

산부인과 펄스형 CO₂ 레이저의 펄스모듈 특성에 의한 동작파형의 일정한 시스템의 구현

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Fixed system of action waveform by pulse module special quality of obstetrics and gynecology pulse style CO₂ laser relationship embodiment

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Abstract - CO₂ laser sees that is most suitable to get this effect through minimum formation damage and advantage that is root enemy of effect that happen in minimum cellular tissue depth of 0.1mm is stable living body organization or internal organs institution. Formation damage by ten can be related in formation's kind or energy density, length of evaporation time. If shorten evaporation time, surroundings cellular thermal damage 200 - because happen within 400ums laser beam in rain focus sacred ground surroundings cellular tissue without vitiation me by evaporation Poe of very small floor as is clean steam can . Application is possible to vulva cuticle cousins by a paternal aunt quantity, uterine cancer, cuticle tumor by laser system that CO₂ laser gets into standard in obstetrics and gynecology application. Because effect that super pulse output is ten enemies of laser if uniformity one pulse durations are short almost is decreased, most of all pulse module special quality of pulse style CO₂ laser for obstetrics and gynecology mode stabilization by weight very, in this research to get into short pulse duration and higher frequency density, do switching by high frequency in DC-DC Converter output DC's ripple high frequency to be changed, high frequency done current ripple amount of condenser for output filter greatly reduce can . Ripple of output approximately to Zero realization applying possible inductor realization through a special quality experiment do .

1. introduction

CO₂ laser had been used mainly much in laparoscope surgical operation mainly. Thermal effect of beam displays other result different constituent of cellular tissue and different conclusion of state examination of laser beam. Temperature increase priority solidification consists and next cutting or carbonization process happens and evaporation by breakdown of cellular tissue happens more than 300°C in cellular tissue. That CO₂ laser is most suitable to get this effect through minimum formation damage, fundamental advantage of effect that see and occurs in minimum cellular tissue depth of 0.1mm is stable living body organization or internal organs institution. Formation damage by ten can be related in formation's kind or energy density, length of evaporation time. If shorten evaporation time, surroundings cellular thermal damage 200 ~ because happen in 400um laser beam in rain focus sacred ground surroundings cellular tissue me by evaporation without vitiation very thin layer clearly steam can . Application is possible to vulva cuticle cousins by a paternal aunt quantity, uterine cancer, quality cuticle tumor by laser system that CO₂ laser gets into standard in obstetrics and gynecology application. Maximum output is inverse proportion at continuance time of pulse. If supermarket pulse output is equal almost but pulse continuance time is short, effect that is ten enemies of laser is decreased. Because most of existent medical treatment equipment select full-bridge DC-DC converter form, control 2 roads passed energy because switch pair that exist in diagonal line does on or off at the same time, important problem that happen in this action does so that energy that is stored in leakage inductance of transformer in case 4 switches are off all may be no exhausted passageway, pick up union capacitance ingredient of switch and serious ringing, enlarge voltage and Piikeu of current and adds stress on switching element. Because ZVS-FB DC-DC converter makes gate signs of switch Q2 and Q4 have delay during time about gate signals of

Q1 and Q3, though energy that energy that is stored in leakage inductance of the first transformer during this time makes low-impedance passageway so that may circulate through body diode of switch, and moreover is stored in leakage inductance discharges energy that is stored in union capacitance of switch, is way that switching element do so that do ZVS (Zero Voltage Switching) action being used. Decide energy amount that is passed by the second as width of pulse that switches do on, off action by each 50% relationship fixed Duty ratio and switch of diagonal line pair of status change of two cancers overlaps. Leakage inductance of some measure is required to get ZVS special quality, and this makes rise slant of the first current, and reduce change width of transformer the second side voltage and lessen validity Duty (Deff). That is, according as leakage inductance value increases, Deff decreases more. Do switching by high frequency in DC-DC Converter, output DC's ripple high frequency to be changed, current ripple that is done high frequency Tuesday can reduce greatly amount of condenser for output filter. But, to do device high frequency Tuesday, there is some measure limit, but ripple of output approximately to Zero realization applying possible inductor realization through a special quality experiment do . Specially, pulse module special quality of pulse style CO₂ laser for obstetrics and gynecology mode stabilization by weight very, in this research to get into short pulse duration and Go output wheat design and result that manufacture and experiment, brought result that improve of 13% about existing product, and if supplement as systematic late, it becomes thought to get into superior result.

2. Design and embodiment of system

Because scattering of beam is much in establishment, century of beam by laying eggs increases. Specially, 600nm ~ if beam between 1500nm is entered a company beam century through laying eggs process increase, and tissue such as kidney increases until 4 ~ 7 times. Formation's absorption changes greatly in wave length (193nm ~ 10600nm) extent of medical laser and laying eggs calculation decreases wave length is big. Carbon dioxide laser beam that is wave length 10.6um expresses transmission depth of about 0.01mm in water. Transmission depth expresses mean distance that beam is transmitted water and blood. Because carbon dioxide laser expresses transmission depth of 1/1000 mm in establishment, whole output can change to row in formation front. Though special quality is decided by hemoglobin optic enemy of blood, the strongest absorption of bluish green color area is caused in red of blood. Absorption of oxidation globin 580nm ~ happening between 805nm than hemoglobin weaker absorption happen . Thermal effect of laser beam is evaporation effect for formation's integrity or solidification in medical treatment application. These phenomenon happens by beam investigations between tens second in Sums between laser output 10 w/cm2.

$$C = 4.17 \text{ kJ / Kg} \cdot K \text{ -----(1)}$$

$$K = 0.54 \text{ W / mK} \text{ -----(2)}$$

$$W = pt = L \rho V \text{ -----(3)}$$

$$D = P / (L \rho dX / t) \text{ -----(4)}$$

$$D = 4 Pt / (L \rho d^2) \text{ -----(5)}$$

$$r = \delta^2 / 4 a \text{ -----(6)}$$

Zeal spread is decided by thermal conductivity and because organization is like with water, thermal conductivity K are appearing to way (6). Rain fan shape process happens when is high power density and short pulse. Storehouse separation of only pulse continuance in 10ps to 10 ns tell. Laser beam must have transmission depth that is less to operate tissue. As a result, high surface temperature is formed and tissue vaporizes. In case ignore heat conductivity, beam energy W for evaporation of volume V are same with way (3). L expresses formation's density which increase being evaporation ten. In case required energy is 2.3J and uses carbon dioxide laser to issue additional paper money volume 1mm³'s formation, big error does not occur in this approximate. For formation exclusion necessary energy 4 ~ because 5J need incision depth for formation incision with way (4) save can. D is beam diameter, increase lineally if dX/t expresses the incision speed and beam diameter of incision depth decreases. Finally, storehouse exclusion displays method to investigate short higher hrust pulse to establishment and make formation bate in Plasma state in gas state. Storehouse exclusion region is through minimum ten enemy damages formation which do and drop launches in gas state. Therefore, incision region temperature 100°C exceed. Before formation which absorb beam energy transmits heat to surroundings organization, exclusion must happen first. These condition can get, and can calculate maximum pulse duration in case ignore thermal conductivity in storehouse exclusion using transmission depth heat spread coefficient A = 1.5 X10^{s-7m2/s} and optic enemy in only short laser pulse. Specially, leisure that try first time by medical is carbon dioxide leisure, and this laser emits wave length 10.6um of infrared rays area and average output is announced from 20 w to 100 w. Beam in formation's water transmission deeply in about 1/100 mm strong absorption have and organization by this strong absorption reaches in heating Go high temperature fast and formation's evaporation which gather to focus of beam happens. Solidification area is using much by integrity by thin relation. Laser output becomes output adjustment from 20 w to 100 w consecutively and time of exposure is available adjustment through water plant in 0.01 seconds. Pulse action can intercept laser beam periodically and supermarket pulse 0.1 ~ between 1ms discharge consist, and laser output that is the moment is increased to 5 ~ 10. There is average output becomes similar or low. If use supermarket pulse, can reduce formation's thermal conductivity. That output laser acts by basis mode and higher hrust mode can operate by multiplex mode action and beam diameter of multiplex mode becomes about double than basis mode beam.

3. Design and embodiment of system

Achieving following process as that display basis circuit diagram and waveform of main circuit main circuit of 30 [V]/50 [A], DC-DC Converter of 20 [kHz] switchings of design wish to. Must do work of design and so on of choice, choice of switching element, transformer design, choice of high speed stoppage diode, output filter of input/output capacity for this.

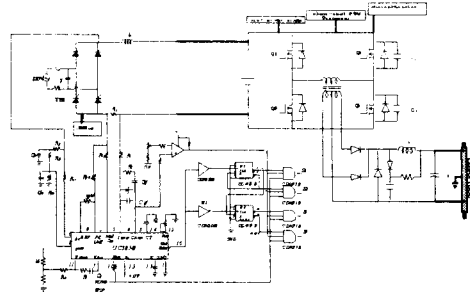


Fig 1. Diagram

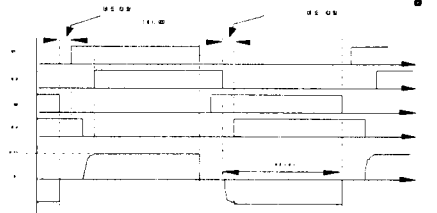


Fig 2. Time Pulse Width

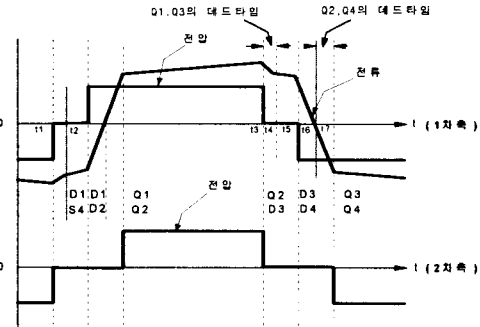


Fig 3. Operation Mode

4. Experiment result

Switching element does suitable IGBT Ro in 20 [kHz] high frequency switchings, chose to do device compact Tuesday me that have drive circuit on interior by IPM that is convenient. Pumping gas (pumping source) makes energy in ground state by here state (excited state) as device that laser for obstetrics and gynecology consists of vitality media that surround by optical activity (optical cavity). If collision between particle of two of here state (excited state), photon that receive stimulation (that high level energy is massed) happens and it is that extended electromagnetism energy comes out for laser. Special quality of laser beam is as following. Laser beam can do focusing 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. Gas laser consists because atom or small molecule or atom or molecule is mixed. Discharge respect for the old and optical axis selected equal domestic animals style and plano-concave resonator. Whole reflector for laser eruption used molybdenum lens that is diameter 1.5 inch, radius curvature 10m, reflexivity 99.5% and is, and partial reflection selected ZnSe (Zinc Selenide) lens that reflexivity is 90% to lower do eruption threshold. Used Pyrex (Pyrex) pipe that laser discharge tube is length 85, inside diameter 16, thickness 2 and volume of discharge tube to generate discharge plasma is 75x64. Discharge department made attaching cathode of cylindrical and anode of saliva shape that make from aluminum to discharge tube, and distance between electrode did by about 75. Manufacture Pyrex tube that is inside diameter 30, thickness 2 doubly to prevent ailment of causable output by temperature rise by discharge Plasma at series action

in discharge tube outer wall and composed water circulation chiller. If momentary complete work kind passes to discharge tube, pressure difference occurs negative pole side of discharge tube and anode side. Laser eruption efficiency drops because of this and state of eruption suspension and so on happens. Establish bypass (Bypass) pipe together to prevent this and reduced occurrence of impurities by CO₂ molecular Harry when flowing of gas minishes temperature upswing and pressure difference of discharge within the jurisdiction by gas overheating round electrode as help and discharges because inserting small fan. After change by pulse of high tension using high voltage high frequency pulse transformer, approved to discharge tube. Laser output made control to be possible as that change the pulse repeat rate in fixed pulse width. Designed so that can be variable to repeat rate 100% ~ 1% and maximum pulse voltage that can get in rural districts were about 20kV. Is main part of pulse power supply to do to think laser whipping stoppage department, switching department, high tension? Is composed at control that use high frequency pulse transformer department, microprocessor. When approved pulse of high tension to discharge tube in pressure 12 Torr, is waveform that measure voltage waveform between quantity electrode using 1000:1 potentiometer (Tektronix:P6015A Opt.1R). As can know in picture, when glow discharge is continued to stabilize in working pressure 12 Torr, it was about 40% as catch pulse waveform and measured pulse width (FWHM : Full Width at Half Maximum).

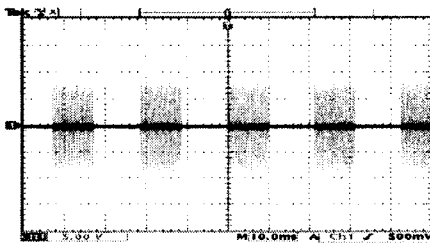


Fig 4. (pulse 2차, gap 10ms, with: 10ms)

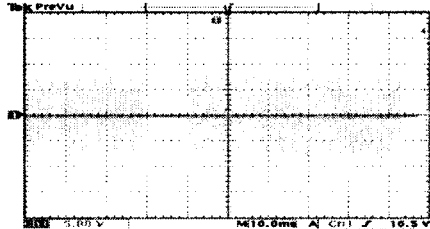


Fig 5. (pulse 2차, gap 10ms, with: 50ms)

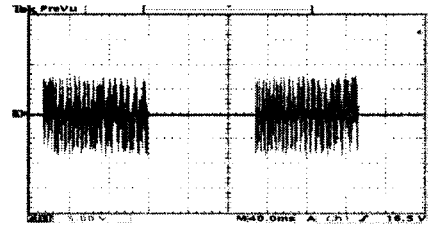


Fig 6. (pulse 2차, gap 10ms, with: 100ms)

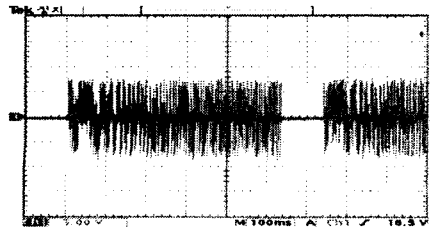


Fig 7. (pulse 2차, gap 10ms, with: 110ms)

5. Conclusion

Mixture ratio CO₂ of gas : N₂ : Measured output increasing working pressure by 3 Torr from 6 Torr to 15 Torr in He = 1 : 9 : 15. When the repeat rate is fixed, if pressure increases, output increased, but increase width of output by increase of pressure decrease in about 12 Torr neighborhoods. According as working pressure rises, because CO₂ and N₂ molecular density increases, density of laser here sub-officer increases and because of spread cooling effect by increase of collision sectional area, laser output increases. Is kept glow discharge in pressure of something wrong, because strong electric field between electrode takes because must join high voltage more, electron density increases. As a result, reducing high position sub-officer density causing gaseous temperature rise because input increases laser output saturant. Therefore, must optimize pressure to do gains by maximum. Because spread cooling is dominate, maximum input that such domestic animals style CO₂ laser can input per unit volume is limited by 0.5 W/W degree. Therefore, must use high speed domestic animals style or sale through illegal channels style etc. that can augment energy that is engaged per unit volume to get higher output.

[참고 문헌]

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