliminate up to 100 μm oil films. In this paper, the basic design concept of a mobile gas dynamic CO₂ laser is introduced, and the possibility of using various types of lasers for solution of required tasks is considered and the selection of GDL is justified. Then, the possible schemes of organization of air supply in the laser installation are considered, and the jet engines are selected as the high quality power unit of GDL installation. The necessary volume of the selected jet engine adaptation/modification experimental works is presented. Finally, the paper describes the design concept of GDL and the pneumohydraulic schematics, and gives structures of the related equipment, fuel tanks and operation control units. Now, the author has completed the conceptual analysis of GDL installation for disposal of petroleum films from a water surface, the basic capability of development of such installation is shown. The basic characteristics of the system are discussed and the schematic and design solutions of basic installation are presented. Furthermore, the GDL platform has been developed and some demonstration operations with scanning beam over water surface covered with petroleum film are carried out. The experiments confirm the effective gathering and burning of oil films on the water surfaces by proposed system.

Keywords: gas dynamic CO₂ laser jet engine water surface pollution environment protection

收稿日期 2012-11-05 修回日期 2012-11-18 网络版发布日期

基金项目:

科技部国际合作资助项目(No.2011DFA50590)

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