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피부질환을 위한 CO_2 레이저의 공극 (1.0mm 및 1.6mm)차이에 따른 동작출력 파형변화에 관한 특성연구

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Special quality research about action output waveform change by gap (1.0mm and 1.6mm) difference of CO_2 laser for skin disease

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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.

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 interatction 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. 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 .

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. Visible ray or infrared rays area dispersion begins much than absorption in establishment and photon passes through several reconsideration laying eggs processes before is assimilated. Need absorption, laying eggs coefficient to express special quality formation's optic enemy.

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

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

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

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

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

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.

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

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).

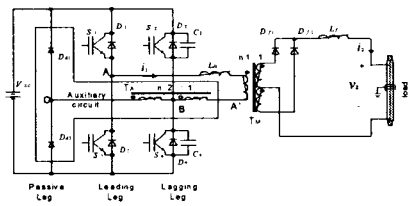

Fig. 1 Schematic diagram of skin excessive expense CO_2 laser that prop ose

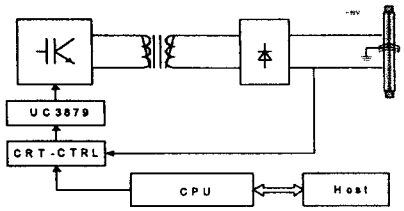

Fig. 2 Control Part hitch

Right side pole of inverter by Llk, 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. This skin excessive expense laser can be used in skin excessive expense laser of constant current system basically and pulse current check and user justice current (piecewise linear) waveform check are available. Skin excessive expense laser relationship controller is consisted with figure 2 - 2. Is divided at current control with current order occurrence department greatly.

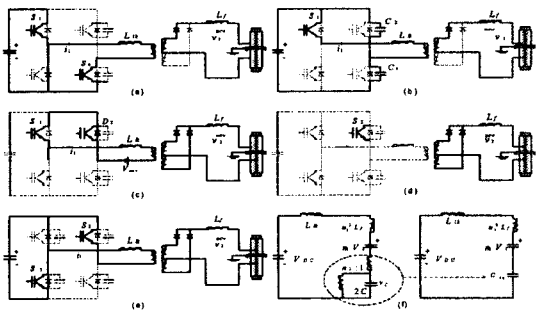

Fig. 3 Control Part hitch

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 Unitrode 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 transmited by high position computer through series communication. Used high frequency ac from power to transmit electric power by skin excessive expense laser tube and high frequency interchange breeds by high frequency inverter. Inverter circuit composed by IGBT with figure 2 - 1. Output of this inverter is passed in load side through transformer. .If heighten frequency to heighten action frequency to shorten size of transformer, switching damage grows. This research used clean bright atmosphere voltage/marks of honor kind (ZV-ZCS : Zero Voltage and Zero Current Switching) technology to reduce switching damage. Because both end voltage of on/off city switch element of switch element are "0" in ZVS, electric power damage decreases and on/off of flowing current consists in "" state on switch element in ZCS and electric power damage at switching decreases. Inverter generates interchange via process such as figure 2 - 4. ZV-ZCS action of inverter is explained in waveform of figure 2 - 5. Figure 2 - 4 of(a) of mode 1 S1 be, military strength is early state to 2 roads supplied section in transformer the first S4 element is lighted. Mode2 of (b) S4 because turn off to begun resonance section S4's ZVS off consist . If voltage of B point arrive on top portion advance guard of dc, S4's ZVS off is completed. Practical equivalent circuit is same with picture (f) that picture (b) omits part for conveniences sake by assistance inning. 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. By next time, all photons of interference (coherence) agree space and time sacred ground. Vitality medium of laser gas, liquid, solid what possible. ost gas laser consists because atom or small molecule or atom or molecule is mixed. rchaism laser is composed by atom that include in archaism matrix or ion. Liquid laser consists of numerator of old tomb self-examination weight that is smelted in liquid. ll materials are lain in the unstable state lowering by population inversion (population inversion) in particular pumping state, lacteal gland energy is emited in peculiar wave length special quality of vitality whipping by this result. CO ₂ laser tube sealed up within DREAM PULSE laser appliance is built-in. Used vitality medium consists of gas mixture. Gas mixture has electrode and is built-in inside glass laser tube. Because whole system divides greatly, resonator and pulse is composed, and do number cold storage all by device, do gas supply chapter, there is vacuum pump and manometer etc. As see in figure 2 - 1 in this research, discharge respect for the old and optical axis selected equal domestic animals style and plano-concave resonator. If momentary complete work kind passes to discharge tube, pressure difference occurs cathode of discharge tube and anode.

Cycle time (T) = ON time + OFF time ------ (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.

Duty cycle (%) = On time 100/T - (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 × 'τ ×' f ---------- (3)

Average output can control by alter maximum output or synthesize and change pulse width, pulse frequency or these parameter.

When do not select supermarket pulse laser operation mode, series welsh onion laser operation mode is goosed at early. In this mode, series welsh onion laser beam is displayed within output extent between 0.5 - 30 W. Specially, cell exposure mode regulates form of laser beam passed continuously to establishment, robber who laser comes inside of skin A ~ by 8 steps that led to H make . Composed by continus, single pulse, repeat pulse three ways in cell exposure mode. In single pulse cell exposure mode, until laser beam applies function that is set already or remove feet in foot switch, what one emits by single pulse (dissolution in continuous wave laser operation mode) by emits by single burst (dissolution in super pulse laser operation mode) during two. Specification of system that compose in this experiment is as

following. Stoppage department is consisted of condenser for up transformer, inrush current limitation and single phase bridge diode rectifier, archery practice bow. 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 ϕ0.55's enamel 56 turns close, and the second ϕ0.2'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].

Therefore, winding ratio a of transformer that manufacture design could know the first, elegy of transformer of the second about 1 : 25 last of the 24 hour period as about 25. Control laser output inclusively with power department and at the same time do interface with Ip·output's watch and outside processor and designed control department so that necessary laser beam, target lighting and monitor ring system, Interock with surrounding parts etc.. may handle at the same time in whole action. Also, had comparator circuit and so on for arithmetic circuit, interface baud, laser beam drive and power for direction lighting, Interock and TC for real time input of MPFN (Modified Pulse Forming Network) of detailed action/output monitor square, and linking each part each other the laser pulse repeat rate through keyboard of computer from 100㎐ to 1㎑ freely adjustable .

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 700㎐ beginning departure in 100㎐, and specially gas mixture ratio CO2 : N2 : Got maximum 20.5 W in He = 1 : 9 : 15, working pressure 15 Torrs. 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%. According as the repeat rate increases, laser output is increasing but decreases gradually from the increase width 500㎐ and 900㎐ can know that the output is decreasing quantity in 700㎐. Because though output got saturated in pulse repeat rate 700㎐, this if the repeat rate increases, input energy is augmented and accordingly because electron density of discharge within the jurisdiction rises, the pumping rate increases as high position sub-officer and density reversal is grown, output increases. According as increase the pulse repeat rate, because electricity input is grown, gaseous temperature zooms from discharge tube center. If gaseous temperature is ascending, bring decrease of high position sub-officer density because the attenuation rate by collision in high position laser sub-officer increases rapidly, and because thermal density of low rank sub-officer increases relatively, density reversal is disappeared. Because gas temperature invincible effect becomes overbearingly gradually although in childhood that increase the repeat rate, density reversal and gains increase, show decrease of output.

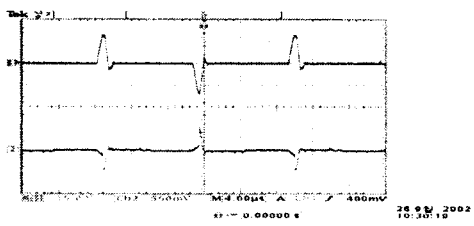

Fig. 4 gap 1mm 1's 22T, 2's 528T CW

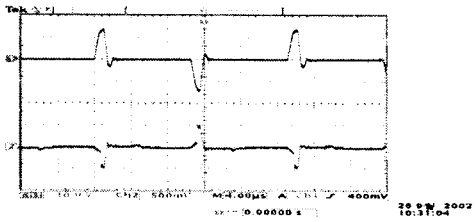

Fig. 5 gap 1mm 1's 25T, 2's 528T CW

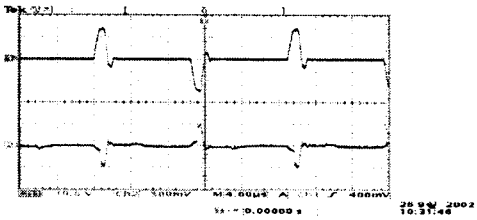

Fig. 6 gap 1mm 1's 28T, 2's 528T CW

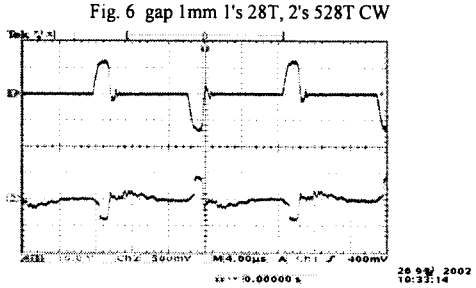

Fig. 7 gap 1mm 1's 30T, 2's 528T CW

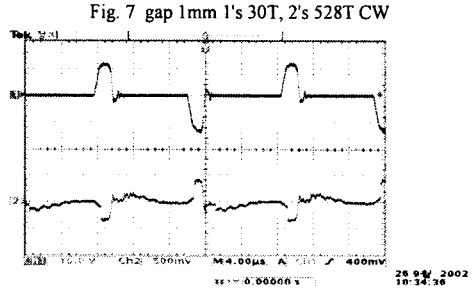

Fig. 8 gap 1mm 1's 33T, 2's 528T CW

5. Conclusion

Developed high repetition pulse style CO_2 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 ㎑ to laser resonator coming high voltage, high frequency to develop economical and compact pulse style CO_2 laser that have the 1㎑ nearby pulse repeat rate. Gas mixture ratio of completed device, the pulse repeat rate, gas mixture ratio CO_2 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 700 ㎐, working pressure 15 Torrs. Here after, is expected to expect higher output if apply high speed gas circulation way improving some of resonator system.

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