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A MOBILE CO_2-LIDAR-SYSTEM FOR THE MONITORING OF HAZARDOUS TRACE GASES IN INDUSTRIAL AREAS

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INTRODUCTION

A compact, tunable CO_2 lidar system for field use has been developed. This instrument will be used to monitor e.g. halogenated ethene, halogenated methane and ozone in the vicinity of industrial areas. The measurement principle is based on the DAS-technique (Differential Absorption Spectroscopy) in the spectral range from 9-11 μm for a distance up to 5 km.

GENERAL CONCEPT

In a first step we are using topographic targets as backscatterers, that means the results of the measurements are concentrations of the detected gas which are integrated over the measurement distance. The first measurements will take place in the end of summer 1994. In a next step a range resolved system is planned to be developed, which should be combined with a FTIR-interferometer as a powerful station for environmental measurements.

TECHNICAL DESCRIPTION

The heart of the lidar is a new double chamber CO_2 laser, which has a very compact construction and which unifies two lasers in one. Both lasers use a common gas volume and can be triggered separately with a pulse repetition rate for each laser of up to 30 Hz. Since the laser is air cooled, auxilary devices such as circulator pumps, cooling hoses etc. are not needed. The resonator consists of the discharge chamber, two gratings (135 grooves/mm) for the spectral tuning and two high reflective output couplers (R=80%, f=10m). The length of the resonator is 0.7 m . The two laser beams are s-polarized and they are combined by a special mirror construction. The technical details of the lidar system are shown in table 1.

The whole system can be operated with a LCD-touchscreen (64 sensible fields), which is integrated in an industrial PC (VME bus). Therefore it is not necessary to use a keyboard or a screen to run the lidar. The results of the measurements can also be shown on the LCD-screen.

INNOVATIONS

In comparison to other lidar systems our device is remarkably smaller and lighter, as shown in fig. 1. The compact size of the system makes the use and handling easier. It increases the mobility and leads to a shorter time of access to measurement results.

The concept of combining the CO_2 lidar system and a FTIR interferometer would unite in a useful way the analytical capability of a FTIR (complete spectral coverage from 2 μm up to about 15 μm) and the possibilities of operating a CO_2 lidar system (active sounding).

Laser:	
Configuration:	CO_2 -TEA laser with two parallel discharge sections
Pulse energy :	> 220 mJ (10P20) > 60 mJ (9R38-10P38)
Spectral range:	9.18 - 10.79 µm
Energy distribution (peak/tail):	> 45 % / 55 %
Energy variation:	< 10 %
Pulse duration:	50 ns (FWHM)
Mode:	TEM_{10}
PRF(continiuous mode):	2 x 30 Hz
Beam divergence laser:	5 mrad
Beam expander:	x 10
Cooling:	air cooling
Gas regeneration:	internal catalyst
Electrical supply:	220 V, 50 Hz, 1500 VA
Optical receiver:	
Aperture of the receiver telescope:	300 mm
Focal length:	600 mm
Detector:	MCT with Joule-Thompson-Cooler
Electronics:	
Main computer:	Industrial PC (IP 54)
CPU:	68030
Bus structure:	VME-standard
Data conversion:	Multi-Channel ADC
Data I/O:	LCD-touchscreen, 3.5" disk, RS 232

Table 1: Technical details of the lidar system.

PREVIEW

Present technical possibilities already allow the construction of a new generation of CO_2 lidar systems, as shown in fig. 2. The size is further reduced and the main emphasis here is put on the ergonomic operation of the lidar, a point that is generally hardly addressed today. This makes only sense if the technical problems of such a complex system are solved. Our next step will be the construction of a system as shown in fig. 2, where we want to use the experience gained from the operation of the system in fig. 1.

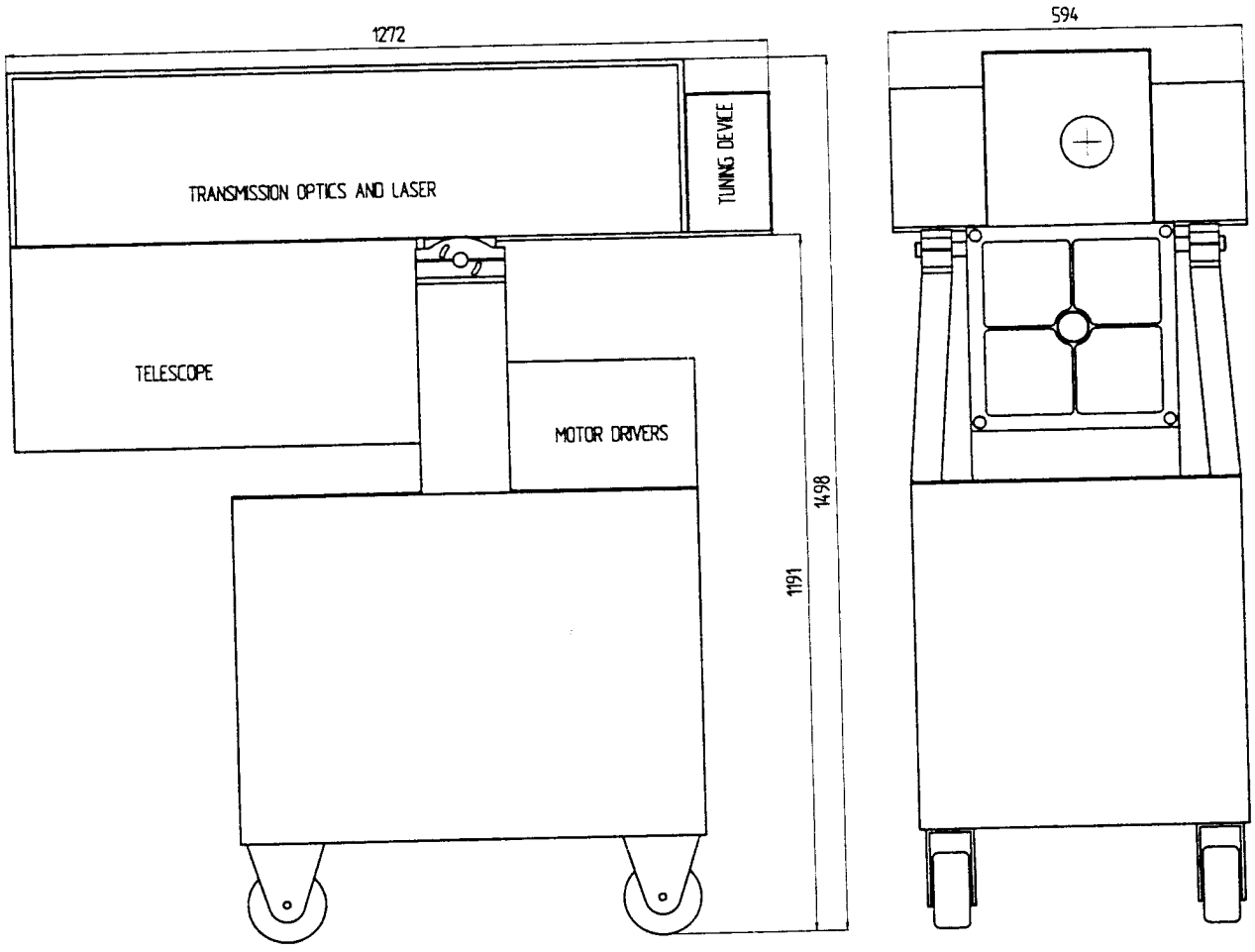

Fig. 1: CO_2-Lidar-System.

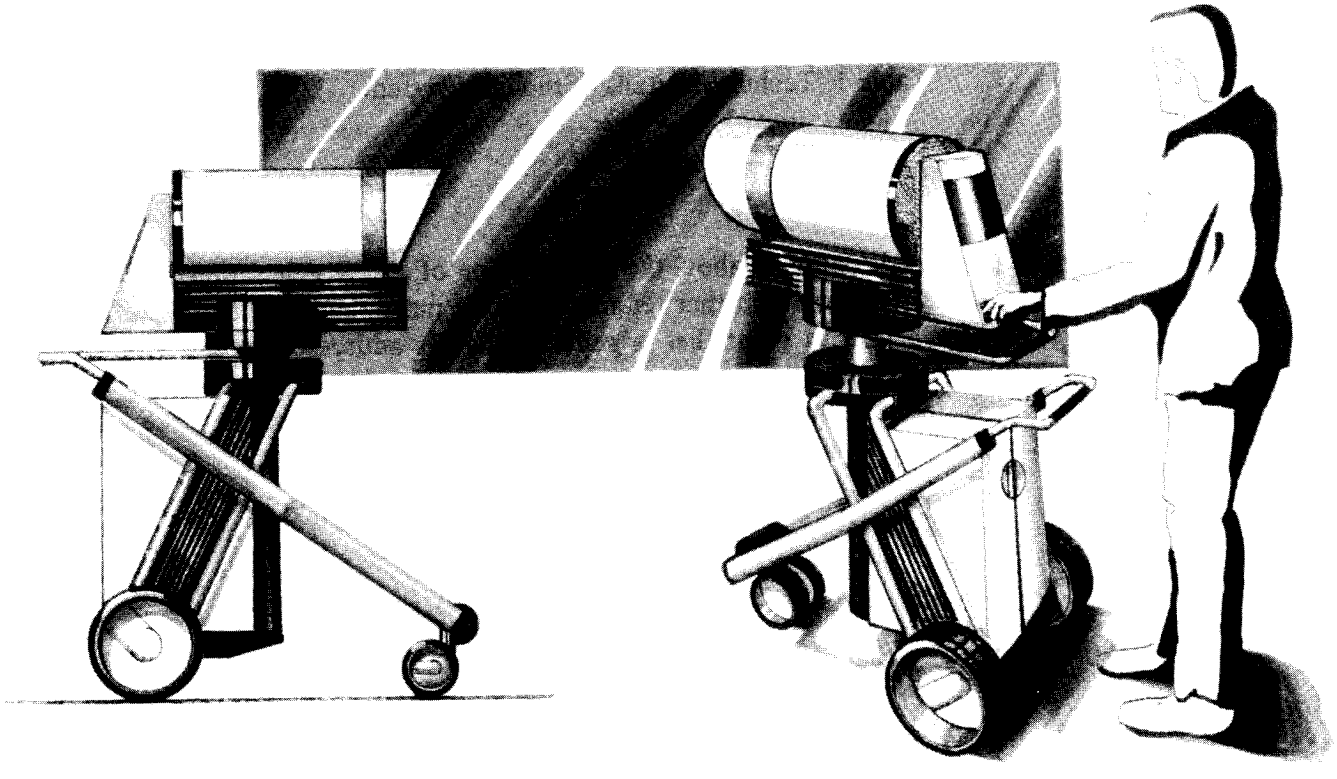

Fig. 2: Ergonomic CO_2-Lidar-System