

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
1 March 2001 (01.03.2001)

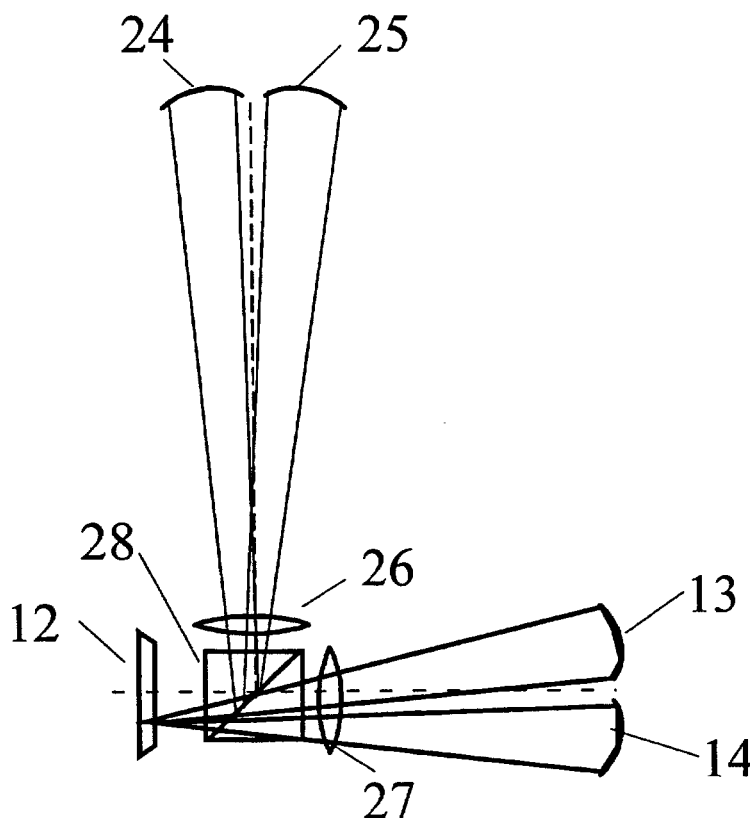
PCT

(10) International Publication Number
WO 01/14924 A1

- (51) International Patent Classification⁷: **G02F 1/03**
- (21) International Application Number: **PCT/US00/23361**
- (22) International Filing Date: **25 August 2000 (25.08.2000)**
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:
60/150,889 26 August 1999 (26.08.1999) US
Not furnished 24 August 2000 (24.08.2000) US
- (71) Applicant: **THE OHIO STATE UNIVERSITY**
[US/US]; 1960 Kenny Road, Columbus, OH 43210-1063 (US).
- (72) Inventors: **COLLINS, Stuart, A.**; 6661 Guyer Street, Worthington, OH 43085 (US). **ANDERSON, Betty, Lise**; 200 Glenhurst Court, Gahanna, OH 43230 (US).
- (74) Agents: **GILCREST, Roger, A.** et al.; Standley & Gilcrest LLP, Suite 210, 495 Metro Place South, Dublin, OH 43017 (US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— With international search report.

[Continued on next page]

(54) Title: **DEVICE FOR PRODUCING OPTICALLY-CONTROLLED INCREMENTAL TIME DELAYS**



(57) Abstract: The present invention includes time delay devices and time delay systems. The invention also includes machines and instruments using those aspects of the invention. The invention may also be used to upgrade, repair, or retrofit existing machines or instruments, using methods and components known in the art. The present invention comprises a true time device that falls into the free-space category but uses a multiple-pass optical cell with a beam splitter (28) and refocusing mirrors (13, 14, 24, 25) that have the advantage of avoiding beam spreading problems. The approach differs from previous free-space approaches in that it uses only one optical switch or spatial light modulator (12) instead of one or more switches for each bit. In one approach, a microwave signal for each antenna element may be modulated onto an optical beam. After the individual optical beams are delayed by the desired amount of time through the system, the signal may then be down-converted to microwave signals for further processing. This process may be used in either the transmit or the receive mode of a phased array radar.



WO 01/14924 A1



— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.