

[54] **METHOD OF ELECTROSENSITIVE
PRINTING OR RECORDING AND
APPARATUS THEREFOR**

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[56]

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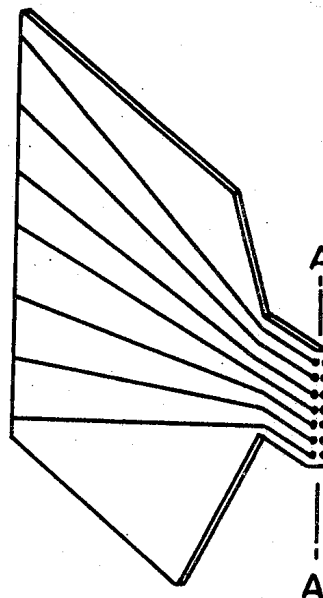
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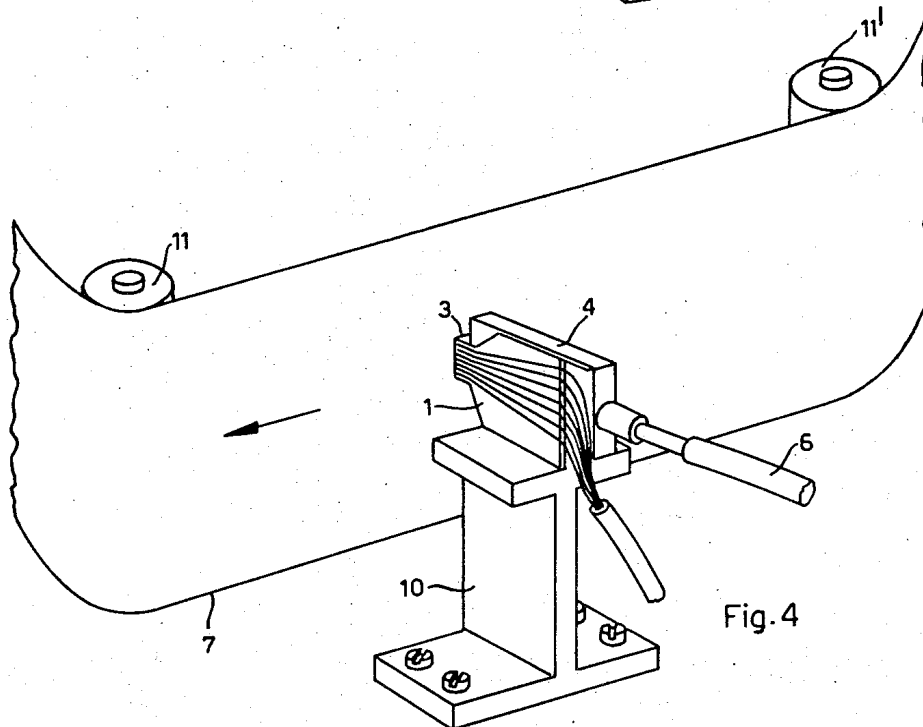
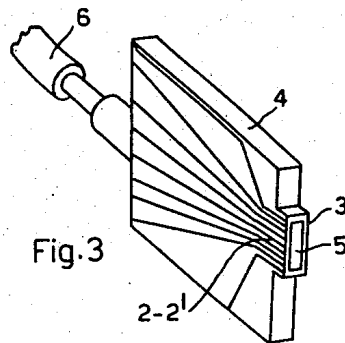
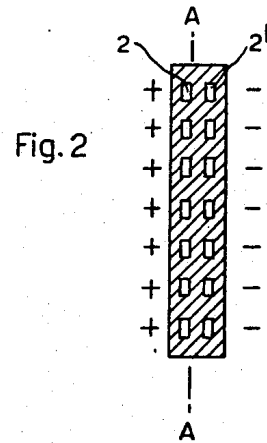
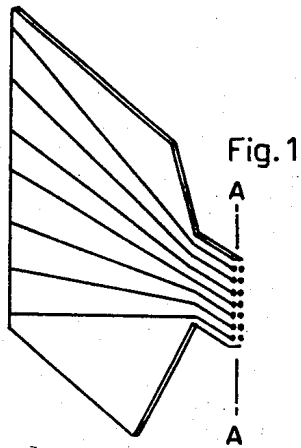
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ABSTRACT

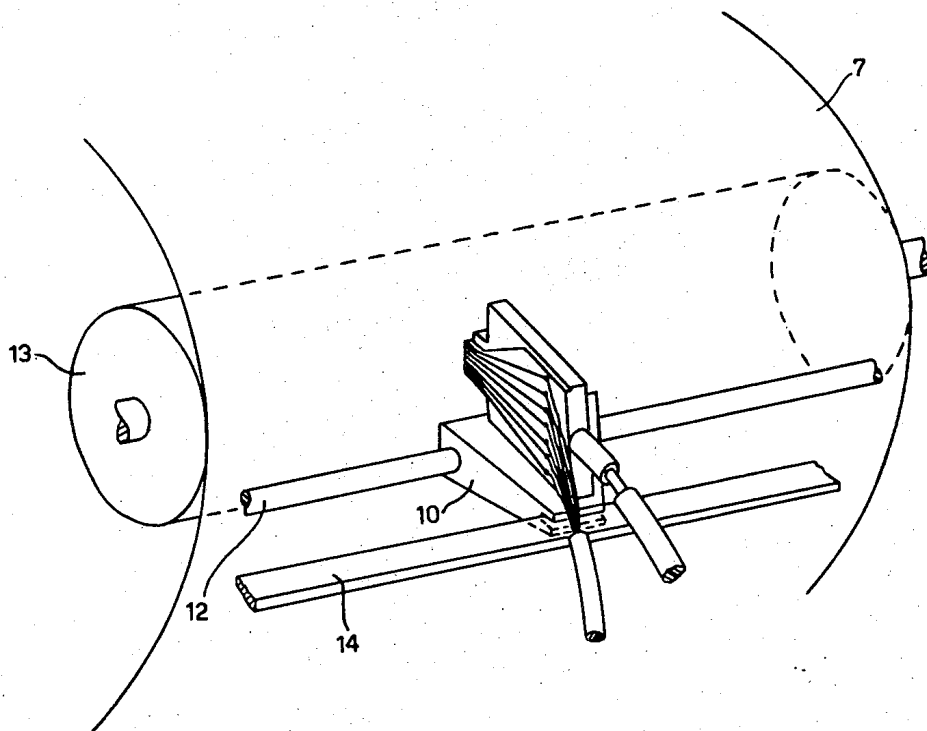
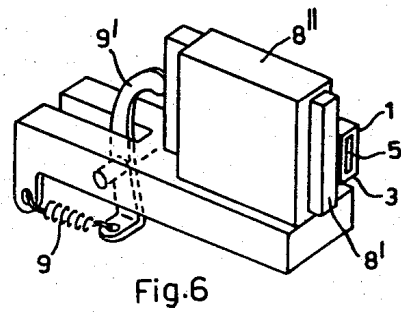
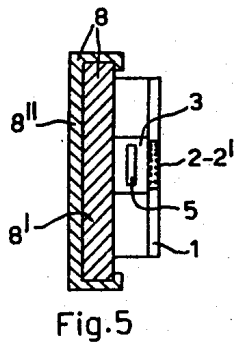
A method and apparatus for electrosensitive printing or recording on a trackless, untreated paper sheet which utilizes a head consisting of a pair or series of pairs of electrodes located on the same side of the paper sheet, the electrodes of each pair being opposite in polarity and the head being coupled to a device for impregnating the paper sheet with an electrolytic solution immediately before printing or recording thereon.

17 Claims, 7 Drawing Figures





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METHOD OF ELECTROSENSITIVE PRINTING OR RECORDING AND APPARATUS THEREFOR

The present invention concerns an improved method and apparatus for the electrosensitive printing or recording on preferably untreated paper.

More particularly, it relates a method of electrosensitive printing or recording free of recording tracks and the relative apparatus wherein a printing head, composed of a pair or of a series of pairs of electrodes, is electrically energized with formation, by spots, of alpha-numeric signs on untreated paper whereon is previously applied, immediately before the printing, an electrolytic solution.

There are known numerous processes using electrode systems on paper previously treated, for the printing or electrosensitive recording of alpha-numeric signs, diagrams, facsimile reproductions or the like.

These processings make normally use of electrode systems wherein the paper destined to the recording is passed between electrodes having opposite sign. For an effective operation of these systems it is necessary to completely impregnate the paper by an electro-chemical solution, what renders the operation intricated in the relative apparatus as it requires an initial phase of total wetting of the paper and consequently a final drying phase of the same.

A further more important inconvenience resides in the low recording speed, namely in the low frequency allowed as a consequence of the formation of tracks and "comets" which would appear in the event the operation should occur at a higher speed, namely at a higher frequency.

In order to obviate these disadvantages it has been proposed the use of recording elements of more complex structure, composed of a non conducting support carrying a layer of electrically conducting material covered by an electrosensitive layer. This system, though obviating the speed limiting, has however many not satisfactory features, both due to the limitation imposed by the use of the necessary special element and for the scarcity of the recordings obtainable therewith. Furthermore, during the operative phase, there occur olfactory emanations which are markedly unpleasant and persistent.

It is known that the recording of a given impulse, both of current or of voltage, is bound to the duration of said impulse and to its amplitude. By means of the impregnated papers used till now, for obtaining the recording of an impulse having a gradually decreasing duration it needs the corresponding increasing of the amplitude till very high voltage values, in the order of 500 V. This is obtained only on the condition of remarkably complicating the electronic control system and with strict observance of safety regulations for the user, considering the voltage values which greatly exceed the ones allowed by international regulations.

A further disadvantage, in the systems wherein is contemplated the wetting of untreated paper, prior to the recording, are conferred by the employed wetting means which, in practice, results in being completely impracticable owing to the difficulty of an uniform and fluent drainage of the contemplated solution, especially at high speeds.

In order to increase the definition of the signs recorded at recording speed limitedly higher of the one previously obtainable a recording system is proposed

wherein a negative electrode is placed insulated from and adjacent the anode of a normal recording head, whereby the motion of the paper is perpendicular to the place containing the electrode axes. A first disadvantage shown by such a system is given by the scarce practical feasibility of the concurrent utilization of a plurality of aligned writing electrodes, as a consequence of the dissymetry of the electric field existing between the most external pins and the internal ones. Such dissymetry turns into a non uniformity in the contrast of the recorded alpha-numeric signs. The above mentioned concurrent utilization of a plurality of writing electrodes has, as a consequence, a not sufficient compactness of the recorded signs, whereby the use of the system remains confined, in the practice, to the recording of tracks by spots, as diagrams and the like. A second disadvantage is given by the impossibility to reach absolutely higher speed as it would lack the definition according to the motion direction of the paper. Such geometric arrangement would in fact not eliminate the disadvantage of the formation of tracks in the direction of the paper motion.

An object of the present invention is therefore the realization of an electrosensitive printing or recording system consenting allowing the elimination of the above mentioned disadvantages and this by means of a recording apparatus of particularly simplified structure and operation principle.

More particularly the present invention contemplates a new electrosensitive printing or recording method and the relative apparatus which operates free of recording tracks, based upon a special construction and disposition of one or a plurality of electrode pairs and, in its preferred embodiment, of the relative device for impregnating the paper to be recorded.

The system comprises, in its preferred embodiment, a writing head composed of a certain number of electrode pairs which may be vertically arranged or in a different way according to the system of the character formation contemplated in the different possible applications, such as for example formation of alpha-numeric characters or recording by parallel, serial printers, facsimile transmission and the like.

The electrode pairs, each being built up of a positive electrode and of a negative one, are located on the same side of the paper sheet to be recorded, what differs with respect to majority of the known systems. The head built thereof shows, in a preferred embodiment, a first row of electrodes of a given sign whereto is closely adjacent a second row of electrodes of opposite sign, being however each electrode of a given sign placed closely sidewise the correspondent electrode of opposite sign. The head is coupled to a device for impregnating the paper, essentially composed of a duct provided with a slit placed, according to its length, in parallel relation to the main axis of the head. Such device is held in contact to the paper by means of a certain pressure produced by means of a suitable system, known per se. For the recording, according to the particular equipment wherein the head can be employed, different conditions of relative motion of the paper and/or of the head can be foreseen, particularly: movable paper and stationary head; movable paper and movable head; stationary paper and movable head. In whatever employing system the relative paper head

motion direction is perpendicular to the main axis of the same head. Obviously, the wetting device will be coupled to the head in such a position as to guarantee the impregnation of the paper immediately before the writing.

The particular parallel disposition of the electrode pairs fulfills different functions, one of the main whereof is that to guarantee the definition of the signs, without formation of tracks. In fact the close position of the electrodes allows that, during the dissociation state occurred in the solution employed for the impregnation of the paper incidental to the flowing of current, the cathodic product results in close proximity to the writing anodic product. In such a condition, the track which would be theoretically produced owing to the mechanical sliding of the writing anodic product being in contact to the head, is immediately annulled by effect of the re-combination of the original compound.

The impregnating solution is contained in a reservoir which concurrently serves to generate the necessary pressure to drain the fluid from the reservoir through said impregnating device, to the surface of the paper. When it has reached the surface of the paper through the impregnating slit, due to the pressure exerted by the draining device, it becomes uniformly laminated ensuring the superficial impregnation of the paper.

The present system provides, in its structure, not only a sure improvement with respect to the known systems, but also delivers numerous advantages of economy and practicality. Particularly, besides a simplifying in the method and in the structure of the relative equipment, the results of recording are characterized by a very high speed of recording, the use of voltages maintained within low values, not exceeding 40 V, a good contrast and a very good definition of the recorded signs, and the use of paper of the type not containing electrosensitive substances, which is conversely necessarily employed by the known systems, but which can advantageously be any writing paper of the type commonly on the market; furthermore the system doesn't require a drying operative phase of the paper as the film of fluid, applied in the described mode, spontaneously evaporate after few fractions of seconds at normal temperature, pressure and dampness conditions.

The special disposition of the electrode pairs furthermore allows a particular writing compactness resulting in the possibility to approximate said pairs, and an uniform and accentuated contract owing to the distribution uniformity of the inter-electrode power lines.

The system according to the invention is adapted for recordings under conditions of variable recording speed, from the minimal admitted to the maximum admitted by the mechanical apparatus the technique can offer nowadays. According to such recording conditions, and within the limits of the lower speeds, there can be employed electrochemical solutions of the type known for impregnating the electrosensitive papers commonly used in the wet electrosensitive recording systems. The same system, modified for the use of the only head with the exclusion of the impregnating system, results in being favorable for the employment of electrosensitive papers of the known dry type.

This and other characteristics of the present invention will become apparent from the following description wherein, by way of example and not in a limiting sense, are illustrated two preferred embodiments with reference to the accompanying drawings, wherein:

DRAWINGS

FIG. 1 is a perspective view of a writing head, according to the invention;

FIG. 2 is an enlarged front view of said head;

FIG. 3 is a perspective view of the head coupled to the impregnating device;

FIG. 4 is a perspective diagrammatical view of a printing system wherein the head-wetting device group is stationary and the paper is movable;

FIG. 5 is a front view of the head-wetting device group, coupled to a guide-pressure device;

FIG. 6 is a perspective view of the embodiment of FIG. 5;

FIG. 7 is a perspective view of a printing system wherein the paper is stationary and the head is movable.

An apparatus according to the invention comprises, in a preferred embodiment (FIG. 1) a head 1 composed of a series of electrode pairs 2 - 2' (FIG. 2), symmetrically distributed with respect to the main axis A, which can be realized according to various methods, known per se, such for example as by serigraphic application of a first row, of a given sign, on a support plate of any suitable insulating material, application of a thin insulating layer and then application of a second parallel row, of opposite sign. In the area reserved for the writing the end portions of the electrode pairs 2 - 2' are arranged in parallel relation, while their extensions diverge so as to allow the connection to the respective electric parts.

The head 1 is integral to a wetting device 3 composed of a duct 4 provided with a slit 5 arranged, referred to its length, in parallel relation to the main axis A of the head 1. Inside the slit 5 is provided a tongue, not indicated in the drawing, which provides for the closure of the duct in the rest phase. The duct 4 (FIGS. 3-4) is connected by means of a pipe 6 to a reservoir, not indicated in the drawing, wherein is contained the impregnating solution in the pressure condition adapted to guarantee the regular draining to the surface of the paper. The wetting device 3, integral to the head 1, is held in contact to the paper 7 by means of a certain pressure generated by means of a suitable system, known per se, which can be for example composed of the aggregate illustrated in FIGS. 5-6, wherein the wetting device 3 is integral, on the side which is opposite to the one connected to the head 1, to a guiding-pressure device 8 composed a pressure support 8', which can be made up of any preferably insulating material, slidable within a guiding housing 8''. The pressure support 8' is held under pressure, together with the wetting device 3, in the direction of but not in contact with the paper 7, while the wetting device 3 is in this way pressed against the paper. Such pressure is guaranteed by devices, known per se, such for example as a lever-spring 9-9' system.

In the operative phase, as the one diagrammatically illustrated in FIG. 4 by way of example, the aggregate composed of the head 1 coupled to the wetting device 3

and pressure device 8 group, is mounted on a stationary support 10, thus resulting in a stationary position with respect to the motion of the paper which is accomplished by means known per se, for example by driving rollers 11-11', in the direction shown by the arrow.

The electric signals are applied to the head 1, by means of the wires which connect the individual electrode pairs 2-2', by an electronic control unit known per se not indicated in the drawing, which obviously will be different according to foreseen specific employments.

From the wetting device 3, held by a pressure against the paper 7, flows an uniform lamina of electrolytic solution which wets the paper, only in its superficial layers, immediately before the passage of the electric signals and which, when the recording is accomplished, spontaneously evaporates in the space of some seconds. The recording speed of the system just now described can reach and exceed the 1,000 whole alphanumeric characters, per second.

Another operative system is illustrated, for example, in FIG. 7 wherein the head 1 and wetting device 3 aggregate, mounted on a support 10, is slidably mounted on a guide 12, with respect to the paper 7, being this stationary during the writing operation but slidable, according a line feed motion, on a platten 13 during the new-line return time of the head-wetting device aggregate. The guide 12 guarantees the parallelism of the head-wetting device system, during the straight-line motion of the latter, in relation to the paper holding platten 13. The guide 14 ensures in turn the perfect contact of the head 1 to the paper holding platten 13, as in this event a slight concavity is imparted to the head according to a radius coincident with the one of the platten. Considering the motion of the head-wetting device aggregate, the connection of the wetting-unit 3 with the reservoir is guaranteed by a flexible pipe. Also in this event the electric signals are applied to the head 1 by means of systems known per se, for example by the medium of connection wires incorporated in a plastic material housing resisting the repeated flexure stresses etc. The reciprocal motion of the system is realized according to systems known per se, which allow to reach printing speeds of the order of 500 whole characters per second, depending the higher speed upon the lower momentum of the head-accessory group.

Very good results have been obtained by applicant by means of the use of one solution which foresees, as components providing to the colored reaction, potassium iodide, potassium bromide and starch, in the presence of polyvinyl alcohol as the dispersion means and of thiourea as a stabilizer, being such solution prepared by such temperature and concentration conditions as to maintain unaltered the initial structure of the starch.

Among the cited components, the presence of the polyvinyl alcohol, known per se as a dispersing means, resulted as particularly efficient for its structural characteristics, comparable, in the electrochemical behavior, to those of the starch. Particularly, by an aqueous solution of polyvinyl alcohol it is possible to obtain values of the viscosity useful for maintaining in suspension granular particles of starch. Furthermore, the polyvinyl alcohol, also in presence of salts, does not appreciably alter the electrolytic conductance.

The solution according to the invention, contained by a reservoir which concurrently generates the pressure necessary for draining the fluid, arrives, through an impregnation device, to the surface of the paper, where it is laminated in an uniform way ensuring the superficial impregnation of the paper. This impregnation is accomplished in the immediate vicinity of the head, the particular disposition of which consents that, during the state of dissociation established during the flow of current, the cathodic product can reside immediately adjacent the writing anodic product. In such conditions, namely, while the iodine which is liberated at the anode reacts with the powdered starch, being the reaction favored by the oxidizing action of the bromine which also liberates at the anode, thus allowing iodine to be incorporated through the helocoidal structure of the starch, there occurs, in the area of mechanical sliding of the head, the immediate re-combination of the original colorless compound.

By the solution according to the invention it is possible to operate with extremely low voltages, in the order of 5 V, and with currents of the order of fractions of 1 milliampere. Furthermore, for a prefixed voltage, the duration time of one impulse can be shorter than 20 microseconds, what allows to attain thereby providing very high printing speeds.

It is intended that changes, improvements and addition of parts may be made to the printing or electrosensitive recording system without departing from the scope of the invention.

We claim:

1. A trackless electrosensitive printing or recording apparatus, for recording or printing information on a receiving element comprising:

a. an electrode system responsive to electrical impulses for printing or recording information on said receiving element, said electrode system being positioned in engagement with and on the same side of said receiving element, said electrode system including at least one spaced apart electrode pair, one electrode of said electrode pair being of positive polarity and the other electrode of said electrode pair being of negative polarity, said positive and negative electrodes being placed in side by side linear relationship; and

b. means for relatively moving said receiving element and said electrode system in a direction parallel to said linear placement so that said receiving element first moves past one electrode of said electrode pair and then past the other electrode of said electrode pair.

2. An apparatus as claimed in claim 1, including a wetting device positioned on an axis drawn through said pair of spaced electrodes.

3. An apparatus as claimed in claim 1, wherein said electrode system further comprises a head including a first row of electrodes of a given polarity and a second row of electrodes of an opposite polarity parallel and closely adjacent to said first row of electrodes, and a wetting device adjacent to said head and biased into engagement with said receiving element.

4. An apparatus as claimed in claim 3, wherein said head comprises a series of electrode pairs, the electrodes of each of said pairs being symmetrically distributed about a central axis through said head, said

electrodes being encased in a support plate of insulating material such that said electrodes of each of said first and second rows are near to one another in the area adjacent said receiving element and divergent in the area remote from said receiving element to facilitate the electric connection of said head to a source of electrical impulses.

5. An apparatus as claimed in claim 3, wherein said wetting device is connected to a reservoir containing an electrolytic solution, and reservoir and said electrolytic solution being under pressure to force said solution through said slit into contact with said receiving element.

6. An apparatus as claimed in claim 3, including a platen supporting said receiving element and wherein said head is provided with a slight concavity having a radius equal to the radius of said platen.

7. An apparatus as claimed in claim 3, wherein said means for relative movement comprise a movable support for said head and a guide slidably carrying said support for movement relative to said receiving element substantially perpendicular to said main axis, and wherein said wetting device is connected to said reservoir by means of a flexible pipe.

8. An apparatus as claimed in claim 3, wherein said wetting device comprises a duct and a slit exit for said duct which is parallel to a central axis of said head established between said first and second rows of electrodes.

9. An apparatus as claimed in claim 8, wherein the wetting device is mounted on a support which is held in sliding engagement in a guide housing.

10. An apparatus as claimed in claim 9, wherein said head is mounted on said support such that when said support is biased toward said receiving element only said head and said wetting device engage said receiving element.

11. A method of electrosensitive printing and recording information on a receiving element comprising the steps of:

- a. positioning at least one pair of electrodes on the

same side of said receiving element, one electrode of said electrode pair being of a given polarity and the other electrode of said electrode pair being of an opposite polarity, said electrodes being in side-by-side linear relationship;

- b. moving said receiving element first past said one electrode and then past said other electrode in a direction parallel to the linear placement of said electrodes; and

- c. supplying to said electrodes electrical impulses to form, by means of spots, alpha-numeric signs on said receiving element.

12. The method as claimed in claim 11 further including:

- a. depositing an electrolytic solution on said receiving element by means of a wetting device positioned adjacent said receiving element on the same side thereof as said electrodes.

13. The method as claimed in claim 12, wherein said recording head includes a first row of electrodes of a given polarity and a second row of electrodes of an opposite polarity parallel and adjacent to said first row, and said wetting device is parallel to the main axis of the recording head between said first and second electrode rows, said method including the step of moving said recording element past said first row of electrodes, said wetting device and said second row of electrodes in succession.

14. The method of claim 12, including the step of applying a solution comprising potassium iodide, potassium bromide and starch in the presence of polyvinylalcohol and thiourea.

15. The method of claim 12, including the step of applying said electrolytic solution to the receiving element in the immediate vicinity of said electrode head.

16. The method of claim 12 including the step of limiting said electrical impulses to voltages on the order of 5 volts and currents in the order of 1 milliampere.

17. The method of claim 12 including limiting the duration of each of said electrical impulses to less than 20 microseconds.

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