A. ROSENBERG.

ELECTROMAGNETIC VIBRATOR FOR LOCAL APPLICATION TO THE PERSON.

APPLICATION FILED FEB. 19, 1910.

1,000,294. **Patented Aug. 8, 1911.**

2 SHEETS—SHEET 1.

Fig. 2.

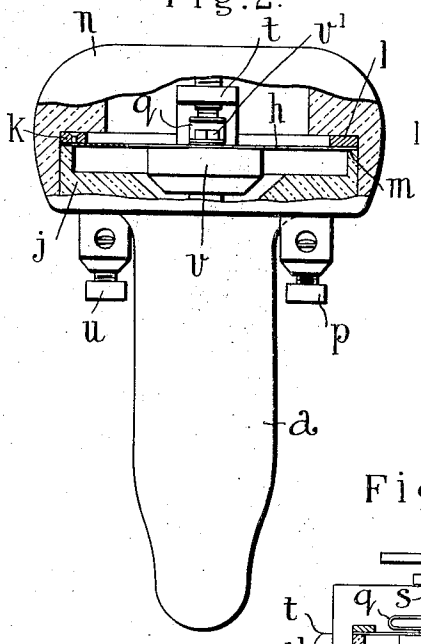

Fig. 1.

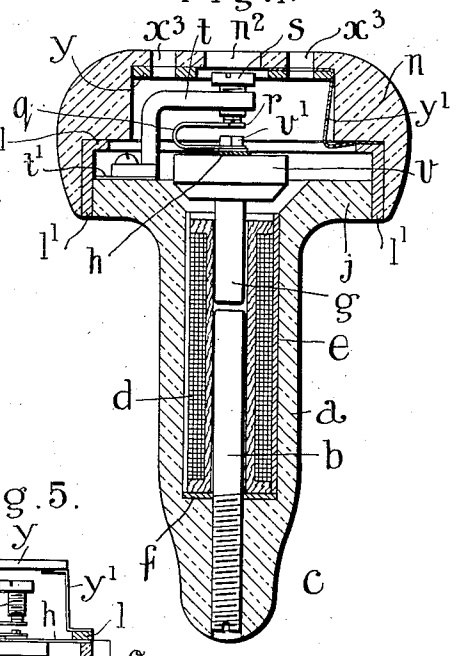

Fig. 5.

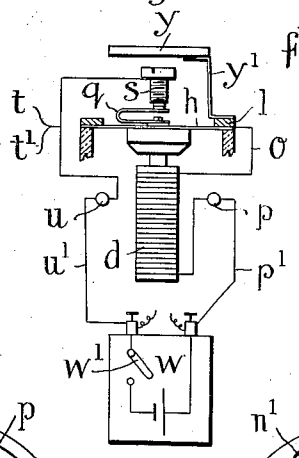

Fig. 4.

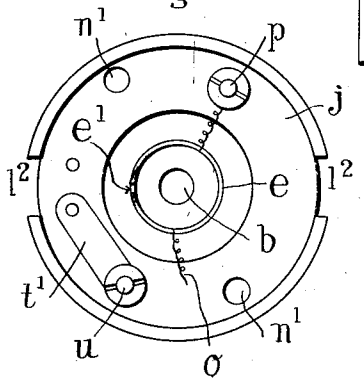

Fig. 3.

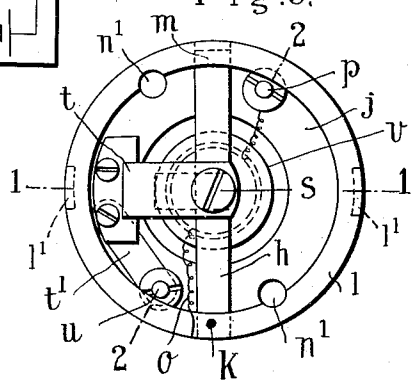

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Fig. 6.

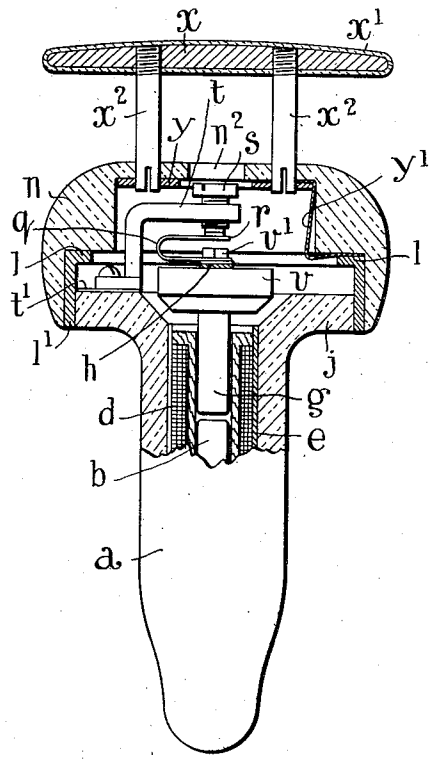


Fig. 8.

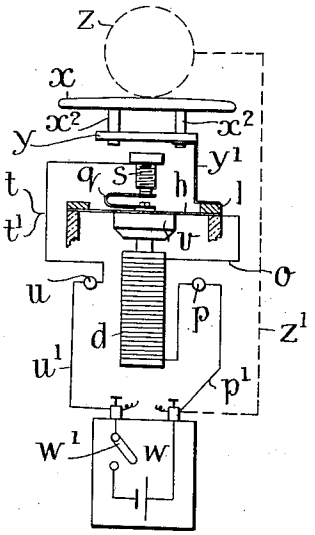


Fig. 7.

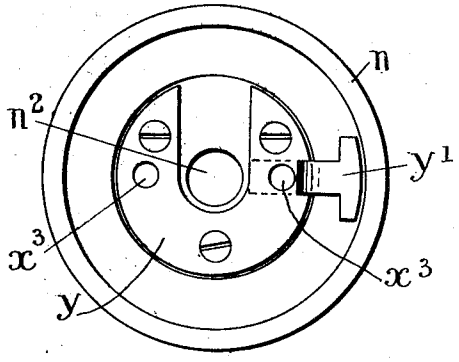
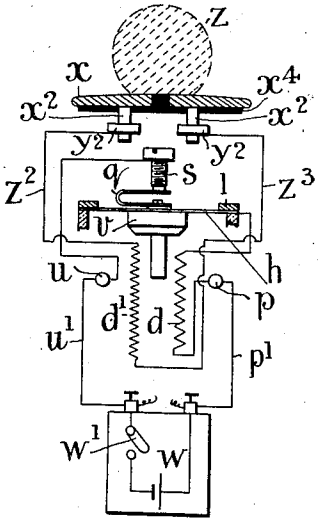


Fig. 9.



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ELECTROMAGNETIC VIBRATOR FOR LOCAL APPLICATION TO THE PERSON.

1,000,294. Specification of Letters Patent. **Patented Aug. 8, 1911.**

Application filed February 19, 1910. Serial No. 544,929.

To all whom it may concern:

Be it known that I, AUGUSTUS ROSENBERG, a subject of the King of Great Britain, and resident of London, England, engineer, have invented an Improved Electromagnetic Vibrator for Local Application to the Person, of which the following is a specification.

This invention relates to an improved instrument for the production, and local application to the person, of continuous, rapid, and intense mechanical vibrations or oscillations of a character suited to the treatment of various maladies which are capable of being temporarily or permanently amelioration thereto of the mechanical vibratory massage, and to the combination with said instrument of means whereby, when desired, a pulsatory electric current may be passed through the body from the point of application thereto of the mechanical vibratory treatment and simultaneously with the latter.

Among the complaints which have been found to yield to vibratory treatment, may be specially instanced sea-sickness and similar distressing maladies, which are relieved by the employment of the instrument in such manner as to effect the transmission, to the aural labyrinth, of the vibrations produced by means of the invention. While the origin of sea-sickness is obscure, the discomfort would appear to be due to a peculiar excitement communicated to the nervous system, more especially in the gastric region, from the nerves of the aural labyrinth in consequence of the relatively slow rhythmical surging of the lymph within the semi-circular canals, induced by the swaying movement (particularly in the vertical direction) to which the whole body is subjected; the relief resulting from the application of the invention being apparently due to the fact that the exciting effects of the relatively slow surging of the lymph are lost in or overcome by the more rapid and intense agitation produced by the mechanical vibrations or oscillations transmitted through the osseous structure of the head.

The invention is also well adapted for use in the treatment of deafness by the application of massage to the middle and inner ear, whether with a view of curing or ameliorating the complaint, or of maintaining in proper condition the structure and tissues of the inner portions of the auditory canal when these have already been treated by other means so as to effect the restoration or improvement of impaired hearing power.

The invention, although thus adapted for application to or through the medium of the auditory canal, is not confined in its use to any one part of the body, but may be employed in connection with any local or general ailment for which the vibratory (or the combined vibratory and electrical) treatment is found beneficial.

In the accompanying drawings, Figure 1 is a longitudinal axial section, taken on line 1—1 of Fig. 3, showing the instrument of the present invention as adapted for the administration of mechanical vibratory treatment only. Fig. 2 is a side elevation, partly in section, on line 2—2 of Fig. 3. Fig. 3 is a view of the outer end of the instrument with the cap removed, and Fig. 4 is a similar view, the armature of the electro-magnet, the bridge-spring and conductive ring which support the armature, and the contact terminal of the make-and-break device, being also removed. Fig. 5 is a diagram of the electrical connections employed for the administration of the mechanical vibratory treatment. Fig. 6 is a part sectional view, similar to Fig. 1, showing a very simple attachment whereby the instrument constructed as illustrated in Figs. 1 to 5 may be adapted for the administration, concurrently with the mechanical vibratory treatment, of electrical treatment by means of "extra current"; Fig. 7 being an inverted plan view of the cap shown in Fig. 6, and Fig. 8 a diagram of the electrical connections employed. Fig. 9 illustrates, diagrammatically, a modified construction and electrical connections employed for the administration, concurrently with the mechanical vibratory treatment, of electrical treatment by means of "induced current".

Referring first to the construction illustrated in Figs. 1 to 5, the instrument, which may be termed an improved electro-magnetic vibrator, comprises a casing, preferably of ebonite or like material, of approximately mushroom shape, the stem *a* being usually of a diameter and configuration adapted for insertion into the external meatus of the ear or other cavity of the body. As the entire instrument thus, as a rule, occupies but a small space, it is important that its internal construction should be adapted to afford the greatest intensity of vibration relatively to the total mass

available. For this reason the electro-magnetic device employed is of a character adapted to combine the functions of an electro-magnet in attracting its armature, with those of a solenoid in producing movement of its core, the combined armature and core being caused (in consequence of the rapid and repeated alternate making and breaking of the circuit of the winding) to produce a rapid and continuous series of vibrations or oscillations which are transmitted to the casing.

Concentrically with the axis of the tubular stem *a* of the casing is fixed a soft iron rod *b* which may be made to screw adjustably through the terminal portion of the stem as indicated at *c*, and which extends longitudinally through a bobbin carrying a winding *d* of fine insulated wire and fitting within the tubular stem; an iron sheath *e* being preferably interposed between the bobbin *d* and the wall of the stem *a*. This iron sheath *e* (which may be formed of split tubing or of thin sheet metal lapped about the bobbin so as to leave a longitudinal gap as indicated at e^1, Fig. 4) serves as an external annular pole-piece for the magnet, the inner end of the sheath being made to seat itself against an iron disk *f* which occupies the bottom or inner end of the bore of the tubular stem and has a central hole through which the core *b* may be screwed so as to maintain contact with the disk.

The fixed core *b* does not extend through the entire length of the bobbin *d;* the outer portion of the axial passage through the latter being occupied by a separate core *g* adapted to serve both as the armature of the electro-magnet and also as the movable core of the solenoid constituted by the winding. The outer end of this core-armature *g* (as it may be termed) is attached to a steel leaf-spring *h* which bridges a cavity within the enlarged mushroom head *j* of the casing; the spring *h*, which extends diametrically of the chamber provided in the mushroom head, being pivoted or otherwise fixed by one of its ends (as indicated at *k*) to a ring *l* of conductive material surrounding the mouth of the casing while its other end *m* is held frictionally between the ring *l* and the edge of the mushroom-head *j*, so as to afford sufficient freedom of movement to the core-armature *g*. The ring *l*, which may be prevented from turning by a pair of lugs l^1 upon the underside of the ring engaging in recesses l^2 provided in the periphery of the mushroom-head *j*, is held in position by means of a cap *n* forming a closure for the cavity in the mushroom-head *j*. This ring *l* serves for the conveyance of current between the spring *h* and one end of the winding, the connection between the ring and winding (which may be maintained by a wire as at *o*) being permanent; while the other end of the winding is attached to a conductor which forms one member of the circuit and is led from one pole of the source of energy into the casing by way (preferably) of a screw-terminal *p* projecting at the underside of the mushroom-head.

Attached to the outer side of the bridge-spring *h* is an auxiliary or buffer-spring *q* which is tipped as at *r* with non-oxidizable metal so as to be adapted to form the movable member of the make-and-break device, the other or stationary member of said device being constituted by a set screw *s* adjustable through a threaded hole provided, in axial alinement with the core, in a bracket *t* of conductive material fixed within the hollow mushroom-head *j* and cap *n*. To this bracket is connected (preferably through the medium of a metal plate t^1) a conductor which forms the second member of the circuit and is led from the second pole of the source of energy preferably by way of a screw-terminal *u* carried by the plate t^1 and projecting at the under side of the mushroom-head.

By the use of the auxiliary or buffer-spring *q* just mentioned, the core-armature *g* is enabled to perform a longer stroke, while the interval between successive closures and interruptions of the circuit is lengthened so that, the core-armature being permitted to acquire greater momentum than would otherwise be attainable, the force of the vibration produced (by the arrest of the oscillation of the core-armature) each time the circuit is closed and broken is considerably increased. The actual length of stroke performed by the core-armature *g* may be regulated by screwing the core *b* toward or from the core-armature, for which purpose the outer end *c* of the core *b* preferably presents a notch at the open extremity of the tubular stem *a* of the instrument as shown. The cap *n*, which is preferably held in position by screws as at n^1 may also have a central aperture n^2 giving access to the head of the set-screw *s* so that the latter may be readily adjusted as required.

In order to augment the mass of material in motion, the outer end of the core-armature *g* may be provided with an enlargement in the form of a relatively thick disk-like piece of iron *v* constituting a head; the buffer-spring *q*, bridge-spring *h*, and head *v* being all secured to the core-armature *g* preferably by means of a nut v^1 screwing upon a reduced and threaded prolongation of the core-armature which passes through holes in those parts.

It is to be observed that, while the employment of an electrical make-and-break device for the purpose of producing a continuous series of mechanical vibrations for

transmission to the body is not new, the present invention enables vibrations to be produced which are devoid of the hard and irritating character practically inseparable from vibrations obtained with apparatus wherein the armature of an electro-magnet performs in effect the function of a rigid hammer beating upon a rigid anvil. This absence of any hard quality in the vibrations is due on the one hand to the cushioning effect of the buffer-spring q when the masses of metal g and v move in the one direction, and on the other hand to the fact that, when these masses move in the other direction, the core-armature g is not permitted to strike upon the core b of the winding d, nor is the mass of metal v permitted to contact with the external pole-piece e, the momentum acquired by the masses g and v being then checked and absorbed by the bridge-spring h alone.

It will be obvious that while the stem a of the mushroom shaped casing is well adapted for introduction into any cavity of the body, the top of the cap n, being relatively broad and flat, is better fitted for application (for example) to the eyeball or other part where a larger surface of contact is desirable. This capability on the part of the instrument, of being reversed or applied in any position or direction, results from the fact that the entire mass of the casing (in consequence of the rapid oscillation of the internal movable masses) is maintained equally in a state of intense (although normally invisible) vibration; the instrument of the present invention being thus distinguished from those apparatus wherein an externally presented element, serving the function of a hammer, moves relatively to the rest of the instrument and is alone adapted for application to the person of the patient.

Current may be obtained from a small battery (w, Fig. 5) carried in the pocket and provided with a switch w^1, so that, the terminals u, p of the instrument being connected to the poles of the battery by wires as at u^1, p^1 respectively, the instrument can be readily brought into operation under any circumstances without attracting special attention.

When the instrument is used for the administration of combined vibratory and electrical treatment, a circuit is established through the body of the patient in such manner that, without any expenditure of power beyond what is necessary for the production of the mechanical vibrations, a series of electrical shocks will be communicated by the passage of a pulsatory current through the body from the point at which the instrument contacts therewith.

The current passed through the body of the patient may either be (as in the arrangement illustrated in Figs. 6 to 8) the "extra current" generated, each time the circuit is broken, in a shunt from the main circuit, the body forming part of said shunt circuit; or may be (as in the arrangement illustrated in Fig. 9) the current induced in the secondary winding of an induction coil whereof the primary winding is constituted by the coil d already described; the body forming part of the secondary circuit. In either case contact is established with the body of the patient by means of a metal contact plate x (preferably of zinc, and circular) detachably mounted on the cap n and covered, as indicated in Fig. 6, with a pad x^1 of absorbent fabric moistened with (say) salt water to insure proper conduction to the skin of the patient.

In the case of the "extra current" arrangement (Figs. 6 to 8), the contact-plate x may be in one piece, which, on being mounted in position, is automatically brought into permanent electrical connection with one member of the circuit of the electro-magnet inside the instrument, the shunt circuit established through the plate x and the body of the patient being closed by the patient touching (directly or through some metallic connection) a pole of the battery w. In the case of the "induced current" arrangement, the contact-plate x may be either in one piece as above described, or (as in Fig. 9) in two portions separated or insulated from one another, these portions, when mounted in position, being automatically brought, respectively, into permanent electrical connection with the opposite ends of the secondary winding coiled about the winding d.

Describing, first, the arrangement illustrated in Figs. 6 to 8, it will be observed that the metal contact-plate x (which is shown as formed of a single piece) is detachably secured to the cap n by means of a pair of spring metal studs x^2 fixed to the back of the plate and passed through holes x^3, (Figs. 1 and 7) in the top of the cap; the inner ends of the studs, when thus inserted, being wedged into corresponding holes in a metal plate y attached to the inner surface of the cap. When the cap is mounted in position on the mushroom-head j of the instrument, electrical connection is established between the plate y and the ring l already mentioned, by means of a spring metal tongue y^1, as indicated in Figs. 1 and 6.

When in use, the moistened pad x^1 is applied to the person of the patient (represented diagrammatically in Fig. 8 by the dotted circle z), who at the same time touches (either directly or through, say, the medium of a metal rod) a pole of the battery w, preferably that pole to which the terminal p of the instrument is connected.

The connection thus established, as indicated by the dotted line z^1 in Fig. 8, closes a circuit wherein an "extra current" of relatively high tension is produced each time the battery-circuit is interrupted by the make-and-break device, with the result that the patient experiences a rapid series of electric shocks, which pass through the body from or to the point whereat the pad x^1 is applied to the skin.

Describing, now, the arrangement illustrated diagrammatically in Fig. 9, it will be observed that the metal contact plate x is formed of two separate portions which are mounted upon, and insulated from one another by, a backing x^4 of insulating material. The spring-studs x^2, which are fixed to the respective portions of the metal plate so as to be adapted to pass through holes in the top of the cap n as before, make wedging contact each with a separate metal plate y^2 attached to the inner surface of the cap, the respective plates y^2 being in permanent electrical connection (through conductors indicated at z^2, z^3) with the opposite poles of a secondary winding d^1 of fine insulated wire coiled about the winding d already described. When both portions of the duplex contact-plate x are applied to the person of the patient (represented diagrammatically in Fig. 9 by the dotted and shaded circle z), the circuit through the secondary winding d^1 is closed through the patient's body between the respective parts of the contact-plate, with the result that a rapid series of electric shocks are experienced locally.

In the event of the "induced current" arrangement being employed with a single instead of a duplex contact-plate x, one end of the secondary winding d^1 is connected to the contact-plate and the other to one pole of the battery w, so that, on the contact-plate being applied to the body of the patient while he (either directly or through some metallic connection) touches the other pole of the battery, the secondary circuit will be closed through the body.

It will be evident that the "induced current" arrangement is adapted to afford a greater range of variation in the strength of the electrical treatment administered, than is the "extra current" arrangement previously described, any desired alteration in the induced current being readily effected by the employment, in combination with the same primary winding, of a secondary winding d^1 of suitably modified character as regards either length of coil or thickness of wire, or both.

Claims—

1. An improved electro-magnetic vibrator for local application to the person comprising a non-magnetic casing of rigid material and of approximately mushroom shape consisting of a tubular stem and a hollow head; an electro-magnet housed within the stem; a core for the electro-magnet extending only partly through the length of the electro-magnet; an armature; a stem of magnetizable material on said armature extending within the remaining portion of the length of the electro-magnet; means for adjusting the core toward and from the stem; an electrically conductive ring within the head; a spring one end of which is rigidly secured to the ring while the other end is slidably engaged in the casing, said spring carrying the armature and retaining the stem out of contact with the core during its vibration; a buffer spring on said armature; an adjustable terminal within the hollow head adapted to be permanently connected electrically with one pole of the source of current and adapted to establish electrical contact with the buffer spring when the magnet winding is deënergized and the armature is moved away from the winding by the spring; a terminal for connection with the source of supply connected with one end of the electro-magnet winding; a second terminal for connection with the source of supply connected with the adjustable terminal; and a connection between the spring and the other end of the winding of the magnet, substantially as set forth.

2. An improved electro-magnetic vibrator for local application to the person comprising a non-magnetic casing of rigid material and of approximately mushroom shape consisting of a tubular stem and a hollow head; an electro-magnet housed within the stem, a core for the electro-magnet extending only partly through the length of the electro-magnet; an armature; a stem of magnetizable material on said armature extending within the remaining portion of the length of the electro-magnet; means for adjusting the core toward and from the stem; an electrically conductive ring within the head; a spring one end of which is rigidly secured to the ring while the other end is slidably engaged in the casing, said spring carrying the armature and retaining the stem out of contact with the core during its vibration; a buffer spring on said armature; an adjustable terminal within the hollow head adapted to be permanently connected electrically with one pole of the source of current and adapted to establish electrical contact with the buffer spring when the magnet winding is deënergized and the armature is moved away from the winding by the spring; a terminal for connection with the source of supply connected with one end of the electro-magnet winding; a second terminal for connection with the source of supply connected with the adjustable terminal; a connection between the spring and the other end of the winding of the magnet, and means for passing the current through the

body of the patient concurrently with the administration thereto of the mechanical vibratory treatment, said means comprising a terminal within the head of the casing; a connection between the ring and the terminal; a metal contact plate on the outside of the casing; and a connection between the terminal and the contact plate, substantially as set forth.

3. An improved electro-magnetic vibrator for local application to the person comprising a non-magnetic casing of rigid material and of approximately mushroom shape consisting of a tubular stem and a hollow head, an electro-magnet housed within the stem; a core for the electro-magnet extending only partly through the length of the electro-magnet; an armature; a stem of magnetizable material on said armature extending within the remaining portion of the length of the electro-magnet; means for adjusting the core toward and from the stem; an electrically conductive ring within the head; a spring one end of which is rigidly secured to the ring while the other end is slidably engaged in the casing, said spring carrying the armature and retaining the stem out of contact with the core during its vibration; a buffer spring on said armature; an adjustable terminal within the hollow head adapted to be permanently connected electrically with one pole of the source of current and adapted to establish electrical contact with the buffer spring when the magnet winding is deënergized and the armature is moved away from the winding by the spring; a terminal for connection with the source of supply connected with one end of the electro-magnet winding; a second terminal for connection with the source of supply connected with the adjustable terminal; a connection between the spring and the other end of the winding of the magnet, and means for passing the current through the body of the patient concurrently with the administration thereto of the mechanical vibratory treatment, said means comprising a metal contact plate on the outside of the casing and adapted to be applied to the person; a secondary winding inclosing the winding of the electro-magnet; a battery; a connection between one end of the secondary winding and the contact piece and a connection between the other end of the winding and one pole of the battery, substantially as set forth.

4. An improved electro-magnetic vibrator for local application to the person comprising a non-magnetic casing of rigid material and of approximately mushroom shape consisting of a tubular stem and a hollow head; an electro-magnet housed within the stem; a core for the electro-magnet extending only partly through the length of the electro-magnet; an armature; a stem of magnetizable material on said armature extending within the remaining portion of the length of the electro-magnet; means for adjusting the core toward and from the stem, an electrically conductive ring within the head; a spring one end of which is rigidly secured to the ring while the other end is slidably engaged in the casing, said spring carrying the armature and retaining the stem out of contact with the core during its vibration; a buffer spring on said armature; an adjustable terminal within the hollow head adapted to be permanently connected electrically with one pole of the source of current and adapted to establish electrical contact with the buffer spring when the magnet winding is deënergized and the armature is moved away from the winding by the spring; a terminal for connection with the source of supply connected with one end of the electro-magnet winding; a second terminal for connection with the source of supply connected with the adjustable terminal; a connection between the spring and the other end of the winding of the magnet; and means for passing the current through the body of the patient concurrently with the administration thereto of the mechanical vibratory treatment, said means comprising a contact-piece in two parts arranged on the casing and adapted for application to the person; a secondary winding encircling the winding of the electro-magnet and electric connections between the ends of the secondary winding and the respective portions of the contact plate, substantially as set forth.

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