상용교류방전 자기자극장치의 동작특성

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Commercial frequency AC discharge magnetic stimulation operating characteristics

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요 약

펄스형 자기자극장치를 누설변압기의 1차측 스위칭 제어로 교류(60hz) 스위칭 제어를 하여 비용과 크기면에서 기존의 전원장치로 구성된 것보다 약 30w의 소용량으로 구성을 할 수가 있었다. 펄스반복률은 자기자극장치의 출력제어를 5-60hz로 적절하게 조절하였다. 이 자석 자극에서는, 고전압 출력 회로를 위한 낮은 전압 열리는 반복 통제가 고전압 표본 추출을 피하기 위하여 채택되며, 또는 스위칭제어와 고전압 누설 변압기는 고전압 하나로 조정된 낮은 전압 펄스를 개조하기 위하여 사용된다. ZCS (영전류스위칭) 회로 및 DSP & FPGA는 SCR의 게이트 신호를 정확하게 통제하기 위하여 사용된다. 펄스 반복 비율은 AC 선과 높은 누설 유도자의 주파수 때문에 60Hz에 의해 제한된다. 최대 자석 자극장치의 출력은 60Hz, 각각 40, 80, 120, 160˚, SCR 게이트의 펄스반복 비율로 33W에 관하여 트리거 각 90°에 대한 전체적인 출력으로 얻어졌다.

ABSTRACT

We propose pulsed magnetic stimulation below 30W by the AC(60Hz) switching control of leakage transformer primary which has some advantage of cost and size compared to a typical pulsed power supply. Pulse repetition rate is adjusted from 5Hz to 60Hz to control magnetic stimulation output. In this magnetic stimulation, a low voltage open loop control for high voltage discharge circuit is employed to avoid the HV sampling or switching and high voltage leakage transformer is used to convert rectified low voltage pulse to high voltage one. A ZCS(Zero Cross Switch)circuit and a DSP & FPGA are used to control gate signal of SCR precisely. The pulse repetition rate is limited by 60Hz due to the frequency of AC line and a high leakage inductance. The maximum magnetic stimulation output was obtained about 33W at pulse repetition rate of 60Hz, total 40, 80, 120, 160˚, SCR gate trigger angle 90° and total output.

키워드

펄스, 자기,자극장치, 고전압, 방전

Key word

pulsed, magnetic, stimulation, high voltage, discharge

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Ⅰ. 서 론

Consequently like this disease High-level Magnetic Field it uses and it diagnoses and the equipment which is simple it will can treat under proposing boil. Like the human body and the organism electric current which transmit Eddy Current to occur, is induced the magnetic field of the pulse style which instantaneously is powerful in the defiant body where the magnetic field transmits well like this in compliance with the electric generation which is electro physiology shows an effect in human body each organization, it makes. The treatment appointment of 20W class outputs which recently have the pulse repetitive ratio below 100Hz and diagnosis magnetic stimulation demands increase according to with maintenance convenient characteristic of repair, usability of course user the insect family it is and miniaturization of magnetic stimulation power supply units, the demand being augmented in about rationality and low price aggravation etc. of output control, making.

The pulse price aggravation etc. of output control, making. The pulse style magnetic stimulation power supply units of existing switching element to want in order to hit to a pulse repetitive ratio, and "on" - "off" the energy which charges in the condenser high tension pulse transformer it leads and it is a method where in the coil probe discharge tube it authorizes. Namely DC switching process it led and after converting by pulse energy, the form which supplies that pulse energy in discharge tube it made. Namely, from commercial business cycle AC here method of existing it respects magnetic stimulation output controls switching it did rightly from voltage variable method substitution commercial business cycle AC (60㎐) transformer first side of the transformer first side which is used and it was a low of the pulse and in compliance with the variable of the pulse frequency it controlled magnetic stimulation outputs. This method compares in magnetic stimulation power supply units which have the pulse repetitive ratio below 60Hz of existing and the energy charging condenser is not the thing is feature entirely necessary. It detects the promotion pressure of SCR and AC sine group ZCS for (Zero Cross Switch) circuits, to want SCR trigger signals in order to hit to the frequency precisely, it controls. Also, it planned magnetic stimulation power supply units which are composed with DSP and FPGA controls. From the research which it sees it uses DSP and FPGA from first side of the leakage transformer and commercial business cycle AC (60Hz) precisely, as the switching box, it authorized the pulse of high tension in magnetic stimulation discharge coils of secondary side. The glow right discharge is stabilized and it investigated the output quality of magnetic stimulation pulses which from the condition which is maintained it follows in pulse repetitive ratios, gas mixture ratio and SCR gate trigger continuity cabinet meeting changes.

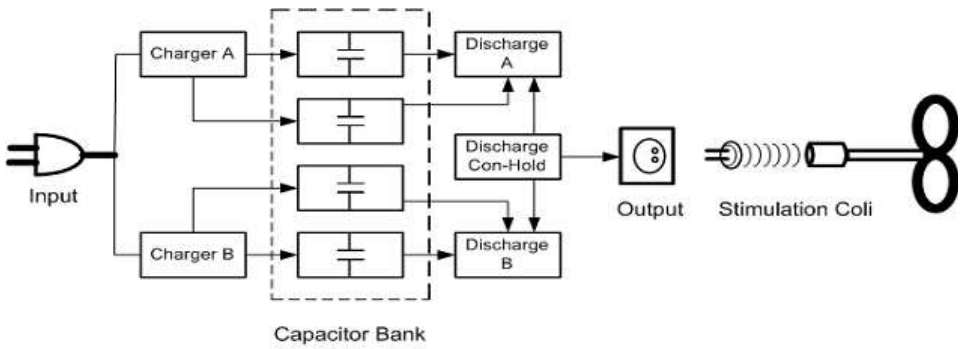

그림 1. 전형적인 자기 펄스기기
Fig. 1 Traditional pulse wave apparatus

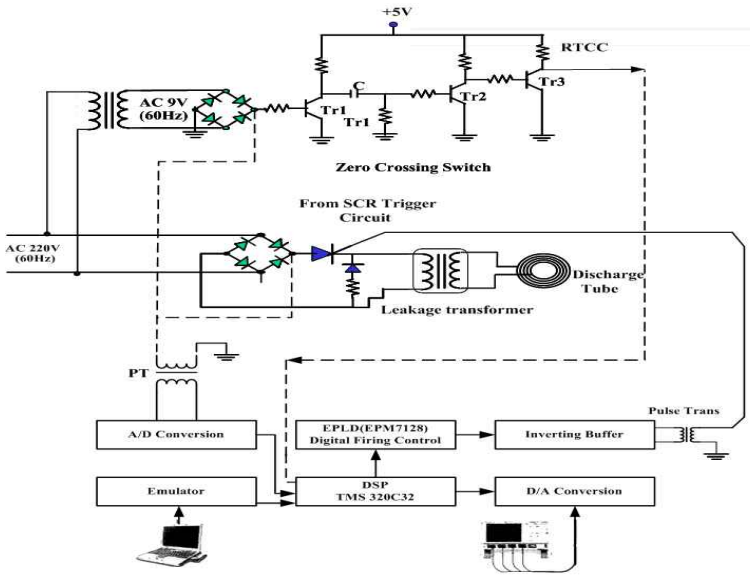

그림 2. 제안하는 자기자극장치 모드
Fig. 2 proposal magnetic system mode

Ⅱ. 자기자극장치 설계

Magnetic stimulation harmlessness not only will be in the human body and the human body deep to permeate the nerve tissue and muscular power organization impact magnetic stimulation and the possibility of doing it is remedial value quite the right toil spinal nerve and the trivial nerve they will use in compliance with the case stress which it will treat the melancholia which becomes the mortar, insomnia, trillion they will cry and it will be able to treat etc. symptoms. The human body it permeates deep and in order treatment description below stand Pulse width to be narrow, the wave shape whose Rise time are quick is best. Also Noise to be few heat to be few to the human body most is a possibility of being suitable with magnetic stimulation. Consequently the wave shape which is suitable Biphasic is a possibility of doing, the inside and outside of the country all Pulsed Magnetic Field is using Biphasic. But method of existing the frequency Pulse repetition rate increases and according to energy transfer efficiency suddenly there is a weak point which it decreases, the pulse shape the low of the arm which is various is impossible.

Thyrister Turn-on-off the possibility of doing it is pulse rise time shortly and it will make the pulse of the shape which is various and not only there is a possibility of reducing the energy transfer loss which it follows in pulse repetition ratio rise. The whole system divides on a large scale and the magnetic pole coil and pulse power supply unit, ZCS (Zero Cross Switch) circuits, it is composed with the control department which uses DSP and FPGA. magnetic in order to stimulate the nerve in stimulation pulses stands in compliance with time variable must reach the degree electric field sizes which are induced will be able to stimulate the nerve.

It will be able to induce electric field above tens V/m to neural, there must be regions, in order to induce electric field where it has like this size it stands from the shape and the epidermis of magnetic stimulation coils until the This Probe conceived etc., the shoulder and the waist, mainly and with etc. is same when treating the wide region, it will be able to use mainly in order, plan and it produced. The whole the possibility of shaking off 10turn and, the diameter is 80mm.

Inductance price of this coil about 9μH and, the maximum magnetic field century is 1.2Tesla. This Probe when mainly the head or treating intensively in the region which it specifies, it will be able to use.

Specially, magnetic stimulation century and frequency, Train Time and Pause time and must control therapeutic timely etc., must consider from magnetic stimulation plans. The power supply unit with variable it will be able to control magnetic stimulation outputs in order, a pulse repetitive ratio from the pulse width which is a schedule. The repetitive ratio will plan and until 5 ~ 60 Hz the variable the maximum pulse voltage which is the possibility which from all the member the possibility of doing in order to be, it will get was about 2 ㎸. The pulse power supply unit for like picture 3 and ZCS, all the member circuit which uses the high tension leakage transformer, the control department which applies DSP and FPGA comes is being composed magnetic stimulation with SCR tree refusals, making.

The signal which is rough the differentiator and the amplifier from the point where the sine group AC voltage which is authorized in Tr1 bases becomes at 0 occurs 5V spherical group pulses of pulse width about 500㎲ degree made make from Tr3 curl racks. The control department which applies DSP and FPGA SCR trigger methods of existing resists, plaque hour it shakes off big, it used OP-AMP etc. The phase angle which it comes to make is decided and with order signal SCR roll call Jr sergeants who compare SCR in the pulse form for from the price which is arithmetic trigger description below it makes.

The concept the bridge diode voltage information which comes out leading in compliance with the voltage sensor from commercial business all the member measures input all the member. Voltage information which is measured DSP where it is a master boards and A/D (AD7864 and Analog device four) with it sends. Voltage information which is input in compliance with control each conversions and PI controllers it makes a phase angle calculate from DSP. The roll call angle which is calculated position uses element etc. with FPGA (Field Programmable Gate Array) from TTL and it composes, at from digital price loading it does and like this digital price in compliance with EPLD internal counters in pulse form becomes trigger in SCR gates. It comes to make from DSP, insides the phase angle which it is a direct trigger in SCR and the pulse for with FPGA etc. uses the same element circuit veryto be simple, existing it knows but only the fan-shaped control which is a feature of log method it knows with noise and reliability improvement of temperature quality, secular change and mains voltage there is a possibility of having a strong feature in the environment which is same external.

Zero voltage detection department (ZCS) from fig 2 it comes like DSP RTCC (Real Time Clock Count) from it accepts the zero voltage signal of commercial business cycle AC. Namely, at 1 seconds the promotion pressure detection pulse signal 120 is authorized in RTCC. A signal in circuit wanted the zero voltage signal per second 120 it accepts from RTCC from DSP insides and in the frequency which to be right with like ticket 1 to be busy SCR trees it stands it authorized. The Laser pulse repetitive ratio like frequency of ticket 1 and did to make be it will be able to control freely.

The fig 3 is by a whole circuit and it is an operational wave shape of ZCS input-output signals which it follows in frequency and SCR trigger signals. SCR trigger signals want AC line promotion pressures (Zero Voltage) from in the frequency in the loach SCR gate It is authorized. The switching department fig comes like SCR, is composed of the high tension leakage transformer and the return current diode. From AC the voltage which is stopped it is a switching and as for the switching element for SCR is used, in order by high tension to authorize in the conversion below-mentioned discharge tube the pulse of the low pressure which becomes switching it stands the neon transfomer high tension leakage transformer first: 220V, secondary: 18kV, it used a peak transformer. And it emitted the energy which is accumulated in inductive load of the transformer and resistance with arranging in a row in order to close the fact that the magnetic flux of the transformer is saturated it stands with the return current diode transformer first side and it connected.

Ⅲ. 실험 결과

Experimental scope the discharge was stabilized and the pulse repetitive ratio 5㎐ ~ 60㎐ which will be made to maintain, magnetic stimulation mixture ratio SCR gate trigger continuity angles did and until with 40°~200° they experimented. Output coil probe of magnetic stimulation output grades it converted a voltage with the magnetic flux and it calculated. Capacitor, after with the allotter making with low voltage, the comparator it uses the high voltage which bank charges and standard voltage and it compares with the case discharge circuit which has become overcharge to lead, to discharge, that the case which will charge to charge with in order to control an output century. The voltage which charges in the case Capacitor bank which will do an output century with 100% 1800V and, the comparative voltage is 2.5V.

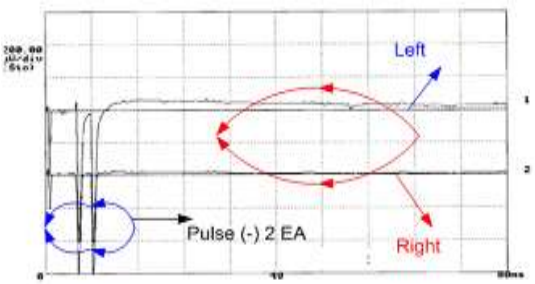

그림 3. 네가티브 펄스모드
Fig. 3 negative pulse mode

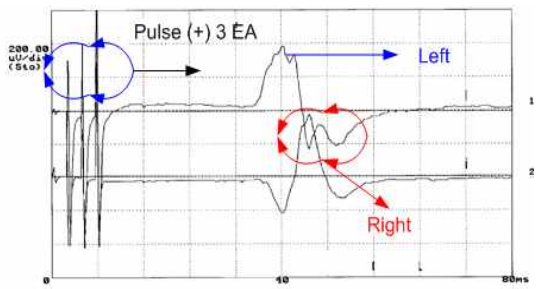

그림 4. 4-트레인 펄스 모드
Fig. 4 4-train pulse mode

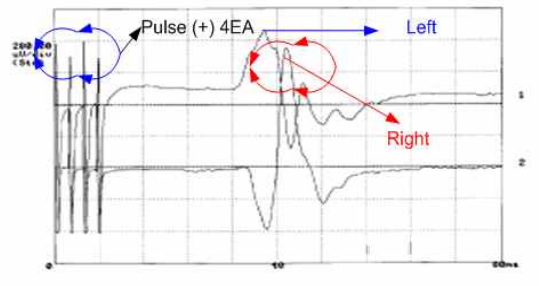

그림 5. 트리거 단계(40-200)
Fig. 5 trigger degree (40-200º)

The recording comparative voltage which 1% decreases an output century will make decrease and 0.00167V it will make. The picture 12 the case which will do an output century with 100% namely, is the voltage wave shape of the oscilloscope of the case where 1800V will charge in Capacitor bank.

This time the comparative voltage 2.5V and, standard voltage also is 2.5V. The fig 5 100%, the case Capacitor bank insect ・discharge comparative voltage wave shapes which operate frequency with 5Hz will make an output century. Each experimental data five time is indicating the average of the result which it experiments. It started a takeoff from 5Hz and most it arrived it got from 60Hz to confrontation, the maximum 23W specially. The repetitive ratio increases according to own magnetic pole output to be a possibility of knowing, repetitive ratio 60Hz it gets peeled off and the output is almost increasing fanwise.

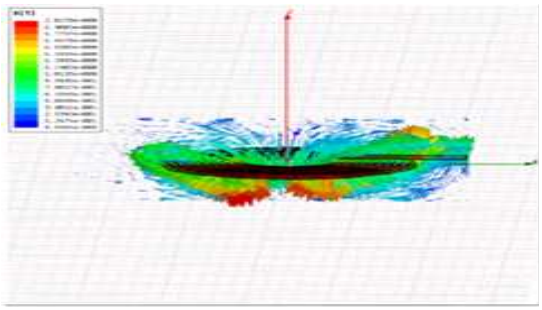

그림 6. 시뮬레이션 파형
Fig. 6 Waveform of a simulation

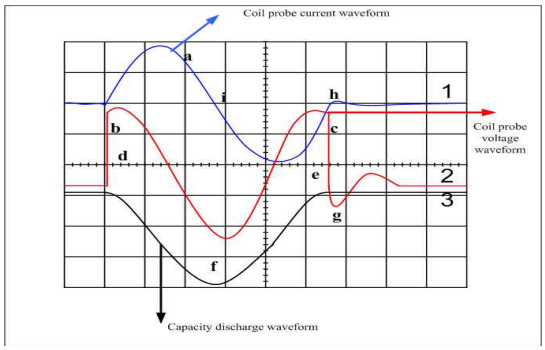

그림 7. 전압, 전류파형
Fig. 7 Waveform of a voltage, current

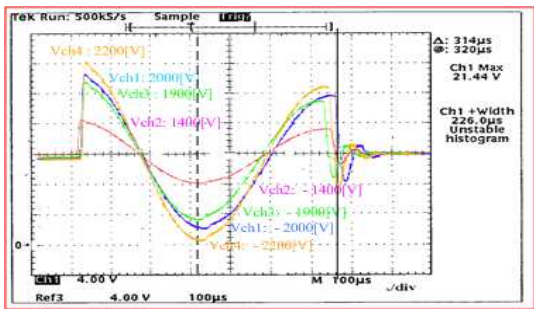

그림 8. 방전전압 파형
Fig. 8 Waveform of a discharge voltage

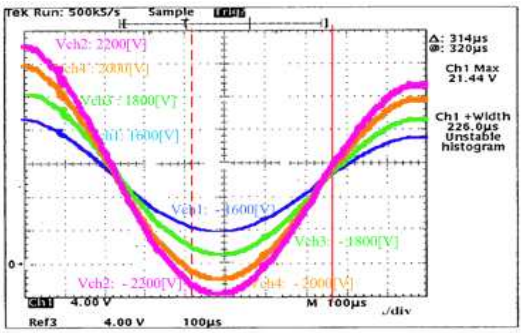

그림 9. 커패시터 방전파형
Fig. 9 Waveform of a capacity discharge

The cause the repetitive ratio increases and when and it is because the input energy being augmented the discharge tube undergarment electron density increases comes to be high pumping ratio with junior warrant officer high position, the population inversion makes become larger and the output to increase. Fig4 the pulse repetitive ratio 60Hz whose own magnetic pole output is highest and SCR gate trigger continuity each 90. It is a result which measures own magnetic pole output which it follows in the case pulse repetitive ratio which is.

The maximum 30% degree which it sees from two cases where the output is different being augmented, there is a possibility of knowing. The fig 5 pulse repetitive ratio 60H and SCR gate trigger continuity angles from 30° until 145°

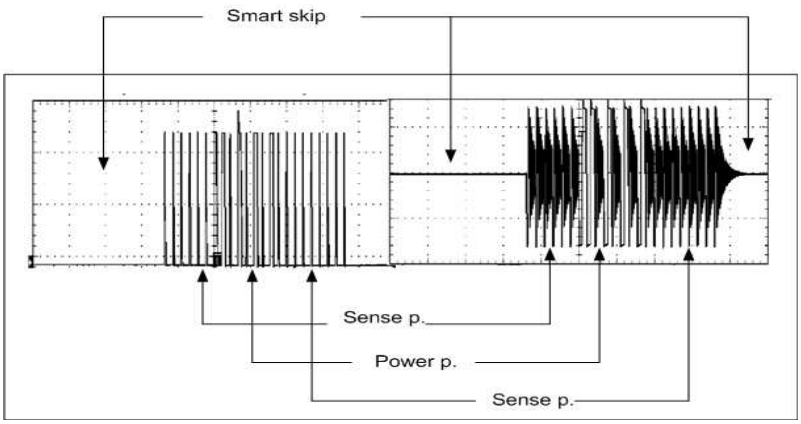

그림 10. 펄스-모드파형
Fig. 10 Waveform of a pulse -mode

15° change possibility will get a maximum output power from the resultant continuity each 90° which it experiments and it made.

The fig SCR gate trigger continuity is showing the profile of each 45° and own magnetic pole from 90° and 135°. According to each continuity angle own magnetic pole pulse width there was not big change. The pulse width was about 3ms at anti-face width. With the fact that it will not affect the continuity angle to own magnetic pole pulse width is big consequently. If used properly, single-pulse TMS has no known harm ful side effects. TMS has been used since 1985 and today some 3,000 stimulators are in use. Protocols should always exclude patients and volunteers with intracranial metallic or magnetic pieces. The magnetic field present in TMS will generate forces on objects exposed to it: magnetic objects will be attracted and nonmagnetic repelled.

The force may be substantial, but decreases quickly with decreasing cross-sectional area and conductivity of the object and with distance from the coil. pacemaker, or any other implanted device. The magnetic field pulse will disturb nearby electronic device. Single-pulse TMS has produced seizures in patients, but not in normal subjects rTMS has caused seizures in patients and in normal volunteers Hearing loss. During TMS there will be a loud clicking sound from the coil. The peak sound pressure is 120-130 dB 10 cm from the coil. Most sound energy is in the frequency range 2-7 kHz where the human ear is the most sensitive. The noise may exceed criteria limits for sensor ineural hearing loss. Heating of the brain - Heating of the brain is unlikely to cause deleterious effects. The oretical power dissipation from TMS is few mW at 1 Hz, while the brain's metabolic power is 13 W. A frequent harmless, but uncomfortable, effect is a mild headache, which is probably caused by activation of scalp and neck muscles. TMS equipment operates at lethal voltages of up to 4 kV. It is hence important not to keep coffee cups or ice bags on the stimulator.

Ⅳ. 결 론

After commercial business frequency AC full-wave rectification from the research which it sees from high tension leakage transformer first side as SCR switching it did. The pulse which becomes the switching the high tension leakage transformer it led and after converting in the high tension pulse, it authorizes in magnetic stimulation discharge tubes of secondary side magnetic stimulation power supply units below 60Hz where it developed. The maximum output power which the resultant operational pressure pulse repetitive ratio it comes to get from 60Hz which it experiments and SCR trigger continuity each 90°was about 23W in about output quality of magnetic stimulation systems which it follows in pulse repetitive ratios, gas mixture ratio and SCR gate trigger continuity angles. And magnetic stimulation pulse width was about 3 ms.

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