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United States Patent [19]

Rieger et al.

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[54] **LOW COST, HIGH AVERAGE POWER, HIGH BRIGHTNESS SOLID STATE LASER**

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[58] **Field of Search** 372/25, 18, 5, 12, 13, 372/22, 30, 31, 70, 75, 69

[56] **References Cited**

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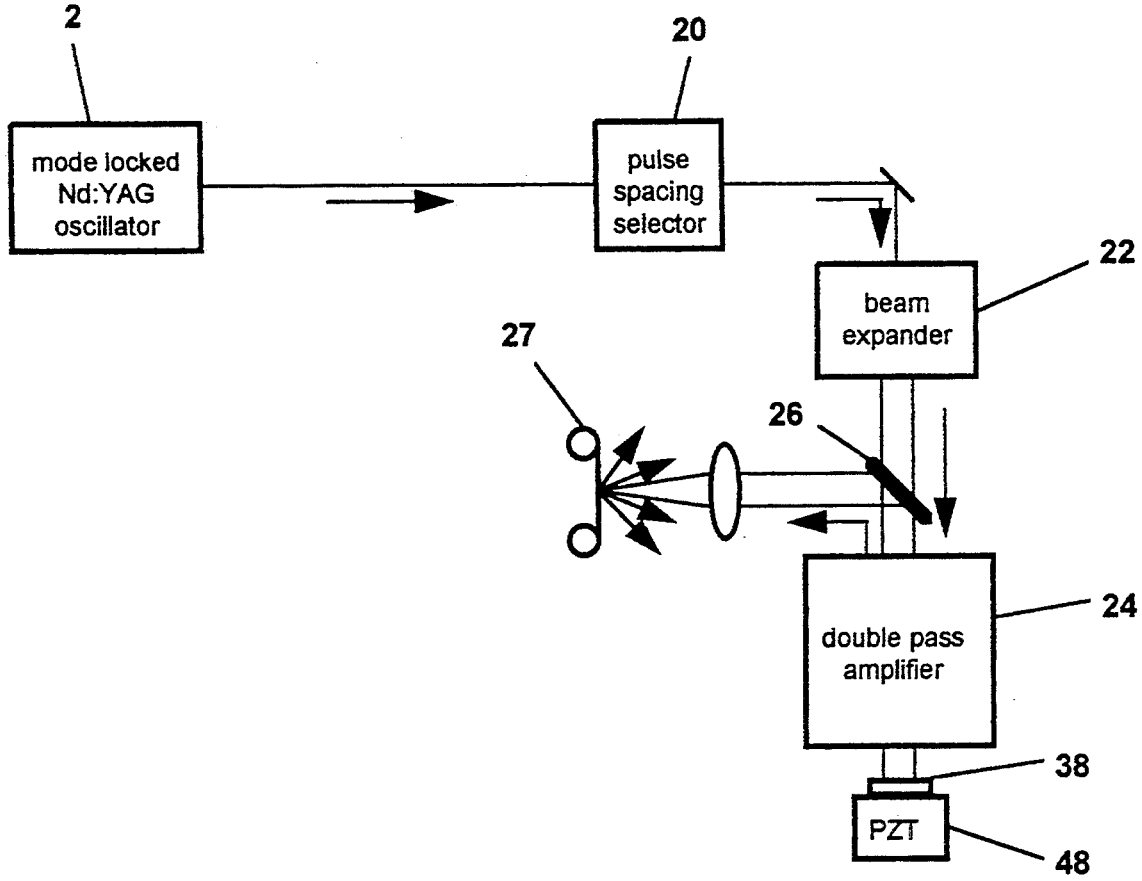
[57] **ABSTRACT**

A high average power, high brightness solid state laser system. A laser produces a first pulse laser beam with a high pulse frequency. A pulse spacing selector removes from the first pulse laser beam more than 80 percent of the pulses to produce a second pulse laser beam having a series of periodically spaced short pulses in excess of 1,000 pulses per second. A laser amplifier amplifies the second pulse train to produce an amplified pulse laser beam which is focused to produce pulses with brightness levels in excess of 10^{11} Watts/cm^2. A preferred embodiment produces an amplified pulse laser beam having an average power in the range of 1 KW, an average pulse frequency of 12,000 pulses per second with pulses having brightness levels in excess of 10^{14} Watts/cm^2 at a 20 μm diameter spot which is steered rapidly to simulate a larger spot size. These beams are useful in producing X-ray sources for lithography.

As compared with prior art high brightness lasers, we have reduced the pulse duration by about 2 or 3 orders of magnitude, from a few ns to 100 ps or less. We achieve our very high brightness by focusing on a very small spot, but we are able to simulate a much larger spot by very rapidly steering our high average power beam over the area we need.

22 Claims, 4 Drawing Sheets