27
5-6-77
25 copy to NTIS

UCID- 17441

Lawrence Livermore Laboratory

ARGUS GLASS LASER TARGET ALIGNMENT SYSTEM

Ted C. Stewart

April 13, 1977

This is an informal report intended primarily for internal or limited external distribution. The opinions and conclusions stated are those of the author and may or may not be those of the laboratory.

Prepared for U.S. Energy Research & Development Administration under contract No. W-7405-Eng-48.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

ARGUS GLASS LASER TARGET ALIGNMENT SYSTEM

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

ABSTRACT

Proper laser infrared irradiation of ball targets 10 to 100 μ m in diameter requires micrometre-step positioning of the system's optical elements. A central control console has been designed that gives the operator nearly complete control of this complex operation. Twin alignment lasers can be operated from the console. Devices can be inserted in the beam lines, mirrors moved, and the target ball aligned, all with fine precision. The focus position can be viewed by closed-circuit TV monitors; disk recording of the TV waveforms is available. The main capacitor banks can be charged for rod shots. Communications with laser operators can be maintained by intercom or radio, and video signals can be sent to remote areas. The console has been instrumental in saving many hours of manual labor.

INTRODUCTION

The Argus glass laser system generates two beams that travel parallel to each other, separated by 10 m. During their final 8.7 m of travel, the beams are partitioned off to allow diagnostics alignment without interfering with the initial laser adjustment. To facilitate alignment, various devices — cross hairs, diffusers, opaque plates, neutral density films, etc. — are inserted in the beam line. Most of these devices are positioned by air-operated cylinders. Mirrors, lenses, and the target positioner require motor drive for positioning with positive indication of movement and final location. The central console is designed to control all these operations.

CONTROL OF BEAM-LINE DEVICES

We use two types of air-operated devices. The first, shown in Fig. 1, raises the selected device into the beam line and operates a microswitch to give positive indication of its actuation. The other, shown in Fig. 2, raises the device by air piston in response to a switched solenoid that admits air into the piston chamber. Electrical control is maintained by 46 toggle

Fig. 1. This positioner raises device into beam line and operates a microswitch to give positive indication of its actuation.

Fig. 2. This positioner raises device by air piston in response to switched solenoid that admits air to cylinder.

switches and 90 indicators — red and amber light-emitting diodes (LED's) — on a control map at the front of the target chamber (see Fig. 3). The map shows the two beams from entry into their partitioned paths to the center of the chamber. Also shown are the beam diagnostic paths. All switches and lights are in the relative positions of the controlled devices. The source voltage is 24 V dc. Amber lights are located in the beam line, with green lights beside them.

CONTROL OF STEPPING MOTORS

For driving the devices, we have chosen a pulsed stepping motor with the following characteristics: step angle 1.8° , permanent magnet, four-phase-drive 12 V dc, torque 40 in.-oz. At this writing, all motors are of this type. LLL stock printed-circuit boards perform the motor drive commutation and translator functions. We devised a special circuit board (LEA 75-1276-04E) for basic drive generation.

A basic oscillator package was designed using an integrated circuit (IC) NE555 timer. The typical 50-ms transistor-transistor logic (TTL) output is fed to a 7404 hexinverter. This output drives an IC 9601 multivibrator, supplying an 800-ms slow-speed pulse. Speed selection is accomplished by a lever switch specially modified to allow the choice of either pulse train. Also available are reverse, slow, or fast pulsing, depending on right or left motion of the switch. To minimize heat production, the motor field potential is automatically switched off by another 9601, 1.9 s after termination of the movement.

For some operations, the stepping motor must move a device 1 or 2 μm with minimum vibration. For others, fast speeds geared down to smooth travel are needed. To prevent damage to optical mounts, lenses, and other components, limit switches are incorporated on all devices as necessary. These normally-open microswitches transmit TTL highs back to the pulse generation section by means of relays. The motors and associated drive electronics have proved very reliable.

The most precise application of the stepping-motor system is for driving the 60-cm-long support rods on which the targets are mounted. For this operation we use stepping motors in three axes. In first lowering the target,

Fig. 3. Argus control map layout.

we must vary the frequency of the drive pulses (altering the resonances of the motor drives and gears) to minimize vibration. This is done for all three axes by adjustments at the control panel.

POSITION READOUT SYSTEM

Because the stepping motor has no feedback mechanism in itself, we have discarded plans to drive the motors with predetermined pulse bursts. (In event of a power failure or other shutdown, the desired positions could be compromised.) Instead, as our sensor for position indication of travel, we have chosen the LVDT (linear voltage displacement transformer). This sensor requires only cigar-size space at the device location. It is built as a transformer whose primary is supplied with an ac sine-wave excitation. Two identical secondaries symmetrically spaced from the primary are connected in a series opposing circuit. Motion of the noncontracting core varies the mutual inductance of the primary to the secondaries, creating a null when exactly centered. At this point the induced electromagnetic forces are 180° out of phase, generating no net output. Any movement generates an emf that is essentially a linear function of displacement.

These sensors are used in all positions needing constant monitoring of position. Their output is 2 mV per 0.001 in.; the standard maximum displacement is 0.078 in. This computes to 2000 μ m and a maximum output of 156 mV. The low-level signal is amplified and fed to digital panel meters that indicate displacement directly in micrometres.

The system provides constant on-line evaluation of the driving system. Green LED readouts are used in the panel meters because red is too greatly attenuated by laser goggles.

CONTROL CONSOLE

The alignment of converging laser beams onto a small target requires many precise measurements and operations. The control console (Fig. 4) has been designed to facilitate these with maximum efficiency. One panel controls 50 devices for modifying, limiting, or stopping the beams. Another operates the stepping motors that position the mirrors. This same panel operates the target-holding device in three axes. Two other panels, identical to each

Fig. 4. Argus target diagnostics console. At the left are the disk and ILEX control, the scan analyzer, and the video indicator switches. In the center beneath the closed-circuit TV monitors, are the mirror controls, the control map, and the lens-position controls. At the right are the pendant, dual holobeam monitors, and intercom.

other, contain lever switches and digital panel meters for 10 lens-positioning motors.

Closed-circuit TV plays an important role in the overall system by providing visual display for focusing, lens positioning, and target positioning. The console allows a mix of views from different cameras to any of three panel monitors or two roving monitors on carts. If quantitative video data are needed, the data are stored on a disk recorder and then evaluated by a video waveform monitor. This monitor, as well as all matrix video switching, is immediately available to the operator. The disk recorder also supplies stored display (single frame) of any selected video input. Radio and intercom are available for communication during alignment and operation. Finally, the console provides space for interconnecting all the above distribution cables and junction boxes throughout the target diagnostics area.

ACKNOWLEDGMENTS

Basic design responsibility of the lens-positioning system was given to the writer. Acknowledgment for contributions is made to John Severyn for the closed-circuit TV system, to Don Holeman for coordinating supply and fabrication, to Don Campbell for project management, and to the many people who pulled cables, wired chassis, and performed other important but unglamorous jobs.

CSM/ck/vt/mla

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research & Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately-owned rights.

NOTICE

Reference to a company or product name does not imply approval or recommendation of the product by the University of California or the U.S. Energy Research & Development Administration to the exclusion of others that may be suitable.

Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Price: Printed Copy \$; Microfiche \$3.00

<u>Page Range</u>	<u>Domestic Price</u>	<u>Page Range</u>	<u>Domestic Price</u>
001-025	\$ 3.50	326-350	10.00
026-050	4.00	351-375	10.50
051-075	4.50	376-400	10.75
076-100	5.00	401-425	11.00
101-125	5.50	426-450	11.75
126-150	6.00	451-475	12.00
151-175	6.75	476-500	12.50
176-200	7.50	501-525	12.75
201-225	7.75	526-550	13.00
226-250	8.00	551-575	13.50
251-275	9.00	576-600	13.75
276-300	9.25	601-up	*
301-325	9.75		

*Add \$2.50 for each additional 100 page increment from 601 to 1,000 pages;
add \$4.50 for each additional 100 page increment over 1,000 pages.

Technical Information Department

LAWRENCE LIVERMORE LABORATORY

University of California | Livermore, California | 94550