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(71) Applicant <b>Ken Hayashibara, 9-2 4-chome Higashi-Furumatsu, Okayama-shi, Okayama, Japan</b>	(58) Field of search <b>A1M A1E A1A A2Q A5R C6F</b>
(72) Inventor <b>Kazumi Masaki</b>	
(74) Agent and/or Address for Service <b>Page White &amp; Farrer, 5 Plough Place, New Fetter Lane, London EC4A 1HY</b>	

(54) **Method for promoting the productivity of animals, plants and microorganisms**

(57) A method for promoting the productivity of animals, plants and microorganisms comprises irradiating animals, plants or microorganisms with an effective amount of alternating pulsed magnetic lines of force having an a.c. waveform, magnetic potential of 10-100,000 ampere turns, pulse width of 1/500-1/50 seconds, and pulse intervals of 1/100-1 second. Yields and qualities of animal- and plant products are improved.

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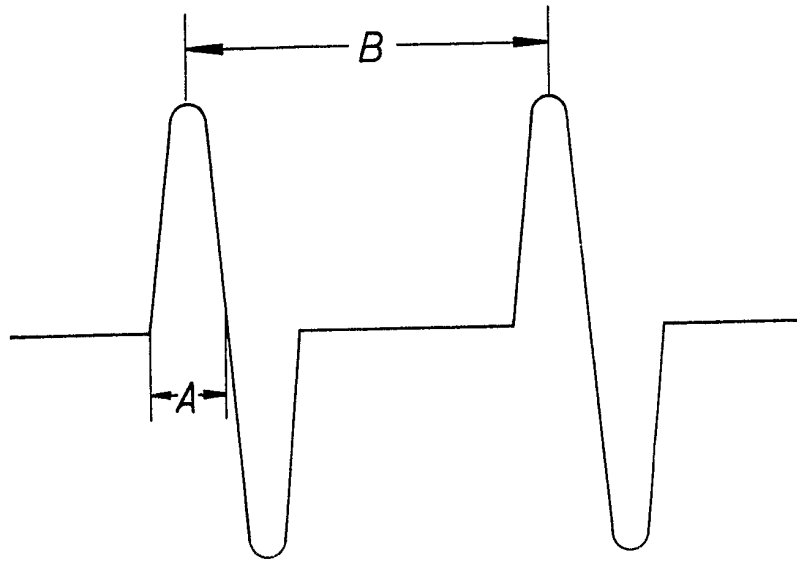


FIG. 1.

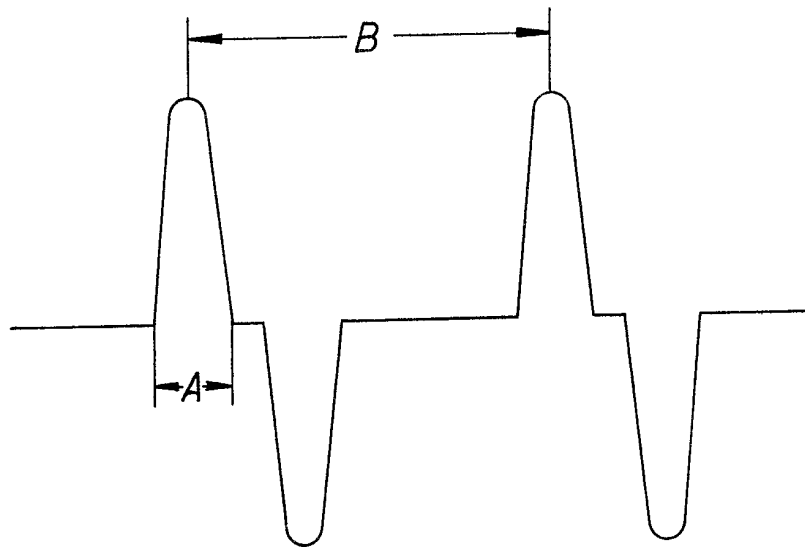


FIG. 2.

## SPECIFICATION

**Method for promoting the productivity of animals plants and microorganisms**

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The present invention relates to a method for promoting the productivity of animals, plants, and microorganisms.

10 In the course of studying the influences of magnetic lines of force (a magnetic field) on the activation of viable cells, we found that alternating magnetic lines of force generated by passing a current having a waveform similar to that of diphasic action potential through a magnetic coil is remarkably effective in activating the growth of viable cells when compared with commercial a.c. current. This may be explained by the fact that a small change of magnetic flux  $d\phi$  during a short period of time  $dt$ , i.e.  $d\phi/dt$ , is very much higher when

20 magnetic lines of force generated by charging a current having a waveform similar to that of diphasic action potential, pass through viable cells, i.e. 100-fold or higher in comparison with using sine waves.

25 It is suggested that a sudden change of magnetic flux density inevitably couples with the increment of electromotive force to cause great electrochemical influences on viable cells. It is also suggested that such sudden change effects spin movements of various atoms, e.g. hydrogen atoms, in the viable cells to amplify the influences.

30 On studying further the activating effect, we have found that the productivity of animals, plants, and microorganisms such as domestic animals, domestic plants and cell cultures, is considerably enhanced by irradiating the substrate with magnetic lines of force generated with a pulse current having a waveform similar to that of diphasic action potential.

40 Accordingly, the present invention provides a method for promoting the productivity of an animal, a plant, or a microorganism, which method comprises: irradiating the animal, plant or microorganism with an effective amount of an alternating pulsed magnetic field having a waveform similar to that of an a.c. waveform (diphasic action potential).

45 The pulse currents having a waveform similar to that of diphasic action potential and which are suitable for use in the present invention are those which have a waveform similar to that generated in a stimulated nerve. The waveforms illustrated in Figures 1 and 2 exemplify such pulse currents.

50 In Figures 1 and 2, the pulse width A is generally from 1/500-1/50 seconds, preferably 1/500-1/100 seconds, and the pulse interval B is generally 1/100-1 second, preferably 1/50-1/5 second. An example of a preferred apparatus capable of generating such pulse current is disclosed in Japan Patent Application No. 71,926/83 (MASAKI, Kazumi). The magnetic potential of such apparatus is generally set to be from 10-100,000 ampere turns.

55 The terms "animals" and "plants", used in the present invention, are used to mean varieties of animals, plants, their tissues or cells which are fed, bred or cultivated in agriculture, forestry, fisheries,

or pharmaceutical industry: for example, animals such as mammals, fowls, fishes, shellfishes, and insects; and plants such as monocotyledonous plants, dicotyledonous plants, seaweeds, basidion-mycetous plants and microorganisms.

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The phrase of "promoting the productivity" used in the present invention means the acceleration of growth, development and proliferation of animals and plants, and shortening of the time required for feeding, breeding or cultivating them, leading to the improvement in the yields and/or qualities of their products, e.g. animal products such as meat, milk, eggs, fur, cocoon, and pearls, plant products such as plant stems, flowers, fruits, mycelia, antibiotics, enzymes and biologically-active substances.

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During the irradiation with the alternating magnetic lines of force to promote the productivity of animals and plants, other suitable treatments, e.g. administration of hormones or vitamins, or control of temperature or intensity of radiation, may be used.

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The following Examples further illustrate the present invention.

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*Example 1*

Litters of newborn pigs were divided into two groups.

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Every morning and evening one group of the newborn pigs was placed in a stable, 1.8 m x 1.8 m in area, equipped around with an apparatus generating a magnetic field having a magnetic potential of 10,000 ampere turns, pulse width, 1/400 seconds, and pulse interval, 1/30 seconds, and irradiated twice with the alternating pulsed magnetic field for 10 minutes every day. During periods when they were not undergoing irradiation, both groups of pigs were fed by the mother pig. The average period required to double the weight of newborn pigs was 10 days in the group treated according to the invention, while the unirradiated control required 14 days.

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*Example 2*

110 Broiler chickens, about 1.0 kg each, were fed with a commercial assorted feed in a conventional manner. Two groups, five chickens each, were placed into different henhouses, 1 m x 1.5 m in area. The henhouse for one group was equipped with an apparatus generating a magnetic field having a magnetic potential of 1,000 ampere turns, pulse width of 1/200 seconds, pulse interval of 1/10 seconds, and the group was fed for one week while subjecting them to irradiation with the alternating pulsed magnetic field for 30 minutes at intervals of six hours. The average increase in weight per 1 kg of feed used during this feeding was 0.41 kg in the group treated according to the present invention, whereas that in the unirradiated control was 0.35 kg.

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*Example 3*

130 A one month-postpartum milk cow was milked while being irradiated with an alternating pulsed magnetic field by use of a teat cup equipped with an apparatus generating a pulsed magnetic field

having a magnetic potential of 5,000 ampere turns, pulse width of 1/50 seconds, and pulse interval of 1/5 seconds. This improved the yield of milk by about 25%.

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#### Example 4

Three year-old pearl oysters, *Pinctada martensii*, were inserted with middle size nuclides, and suspended in sea water from a culturing raft in the

10 usual way.

An apparatus generating a pulsed magnetic field having a magnetic potential of 100,000 ampere turns, pulse width of 1/100 seconds, pulse interval of 1/10 seconds, was laid around the raft and the

15 pearl oysters daily received 30 minute irradiations of the alternating pulsed magnetic field in the morning and evening for six months.

The pearls so obtained were top quality pearls excellent in the growth of nacre layer, colour, and

20 brilliance.

#### Example 5

A soil bed was placed in two different vessels, 1.0 m x 0.5 m in area, to prepare seed beds. The

25 seed beds were then sown with seeds of Japanese radish, *Raphanus sativus* L., sprinkled with water, and kept in the shade, in the usual way.

An apparatus generating pulsed magnetic lines of force having a magnetic potential of 1,000 am-

30 pere turns, pulse width of 1/100 seconds, and pulse interval of 1/20 seconds, was placed around one of the seed beds to irradiate it with an alternating pulsed magnetic field for five days. After harvesting young radish plants from each seed bed, the

35 crop from the seed bed treated according to the invention was about 40% higher than that from the unirradiated control.

#### Example 6

Ten-year old plants of muscut of Alexandria in a

40 greenhouse were divided into two groups.

Apparatuses generating pulsed magnetic lines of force having a magnetic potential of 1,000 ampere

45 turns, pulse width of 1/100 seconds, and pulse interval of 1/20 seconds, were placed around one of the groups about 0.5 m above the root, and the group received 15 minute irradiation of the alternating pulsed magnetic field every morning and evening for one year.

The group of plants treated according to the

50 present invention was significantly strong in tree vigor, and their fruits were superior in colour and taste to those of the unirradiated control. Also, on average, a Z-fold increase in the yield of the crop

55 was obtained.

#### Example 7

Seed of "ENOKI-TAKE", *Flammulina velutipes*, a

60 type of mushroom, which had been subjected to 20°C seed culture using a liquid culture medium containing 2 w/v - malto extract was inoculated on two aliquots of a solid culture medium, consisting of 4 parts by weight of sawdust of a chinquapin, *Castanopsis cuspidata* var. *Sieboldii*, 1.5 parts by

65 weight of rice bran and 7.5 parts by weight of

water, and cultivated at 18-20°C for 40 days, in conventional manner. During the cultivation, one of the solid cultures was placed at about 1 m from an apparatus generating pulsed magnetic lines of

70 force having a magnetic potential of 1,000 ampere turns, pulse width of 1/200 seconds, pulse interval of 1/10 seconds, and irradiated every six hours with the alternating pulsed magnetic field for 15 minutes.

The culture treated according to the present invention was superior in the growth of mycelia to the unirradiated control, and the average yield of mycelia was about 3.3-fold higher than that of the

75 control.

#### Example 8

Each of 15 liter liquid medium aliquots, consisting of 2 w/v % soluble starch, 1 w/v %  $\text{NH}_4\text{NO}_3$ , 0.1 w/v %  $\text{K}_2\text{HPO}_4$ , 0.05 w/v %  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ , 0.5 w/v %

85 corn steep liquor, 1 w/v %  $\text{CaCO}_3$  and water, was placed in a jar fermenter, and sterilised by heating at 120°C for 20 minutes. After cooling each liquid medium to 50°C, a seed culture of *Bacillus stearothermophilus* FERM-P No. 2222 was inoculated thereto in an amount of 1 v/v %. An apparatus

90 generating pulsed magnetic lines of force having a magnetic potential of 1,000 ampere turns, pulse width of 1/400 seconds, and pulse interval of 1/10 seconds, was placed on the inside wall of one of the jar fermenters which was then incubated at

95 50°C for 48 hours under aeration-agitation conditions while irradiating with the alternating pulsed magnetic field. Another jar fermenter, used as the control, was incubated similarly as above but without irradiation.

The level of cyclodextrin glucanotransferase in the jar fermenter treated according to the present invention was about 45% higher than that in the

100 unirradiated control.

#### CLAIMS:

1. A method for promoting the productivity of an animal, a plant, or a microorganism, which method comprises: irradiating the animal, plant or

110 microorganism with an effective amount of an alternating pulsed magnetic field having a waveform similar to that of an a.c. waveform (diphasic action potential).

2. A method as claimed in Claim 1, wherein the pulse width of the magnetic pulse is from 1/500 to

115 1/50 seconds.

3. A method as claimed in Claim 1 or 2, wherein the pulse interval of the magnetic pulse is

120 from 1/100 to 1 second.

4. A method as claimed in Claim 1, 2 or 3, wherein the magnetic potential of the magnetic pulse is from 10 to 100,000 ampere turns.

5. A method as claimed in any one of the preceding Claims, wherein the alternating pulsed magnetic field is generated by passing a pulsed

125 current having an a.c. waveform (diphasic action potential) through a magnetic coil.

6. A method as claimed in any one of the preceding Claims, wherein the animal is a pig,

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chicken, cow or pearl oyster.

7. A method as claimed in any one of Claims 1 to 5, wherein the plant is a Japanese radish, muscut of Alexandria or "ENOKI-TAKE".

5 8. A method as claimed in any one of Claims 1 to 5, wherein the microorganism is one of the species *Bacillus stearothermophilus*.

9. A method for promoting the yield and quality of a product obtained from an animal, plant or microorganism, which method comprises: irradiating the animal, plant or microorganism with an effective amount of an alternating pulsed magnetic field having an a.c. waveform (diphasic action potential).

10 10. A method as claimed in Claim 9, wherein the animal- or plant product is meat, milk, egg, fur, cocoon, pearl, a plant stem, flower, fruit, cell, antibiotic, enzyme or biologically-active substance.

11. A method according to Claim 1 substantially as described in any one of the foregoing Examples.