

피부질환을 위한 CO₂ 레이저의 공극차이에 따른 동작출력 변화에 관한 연구

**Special quality research about action output waveform change by gap (1.0mm and 1.6mm)
difference of CO₂ laser for skin disease**

Kim Whi Young

Dongju College, Biomedical Engineering

Abstract – Laser wave length can have evaporation effect by absorption because outer skin or tissue of focus is consisted of water almost though absorption of water occurs more than 90% almost in formation thickness of very thin floor. Can operate outer skin, steam by floor and correct incision of formation is available. Suture surgical operation is available to vein or lymph system and surgical operation region can dry and see as eye and radish bleeding surgical operation is available. Specially, stability of tube both end output about pulse by weight very, this research can cause various curative effect because can reduce bulk and control easily current wave style of medical laser using electric power conversion device of high frequency way. If introduce ZVS (Zero Voltage Switching) or ZVZCS (Zero Voltage and Zero Current Switching), is more profitable because can reduce switching damage. Because electric power department of proposed medical laser can do stable soft-switching in wide subordinate extent introducing ZVZCS technique by the first help and control department composes microcontroller, output current waveform user have free form make . Result that experiment because design and manufacture, brought result that improve of 20% than existing equipment, and will be bought to get into superior result if supplement as systematic late.

Key Words : Laser, wave length, absorption, water

1. Introduction

Though can apply thermal action of beam and cellular tissue in skin treatment, leading person who is optic enemy of skin such as absorption or scattering is affinity in stable conclusion of state examination of laser beam, and various component of cellular tissue can accomplish interaction with beam and cell by selection of different laser kind. Skin does defense function in body and have relation of temperature control with outside through nervous system, nerve class. Laser wave length can have evaporation effect by absorption because outer skin or tissue of focus is consisted of water almost though absorption of water occurs more than 90% almost in formation thickness of very thin floor. Can operate outer skin, steam by floor and correct incision of formation is available. Suture surgical operation is available to vein or lymph system and surgical operation region can dry and see as eye and radish bleeding surgical operation is available. Specially, stability of tube both end output about pulse by weight very, this research can cause various curative effect because can reduce bulk and control easily current waveform of medical laser using electric power inverter of high frequency way. If introduce ZVS (Zero Voltage Switching) or ZVZCS (Zero Voltage and Zero Current Switching), is more profitable because can reduce

switching damage.

2. Main

It is important first of all that understand in establishment to use medical laser for rehalitation treatment by war how beam is transmited. Because formation's constituent is complicated, it is very difficult work to expect century distribution of beam. Dispersion that influence in propagation of beam beside thing that absorption of laser beam occurs in establishment begins, because of refraction coefficient that is not equal of formation, is dispersion begins extremely. Happen as angle and century of laying eggs beam are related topology and size of laying eggs center and laying eggs is small relatively molecule of 1/10 degree size of beam wave length or small particle and laying eggs is polarized.

$$dBA / dX = - \sum A XB \text{ -----(1)}$$

When is absorption, scattering, thickness dX, beam century B, absorption century dBA, is same with way (1), laying eggs coefficient

$$dBC / dX = - \sum C XB \text{ -----(2)}$$

Way (3), century of beam is expressing conjunction of scattering and absorption coefficient in way (4)

* 김휘영 : 동주대학 의료기공학과

$$\sum F = \sum A \oplus \sum C \text{ -----(3)}$$

B emanates to space by spread because photon is laid eggs strongly in establishment as power density of entering a company beam. Therefore, space power density has density that spread to wide space in small place. Decrease of space power density by formation's depth expression does possibility by real laying eggs calculation and reciprocal for this cost goes and number transmission of beam deeply.

$$\delta = 1 / \sum Cf \text{ -----(4)}$$

3. Design and embodiment of system

-Though load current of designed skin excessive expense laser is controlled by DC/DC converter, DC/DC converter is composed laying stress on full bridge inverter with figure 2 Right side pole (or lagging leg) of this inverter acts by ZVS (Zero Voltage Switching) and middle pole (leading leg) acts by ZCS (Zero Current Switching).

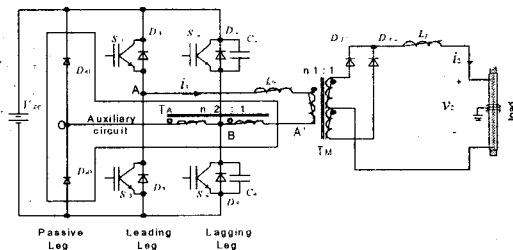


Fig. 1 Schematic diagram of skin excessive expense CO₂ laser that propose

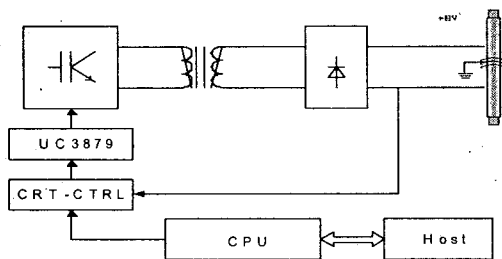


Fig. 2 Control Part hitch

Right side pole of inverter by Lk, C2, C4 relationship help ZVS action and real situation pole by assistance inning by help ZCS action do. Left side pole (passive pole) is used with assistance and is acted passively according to transformer the first current. If the first current is plus direction, DA3 is, and if is minus direction, DA1 becomes on. ZVS or ZCS does to reduce greatly switching damage of switching element and can heighten action frequency. Voltage of inverter that act by ZV-ZCS are controlled by status change (phase-shift). Uni trode company's

UC3879 of status change and spiritual enlightenment order of switch element decides. Make level direct current because there are diode stoppage circuit and filter inductor to the second of transformer.

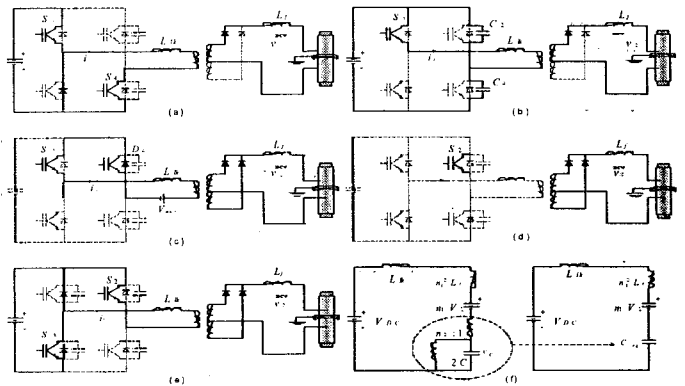


Fig. 3 Control Part hitch

Occurrence department receives issue number of a periodical in high position system through series communication though was composed laying stress on microprocessor. Digital current order that is given by CPU is made by analog through D/A converter. Current controller is consisted of analog controller (error amplifier) and Unitorde company's UC3879. Comparison and compensation with current order and actuality current do in analog controller and UC3879 controls PWM accordingly. Action state of skin excessive expense laser is transmitted by high position computer through series communication. ZV-ZCS action of inverter is explained in waveform of figure 2 - 5. After current becomes "0" by step that remove current that Mode 3 of (c) passes to transformer the first by reset voltage by assistance inning, S1 becomes ZCS off if put out S1. Assistance transformer the second is linked in dc through DA3 and D2 for this section and dc voltage are approved adversely to the first through assistance transformer. Laser beam can converge on microscopic part as is easy because is monochrome, and thin stamen is achieved because taking advantage of this prognostication.

$$\text{Cycle time (T)} = \text{ON time} + \text{OFF time} \text{ ----- (1)}$$

Time that it is known that this time is all time (On-time) and laser malfunctions during cycle of all time and off time is continued when time that laser operates within cycle is continued. Efficiency does that (duty cycle) expresses ratio between all time and total cycle by percent.

$$\text{Duty cycle (\%)} = \text{On time} / T \times 100 \text{ - (2)}$$

Maximum output voltage (P peak) is being supplied maximum output while laser emits, and average output voltage (P av) expresses mean value of output that occur while laser emits, pulse width (r) as continue that pulse width at way point of maximum output from this part all time (ON time), off time (OFF time), efficiency terminologies such as (duty cycle) are thing about laser operation mode cell exposure mode be. To change by average

output in rated power (constant peak power) by this way, efficiency (duty cycle) according to this adjust must . In general cycle function the most resemblant equation

$$P_{av} = P_{peak} \times \tau \times f \text{-----} (3)$$

Average output can control by alter maximum output or synthesize and change pulse width, pulse frequency or these parameter. Change of input voltage by subordinate change balds by single phase interchange voltage regulator did so that can regulate, and pulse transformer union degree of the first, the second superior ferrite core (TDK3415) use. By winding of the first $\phi 0.55$'s enamel 56 turns close, and the second $\phi 0.2$'s enamel by 1430 turns use .As measured by digital LCR Meter (HUNG CHANG company Model Name Z216s), inductance worth of the first was 37 [mH], and the second was 21 [H].

4. Experiment result

Is expressing laser output special quality by the pulse repeat rate schedule pressure and schedule gas mixture ratio (CO₂ : N₂ : He = 1 : 3 : 10, 1 : 1.5 : 5, 1 : 9 : 15). Each experiment data is marking mean value with wave that experiment. Output reached in outside in 700Hz beginning departure in 100Hz, and specially gas mixture ratio CO₂ : N₂ : Got maximum 20.5 W in He = 1 : 9 : 15, working pressure 15 Torr. This time, because electricity input that measure by single phase interchange wattmeter (Hwashin company Model Name 7013) was about 260 W, output efficiency about whole electrical input becomes about 8%.

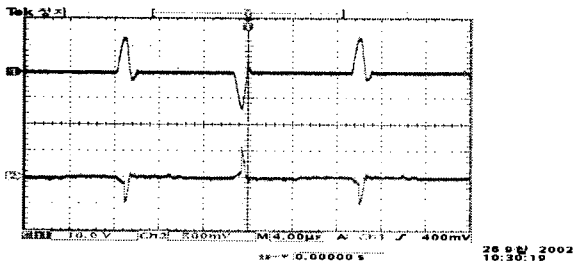


Fig. 4 gap 1mm 1's 22T, 2's 528T CW

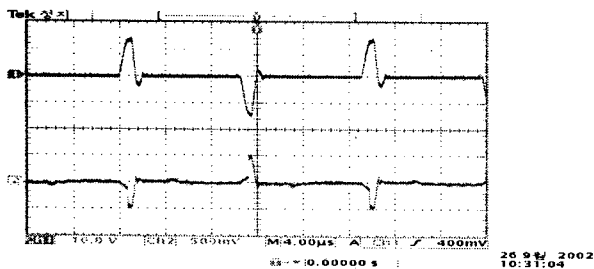


Fig. 5 gap 1mm 1's 25T, 2's 528T CW

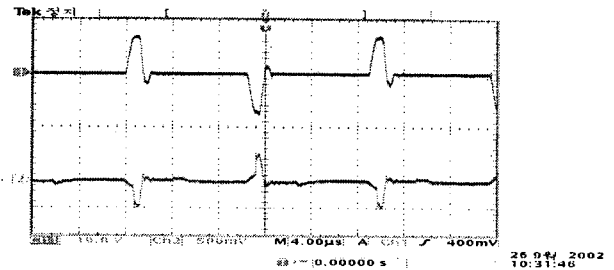


Fig. 6 gap 1mm 1's 28T, 2's 528T CW

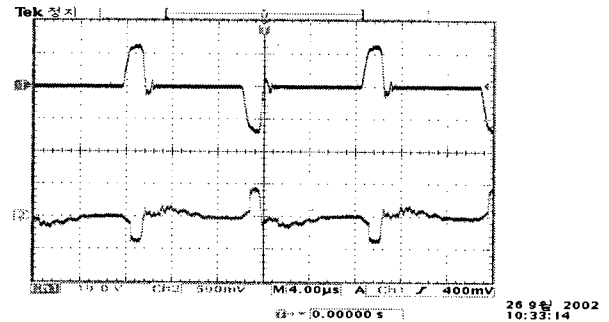


Fig. 7 gap 1mm 1's 30T, 2's 528T CW

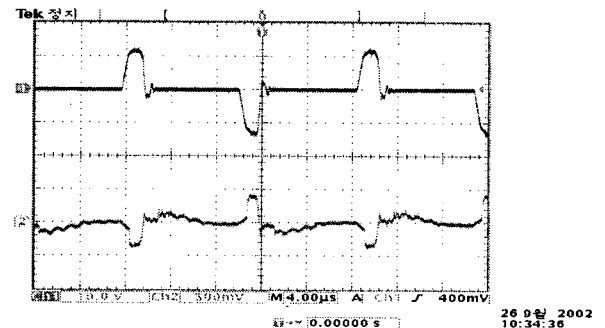


Fig. 8 gap 1mm 1's 33T, 2's 528T CW

5. Conclusion

Developed high repetition pulse style CO₂ laser device of new way because do to graft together number ten k high tension pulse power device that use suitable IGBT in switching of Hz to laser resonator coming high voltage, high frequency to develop economical and compact pulse style CO₂ laser that have the 1kHz nearby pulse repeat rate. Gas mixture ratio of completed device, the pulse repeat rate, gas mixture ratio CO₂ through a laser output special quality experiment by working pressure : N₂ : Achieved maximum laser output about 20.5 W, maximum efficiency about 8% in He = 1 : 9 : 15, pulse repeat rate 700Hz, working pressure 15 Torr. Here after, is expected to expect higher output if apply high speed gas circulation way improving some of resonator system.

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