

(54) Title of the Invention: **Tattoo device**

(51) INT CL: **A61M 37/00** (2006.01)

(21) Application No:	1817950.7
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(22) Date of Filing:	02.11.2018
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(43) Date of A Publication	20.05.2020
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(56) Documents Cited:
US 20180000419 A1

(58) Field of Search:
As for published application 2578638 A viz:
INT CL **A61M**
Other: **EPODOC, WPI, Patent Fulltext**
updated as appropriate

Additional Fields
Other: **None**

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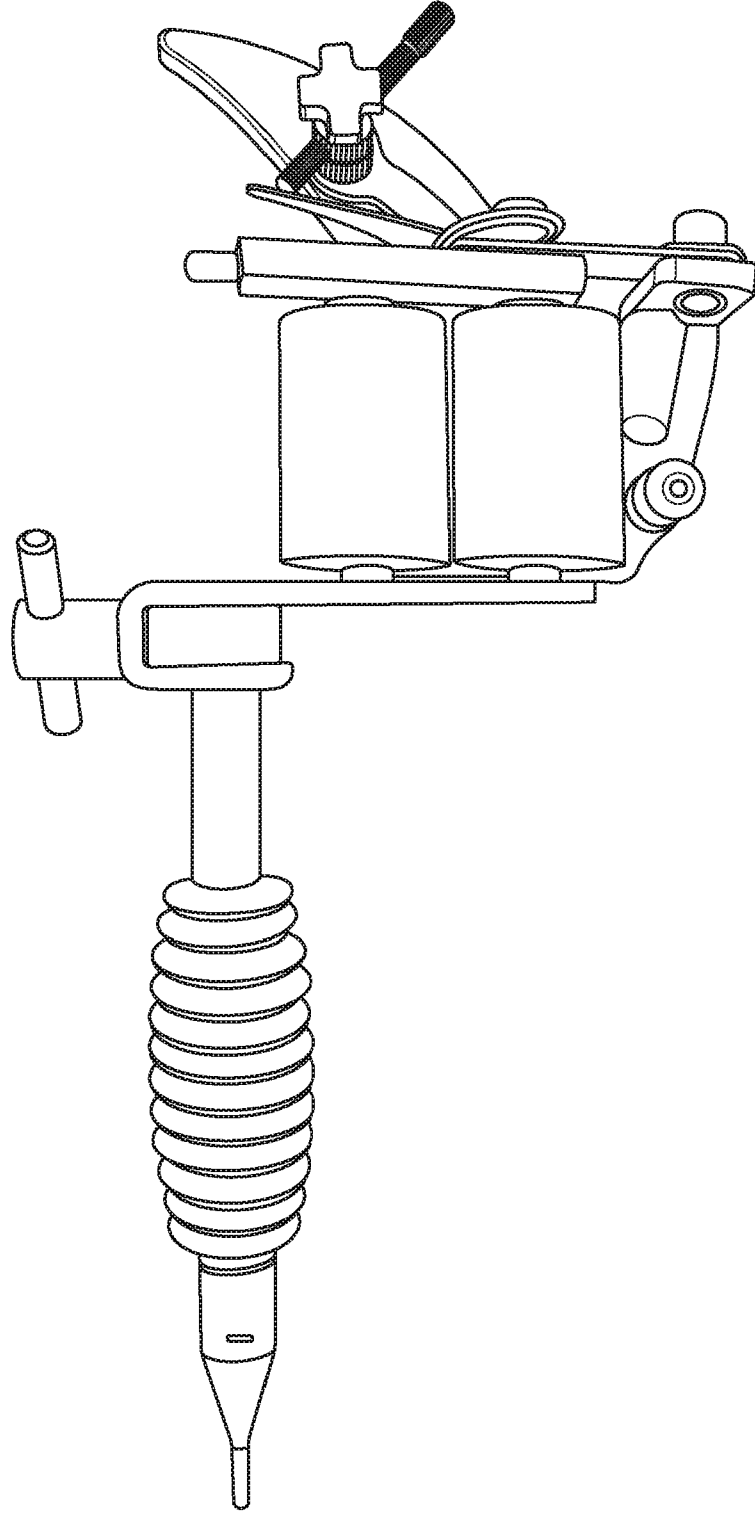


Fig. 1

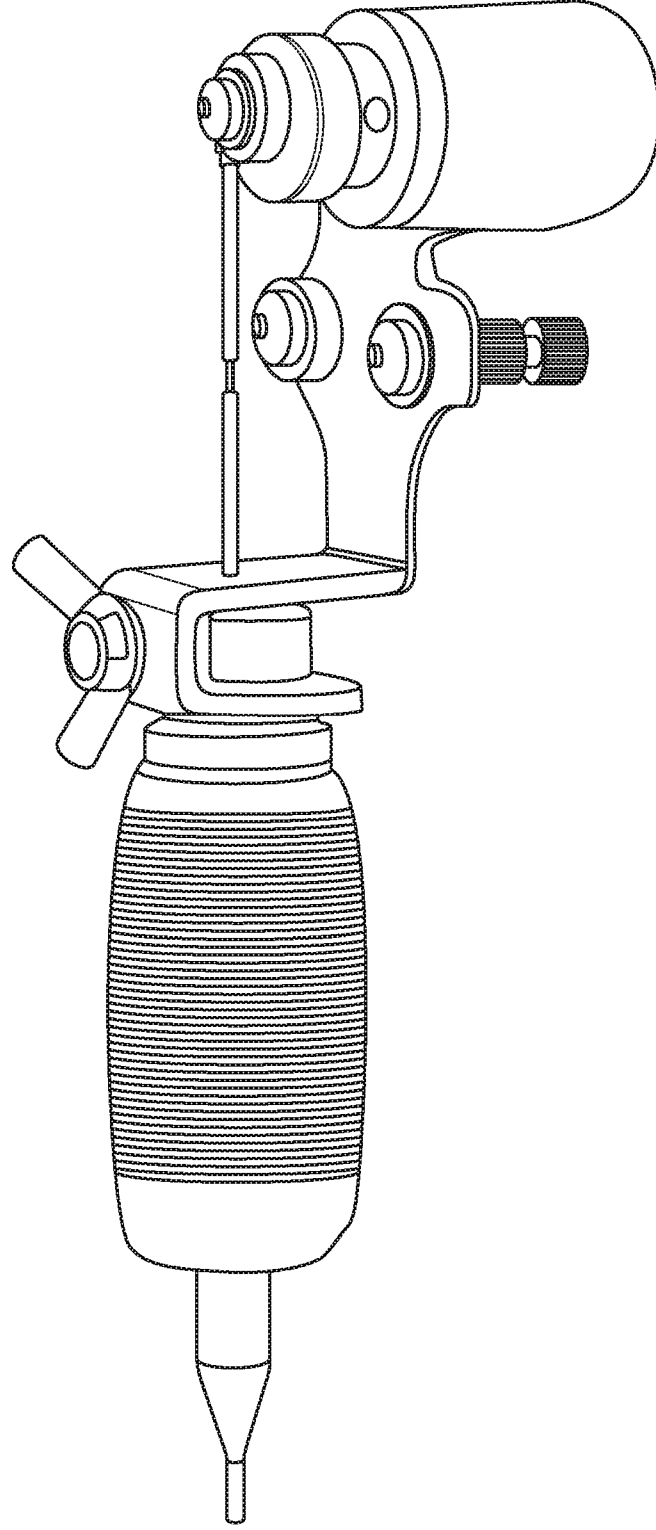


Fig. 2

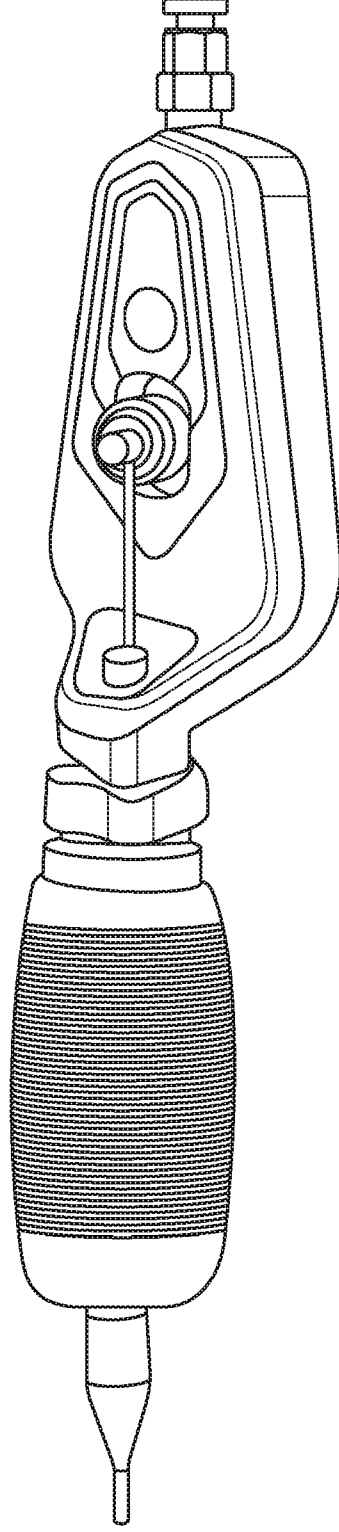


Fig. 3

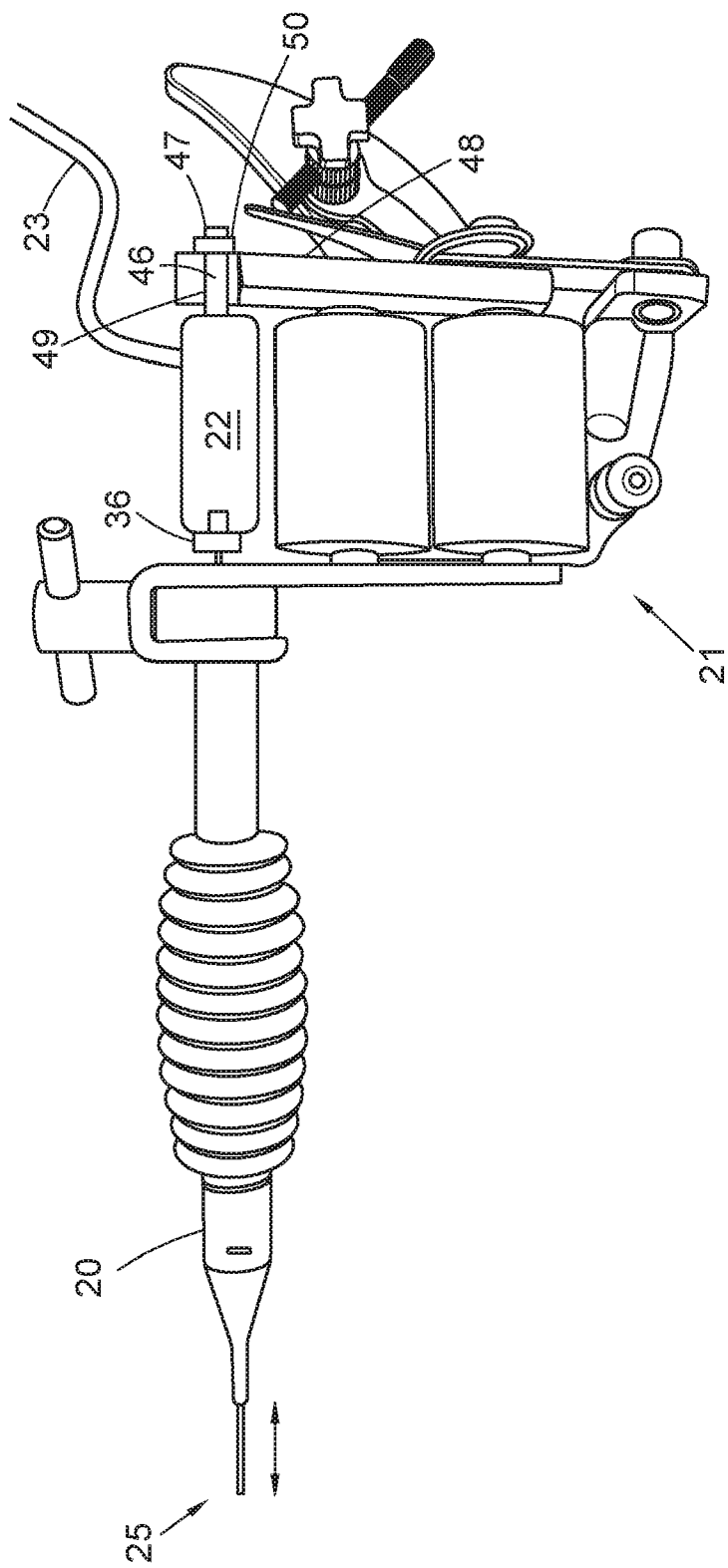


Fig. 4

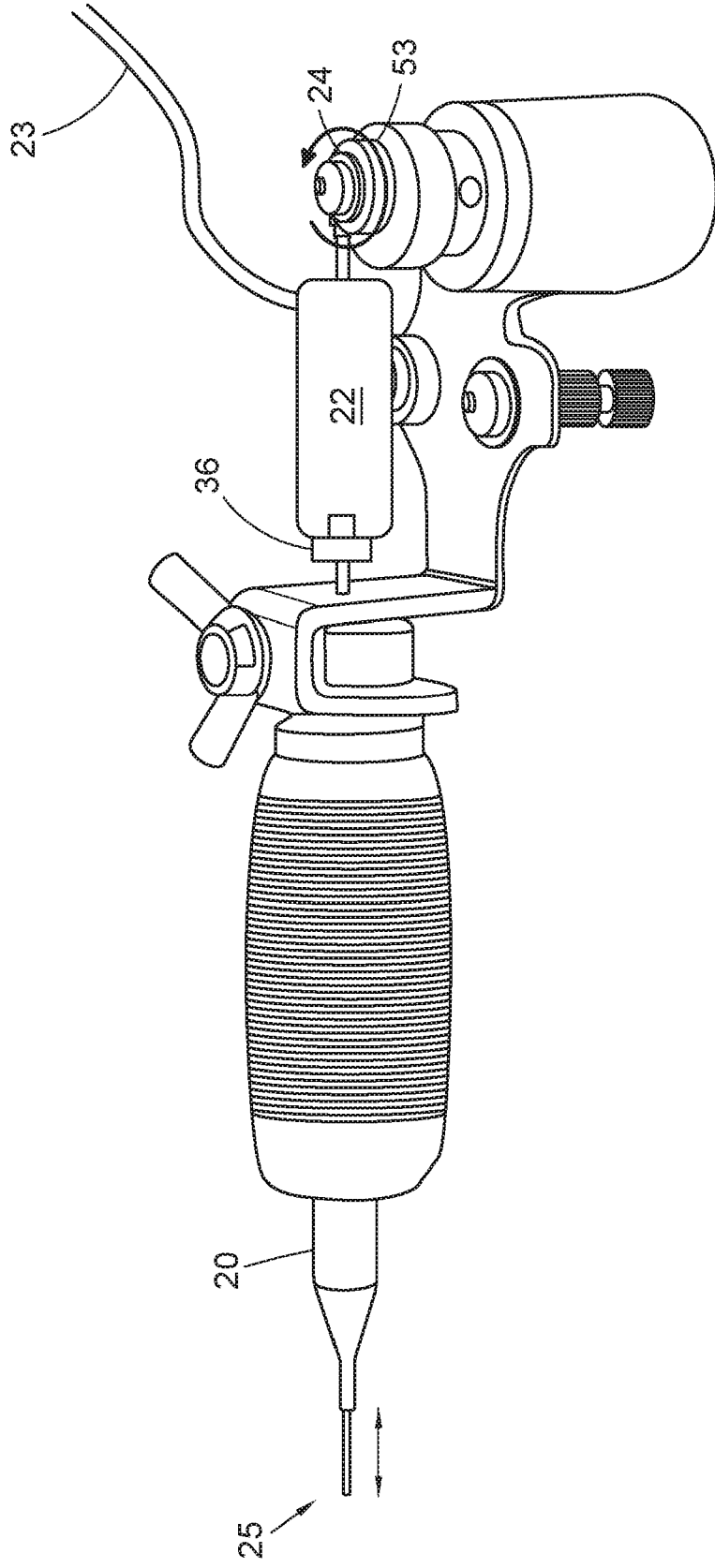


Fig. 5

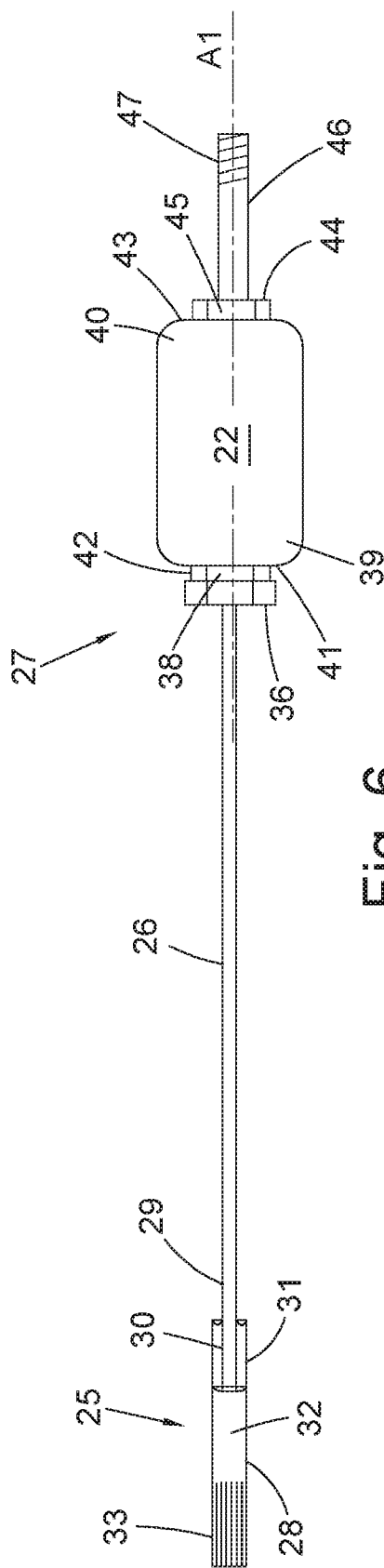


Fig. 6

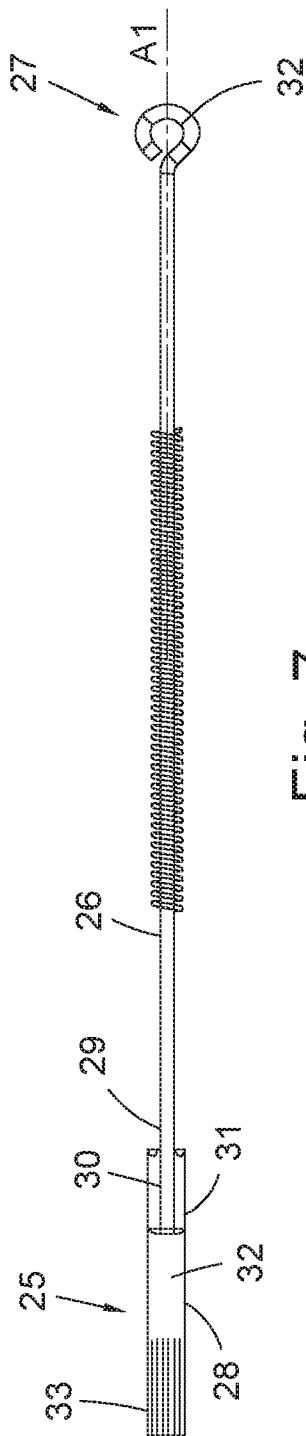


Fig. 7

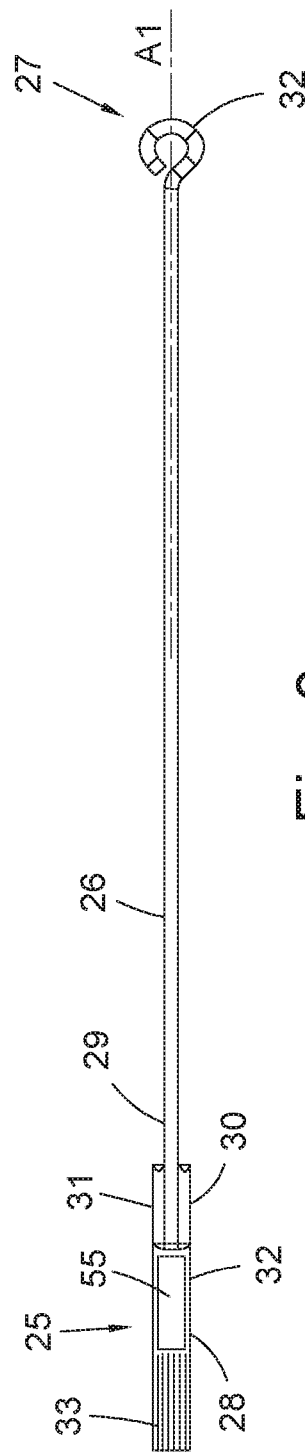


Fig. 8

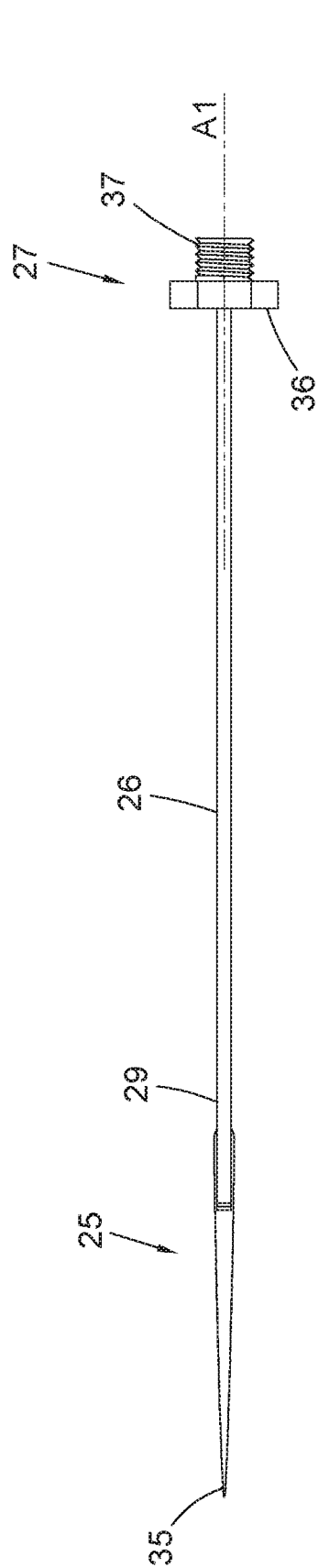


Fig. 9

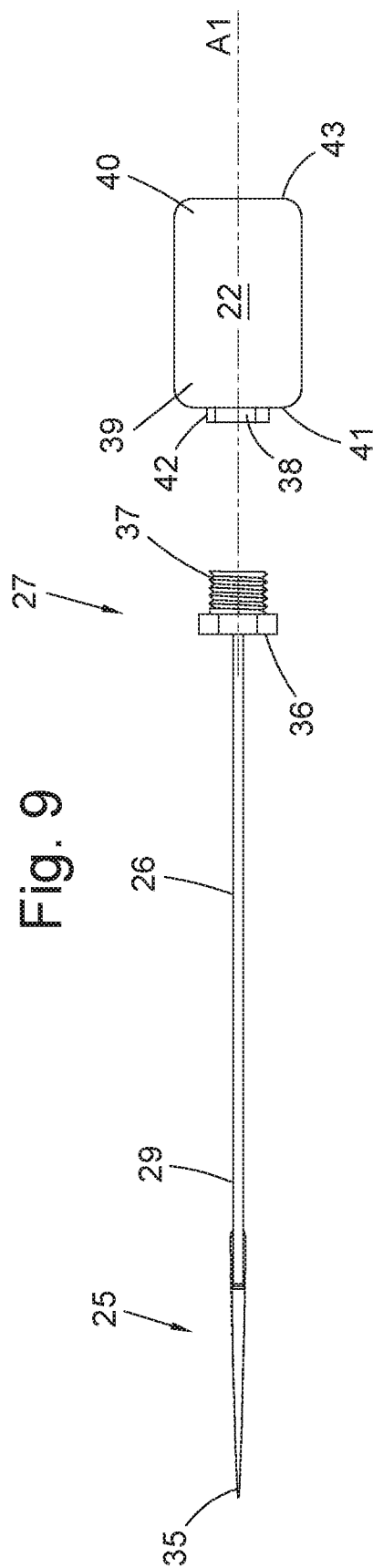


Fig. 10

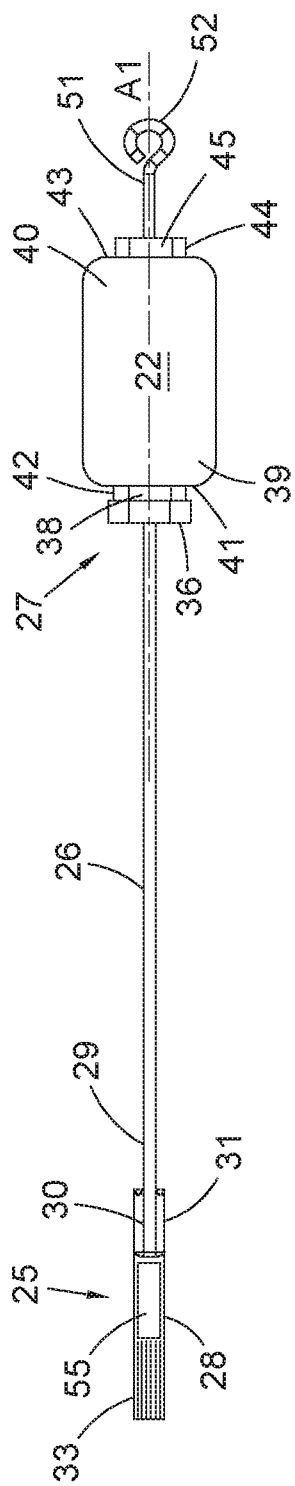


Fig. 11

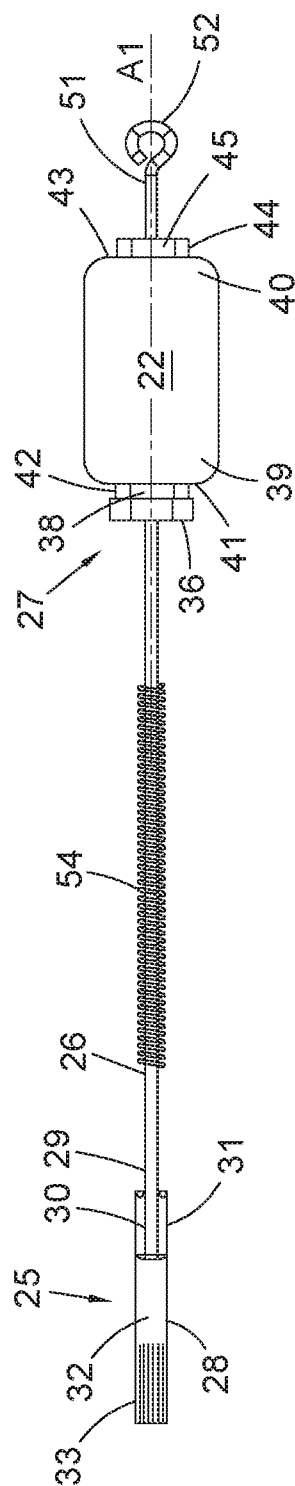


Fig. 12

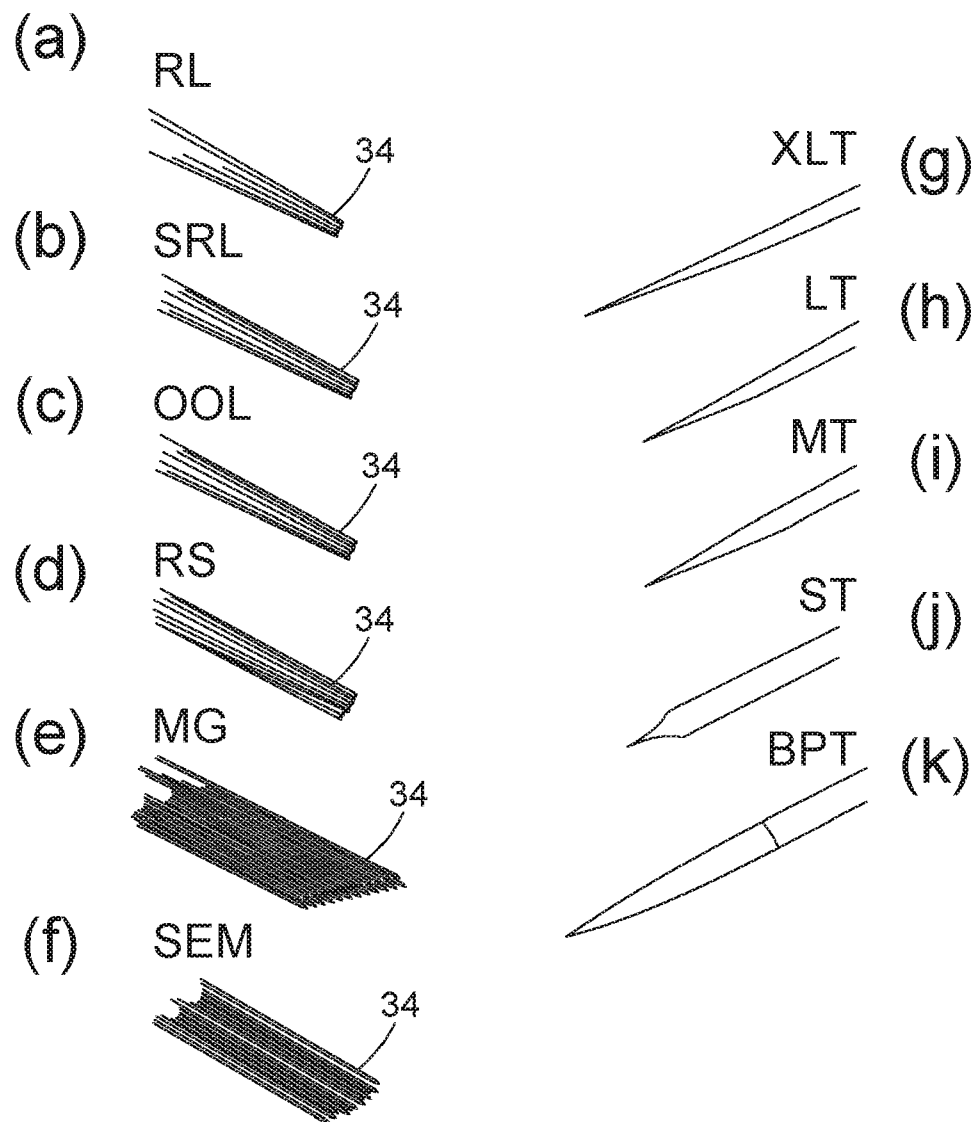


Fig. 13

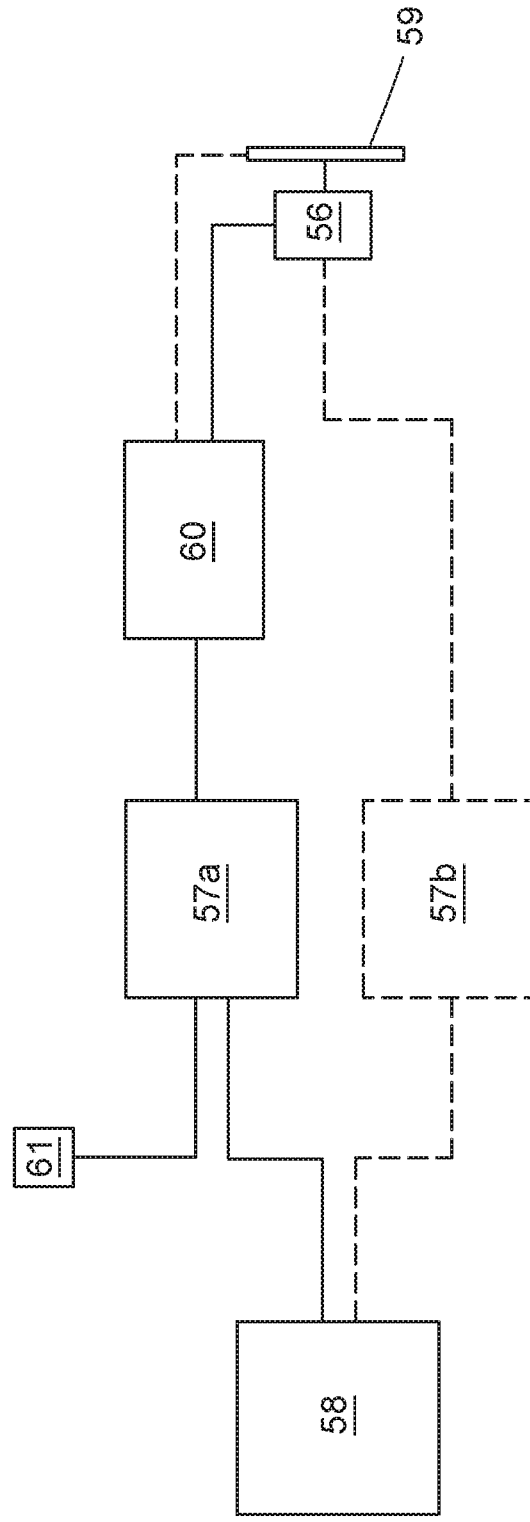


Fig. 14

Tattoo Device

Field of the Invention

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The present invention relates to a vibrating needle, specifically the invention relates to a vibrating tattoo needle for use in tattooing devices.

Description of the related art

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Tattooing devices are well known in the prior art, including tattooing devices for performing a tattoo on an animal. Typically, such tattooing devices include a motor housing and a needle housing secured thereto, with the motor housing having a reciprocating drive structure mounted therein, and with the needle housing having a needle shaft and a tattooing needle mounted therein to be reciprocated by the eccentric drive structure.

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At present, there are two main means of generating tattooing needle motion, being coil and rotary devices. Figure 1 shows a prior art coil tattoo machine.

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The second commonly used mechanism is the rotary device. Figure 2 shows a prior art rotary tattoo. The motor housing contains a motor, which is connected to a cam with a protruding nipple offset from the motor housing central axis. The needle, being mounted to the nipple by means of the second end loop, will be moved up and down the longitudinal central axis of the needle housing by the rotational movement of the cam, providing the desired tattooing motion.

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Additionally, there is a less commonly used needle motion generating means which is pneumatically powered. Figure 3 shows a prior art pneumatic tattoo machine. In this means, compressed air is used to drive a cam which rotates. The cam provides an offset nipple, which the tattoo needle arrangement may attach to.

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Although such tattooing devices are generally satisfactory, there have been a number of problems and drawbacks experienced with these devices which could be improved upon.

5 **Background**

Current tattooing methods involve piercing the skin using a powered needle which vibrates in a longitudinal manner allowing ink to enter the dermis, where it is retained, thus forming the desired pattern or mark. The user may control the speed at which the longitudinal vibration of the needle occurs by varying the power supplied to the tattoo device, which typically ranges from 0.9Hz to 50Hz. It is known that this method of tattoo application causes pain to the subject as the needle or needles impact the skin. Both the initial impact of the needle to the skin and the proceeding motion can cause varying levels of pain to the subject and subsequently cause bleeding and scabbing which is undesirable when applying a tattoo.

It would be advantageous to have a tattoo device which does not suffer from some of the abovementioned drawbacks.

20 **Summary of the Invention**

According to an aspect, there is provided a tattoo device as claimed in claim 1. According to another aspect, there is provided a method as claimed in claim 11.

25 **Detailed Description of the Preferred Embodiments**

These problems are addressed by a device providing a tattoo needle assembly which in addition to conventional lengthwise tattooing motion, or the base frequency, controlling the entry and exit of the needle into the skin, maintains a comparatively higher second frequency. It is this higher frequency which provides needle vibration in addition to lengthwise vibrations of the base frequency as the

needle enters and exits the skin, lowering both the insertion forces of the needle and the resulting forces experienced by the skin.

5 The needle assembly comprises a longitudinal needle body, and a first sharps end which may be of a single point or array of points. It is known in tattooing that different needle arrays are used to create different effects, for example line, shading and colouring are achieved by different patterns and quantities of needle points, all branching from the same needle stem.

10 A distance from the sharps end, the remainder of the device is configured to connect to the needle. The device further comprises a first and second oscillator, and these are coupled to the needle such that energy may be efficiently transferred thereto so as to oscillate the needle and ultimately the sharps end. The oscillators may be contained in the housing; alternatively, one or both of the
15 oscillators may be attached to the needle outside the housing, or be integral with the needle.

Preferably, the needle is releasably connected to the remainder of the device. This permits interchange of needles for reasons of hygiene, or to change needle
20 type during a tattoo procedure. The connection may comprise a male connection member and a corresponding female connection member which may be configured to mate with each other. The male connection member may be on the needle. The female connection member may be on the remainder of the device. The male connection member may be on the remainder of the device, and the
25 female connection member may be on the needle.

The connection arrangement may comprise a screw mechanism. A screw mechanism may provide a large point of contact between the needle and the transducer. This may help ensure that there is a secure and stable connection
30 between the needle and the transducer. A larger point of contact may also provide more reliable transmission of vibrations from the transducer to the needle. Thus there may be less energy loss, making the connection more efficient in transferring energy.

Alternatively, the connection arrangement may comprise a bayonet mechanism. The connection arrangement may comprise a snap-fit mechanism. Both a bayonet and snap-fit connection mechanism may provide a large, secure point of contact between the needle and remainder of the device, and do not rely on the provision of compression, or a gripping mechanism, to secure the probe to the transducer.

The needle may be connected to the remainder of the device using a connection member. The connection member may be connected between the needle and the remainder of the device. The connection member may be an additional, intermediate component between the needle and the remainder of the device. The needle may be connected to the connection member using a screw mechanism. The needle may be connected to the connection member using a bayonet mechanism. The needle may be connected to the connection member using a snap-fit mechanism. The needle may be connected to the connection member using a clip mechanism. The transducer may be connected to the connection member using any of the aforementioned connection means. The probe and transducer may be connected to the connection member using the same or different connection means.

The connection member may be a clip. The clip may comprise a first and a second gripping end. The first gripping end may be configured to attachment to the needle. The second gripping end may be configured for attachment to the remainder of the device. The first and second gripping ends may be first and second arms. The first and second arms may be curved. The clip may be made of plastic.

The provision of an intermediate connection member may allow the needle and transducer to be connected together without the need to redesign either the needle or the transducer to allow the connection to happen. Thus any needle may be connected to the device of the invention. Thus, the device may be configured to vibrate any needle, through the use of the connection member, and a specially designed needle does not need to be used.

The device according to the invention comprises a first and a second oscillator, operably coupled to the needle.

5 The first oscillator is adapted to produce vibrations at relatively low frequencies, i.e. from 1 to 1000 Hz, preferably 5 to 250 Hz, more preferably from 10 to 150 Hz. Suitably, the first oscillator is any of the types known in the art, and may suitably be selected from: a coil which utilizes electromagnetic current passed through a coil, pair of coils, or multiplicity of coils to provide oscillation; a rotary oscillator which utilizes an eccentric attachment to the spindle of an electric motor; or a
10 pneumatic oscillator which utilizes compressed air to force a motor to spin which in turn would crank the needle bar up and down.

The magnitude of the oscillations produced by the first oscillator is typically between 0.1 and 10 mm, preferably between 1 and 6 mm.

15 Such oscillators and their use in tattoo machines are well known in the art. The first oscillator is operably coupled to the needle to induce vibrations substantially longitudinally along the axis of the needle. The first oscillator produces oscillations of a frequency and magnitude sufficient to cause the sharps end of
20 the needle to penetrate the dermis and cause a puncture into which the tattoo ink is subsequently introduced.

The device further comprises a second oscillator. The second oscillator is configured to produce vibrations at a higher frequency than the first oscillator.
25 Preferably, the second oscillator is configured to produce oscillations at between 5 kHz and 200k Hz, preferably between 10 kHz and 100 kHz, more preferably between 25 kHz and 75 kHz such as around 40 kHz.

30 The magnitude of the oscillations produced by the second oscillator is preferably smaller than those produced by the first oscillator. Preferably, the oscillations are between 0.1 and 500 μm , more preferably between 1 and 100 μm .

Surprisingly, it has been found that this high frequency motion has the effect of lowering the insertion forces required to penetrate the skin layers and hence
35 reduces pain (nociception) and other triggers. In addition, pain can be triggered

after insertion but before removal in a stroke of the needle by dint of the friction caused by a moving needle. The high frequency motion of the needle greatly reduces these frictional forces, further reducing pain triggers.

5 The second oscillator may be a magnetic coil which is coupled to the needle. The coil may surround the needle about its longitudinal axis. The coil may be arranged so that vibrates the needle by attachment to any section of the needle. In this configuration, the second oscillator is indirectly coupled to the needle. The second oscillator may be a pulsatory material, suitably coupled to the needle
10 assembly. The pulsatory material may be a piezo-electric material, such as ceramic, crystal or other such that an oscillatory response is provided from a stimulus. The stimulus may be provided by an electric current, such as an alternating current. The electricity for the stimulus may be provided via a transducer. A plurality of pulsatory materials may be coupled to the needle,
15 arranged to provide symmetry and even weight distribution across the needle arrangement.

The second oscillator may be configured to attach to an armature bar of a tattoo device. The second oscillator may be connected to the armature bar by way of
20 connection arrangement.

The second oscillator may comprise a second end which is configured to attach to a modified armature bar of a tattoo device. The armature bar may be modified to connect to the second oscillator using a screw mechanism. The armature bar
25 may be modified to connect to the second oscillator using a bayonet mechanism. The armature bar may be modified to connect to the second oscillator using a snap-fit mechanism. The armature bar may be modified to connect to the second oscillator using a clip mechanism. The second oscillator may be connected to the connection member using any of the aforementioned connection means.

30 The armature bar may be modified to provide a socket to which the second oscillator is connected. The socket may be threaded so as to receive a corresponding threaded second oscillator collar. The socket may be smooth to allow a corresponding second oscillator bolt to be inserted. The armature bar may
35 provide a hole in which a second oscillator bolt may be inserted. The socket may

be partly threaded. The second oscillator bolt may be threaded at its proximal end to engage with a nut. The second oscillator bolt may be partly threaded. The nut may be tightened against the armature bar to mount the second oscillator and needle arrangement to the tattoo device.

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The second oscillator may comprise a connector which is configured to attach to a modified cam of a tattoo device. The cam may be attached to a motor. The cam may provide an offset protruding connection means, such as a nipple. The cam may be modified to connect to the second oscillator using a screw mechanism.

10 The cam may be modified to connect to the second oscillator using a bayonet mechanism. The cam may be modified to connect to the second oscillator using a snap-fit mechanism. The cam may be modified to connect to the second oscillator using a clip mechanism. The second oscillator may be connected to the cam using any of the aforementioned connection means.

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The cam may be modified to provide a socket to which the second oscillator is connected. The socket may be threaded so as to receive a corresponding threaded second oscillator collar. The socket may be smooth to allow a corresponding second oscillator bolt to be inserted. The cam may provide a hole in which a second oscillator bolt may be inserted. The socket may be partly threaded. The second oscillator bolt may be threaded at its proximal end to engage with a nut. The second oscillator bolt may be partly threaded. The nut may be tightened against the cam to mount the second oscillator and needle arrangement to the tattoo device.

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The amplitude and/or frequency of the voltage supplied to the second oscillator may be manually controlled by a user. The user may control the voltage using a control panel. This may allow the user to adjust the voltage so that it is optimised for different types of needle. Thus, the user may ensure that the needle being used is being vibrated at its optimum frequency for tattooing.

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The amplitude and /or frequency of the voltage supplied to the second oscillator may be controlled by an electronic control programme, programmed to maintain the required frequency of oscillation. Said programme may receive feedback from

the needle assembly and interpret the data to vary the frequency and subsequently maintain the required levels of needle oscillation.

The needle may be housed in a needle housing. The needle housing may
5 comprise a grippable section for controlling the position and movement of the tattoo device when in use. The grippable section may be ergonomically designed to fit the human hand. The grippable section may provide a surface which increases friction between the grippable section and the human hand. There may be an arrangement of ribs to aid gripping of the needle housing grippable section.

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Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a prior art coil tattoo device

15 Figure 2 shows a prior art rotary tattoo device

Figure 3 shows a prior art pneumatic tattoo device

Figure 4 is a side view of the needle assembly connected to a coil tattoo device

Figure 5 is a side perspective view of the needle assembly connected to a rotary tattoo device

20 Figure 6 is a side view of a needle assembly with a linear needle point array, transducer and coil tattoo device connecting means

Figure 7 is a side view of a needle assembly with a linear needle point array, loop attachment and electromagnetic coil

25 Figure 8 is a side view of a needle assembly with a linear needle point array, loop attachment and pulsatory material attachment

Figure 9 is a side view of a needle assembly with a singularly pointed needle end and transducer attachment means

Figure 10 is a side view of a needle assembly with a singularly pointed needle end, transducer attachment means and transducer unit

30 Figure 11 is a side view of a needle assembly with a linear needle point array, loop attachment, pulsatory material attachment and attached transducer unit

Figure 12 is a side view of a needle assembly with a linear needle point array, loop attachment, electromagnetic coil attachment and attached transducer unit

Figures 13a-k are perspective views of tattoo needle points

35 Figure 14 is a diagram of a possible system layout

Hereinafter, the present invention will be described with reference to the drawings.

5 Figure 4 shows an embodiment of a vibrating needle assembly in connection with a tattoo machine body, in this embodiment the tattoo machine uses a coil system to generate low-frequency needle movement. Here, the needle assembly is housed in a needle housing 20 which is connected to the tattoo machine body, shown generally as 21 via a transducer housed in a transducer housing 22. A
10 transducer connecting wire 23 is shown, which connects to a user-controlled generator unit (not shown). The transducer is configured to provide high-frequency vibration to the needle assembly. The frequency of the vibration may be controlled by the user, by adjusting the controllable generator unit. The coil system is powered by a separate power supply which itself is controllable by the
15 user to vary the frequency of the lengthwise needle vibration. Said needle vibration is activated by a user-actuated foot pedal.

Figure 5 shows the needle assembly when attached to a rotary system. Here the needle assembly connects to the tattoo device using the looped needle end 24 as
20 currently used in tattoo machines to attach the needle to the tattoo device, seen at 24.

In figure 6, one embodiment of the needle assembly is shown. The needle assembly comprises a first end section 25, an elongate cylindrical body section
25 26 and a second end section, seen generally as 27. In the first embodiment the first end section comprises a flat rectangular plate 28 which is mounted to the first end of the needle body 29 so that a portion of the needle body is overlapping the flat surface of the rectangular plate and the surface of the needle body is tangential to the flat surface of the rectangular plate where it is joined, seen at 30.
30 The needle body 26 overlaps the rectangular plate by approximately one third of the length of the rectangular plate 30, however, any overlap which results in fixture of the needle body and rectangular plate will be sufficient.

The flat rectangular plate 28 comprises a needle body joining end 31, to which
35 the first end section of the needle body 29 is connected, a central body region 32

and a needle array end section 33. The needle array end section comprises an arrangement of small diameter needles known as sharps, seen in figures 13a to 13f as 34. Each sharp is separated such that the gaps formed may hold ink once the needle array is dipped into an ink source and provide capillary action once the needle array enters the skin of the tattoo subject to introduce the ink to the dermis. Where a singular point is used as the tattooing end, seen as 35 in Figures 9 and 10, the flat central bar region 28 is not present as in rectangular needle point arrays, seen in figures 13e and 13f. This is also true of circular needle point arrays seen in figures 13a to 13d.

The second end section of the elongate needle body portion 27 is connected to the flat surface of a hexagonally profiled collar 36 so that the longitudinal axis of the needle body and the collar are coaxial A1. The hexagonal collar provides a protruding threaded cylinder 37 which originates from centre point of the outwardly directed face of the collar. The threaded cylinder is designed such that it may be inserted into a corresponding female threaded socket 38 in the transducer housing 22.

The transducer housing 22 is a generally cylindrical hollow component containing a pre-assembled electrical transducer (not visible). The generally cylindrical profile of the transducer housing extends along a central longitudinal axis A1 from a first needle end section 39 to a second machine end section 40. The transducer housing is closed at each end by a flat face which is oriented 90 degrees from the longitudinal axis of the housing A1. At the first end 39 protruding from the flat face 41 central to the longitudinal axis of the transducer housing A1 is an annular collar 42 which provides the threaded socket 38 designed to correspond to the threaded cylinder of the second needle end 27.

The flat face of the transducer housing second end 40 may provide an annular collar 44 extending away from the transducer housing second end flat face 43 along the central longitudinal axis A1 of the transducer housing 22 so that the annular collar 44 and transducer housing are coaxial. The annular collar providing an internally threaded socket 45. In the first embodiment, the threaded socket of the transducer housing second end 45 may engage with a cylindrical bar 46. The bar 46 is an elongate cylindrical member with a threaded portion at its first end

(not visible) and a threaded portion at its second end 47. The bar 46 has a diameter less than the width of the armature bar 48 of a coil tattoo machine, seen in figure 4.

5 In this embodiment the armature bar is modified to provide a hole at its distal end with a greater diameter than the transducer connecting bar 46 such that transducer connecting bar second end threaded portion 47 may pass through the hole in the armature bar 49. This provides a protruding transducer bar second end section to which a nut 50 may be screwed. By screwing the nut against the
10 threaded transducer bar section in the direction of the transducer housing, the armature bar will be connected to the transducer housing 22 and consequently, the needle assembly. As the assembly is completed, when armature bar movement is generated by the coil tattoo machine, the needle will subsequently move in the required longitudinal direction for tattooing.

15 In a second embodiment, the transducer machine end section 40 may provide a cylindrical needle bar 51 (as shown in figures 11 and 12), extending from the transducer housing second end flat face 43 along the transducer housing central longitudinal axis A1 such that the needle bar central longitudinal axis is coaxial to
20 the transducer housing. At the second end of the extended needle bar is a loop 52 which has an inner diameter which corresponds to the rubber nipple provided by current tattoo devices (seen in figure 5 as 24) such that the loop 52 may attach to the rubber nipple 53 to hold the needle in place as lengthwise movement of the needle is generated. Said connection means may be used in conjunction with
25 coil, rotary and pneumatic tattoo devices.

The threaded needle end 27 may be inserted into the corresponding threaded socket in the transducer housing 38 by way of a screwing motion, aligning the longitudinal axis of the transducer housing with the longitudinal axis of the needle
30 A1 and pushing the threaded needle end 37 towards the threaded transducer housing socket 38 whilst rotating the threaded needle end in a clockwise manner until fully engaged.

Figure 7 shows a needle assembly comprising a linear needle point array 33, with
35 a second end loop attachment 52 configured to connect to current tattoo devices.

In this embodiment, the needle body 26 is shown encircled by an electromagnetic coil 54, said coil reacting to a variable electrical stimulus which may be connected to the needle assembly such that the needle is caused to vibrate at a second higher frequency.

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Figure 8 shows a needle assembly comprising a rectangular needle point array 33, with a second end loop attachment 52 configured to connect to current tattoo devices. In this embodiment, the tattooing end of the needle provides a central flat region 32 to which a pulsatory material 55 such as a piezoelectric plate, ceramic or other, is attached. Said pulsatory material reacts to a variable electrical stimulus which may be connected to the needle assembly such that the needle is caused to vibrate at a second higher frequency.

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Figure 9 shows a needle assembly comprising a singularly pointed first needle end 35 and a second needle end comprising the aforementioned transducer connecting means 27.

Figure 10 shows the needle assembly of figure 9 with a disengaged transducer housing unit 22.

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Figure 11 shows a needle assembly comprising a rectangular needle point array 33, a second needle end comprising the aforementioned transducer connecting means 27, a transducer housing 22 and a transducer end loop attachment 52 configured to connect to current tattoo devices. In this embodiment, the tattooing end of the needle provides a central flat region 32 to which a pulsatory material 55 such as a piezoelectric plate, ceramic or other, is attached. Said pulsatory material reacts to a variable electrical stimulus which may be connected to the needle assembly such that the needle is caused to vibrate at a second higher frequency.

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Figure 12 shows a needle assembly comprising a rectangular needle point array 33, a second needle end comprising the aforementioned transducer connecting means 27, a transducer housing 22 and a transducer end loop attachment 52 configured to connect to current tattoo devices. In this embodiment the needle body 26 is shown encircled by an electromagnetic coil 54, said coil reacting to a

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variable electrical stimulus which may be connected to the needle assembly such that the needle is caused to vibrate at a second higher frequency.

The needle array may comprise a variety of commonly used patterns, shown in figures 13a to 13k. The patterns vary in number of needle points and arrangement of needle points to provide different ink coverage of the skin when tattooing. The sharps extend from a needle bar 32 which may be cylindrical to accommodate circular sharps patterns (as seen in figures 13a to 13d) or flat to accommodate linear sharps patterns (as seen in figures 13e and 13f). The needle array is permanently connected to the first end of the needle body 29 by a metal weldment such as solder or other permanent metal adhesive.

Any combination of the previously described embodiments, shown in figures 6 to 12 may be used as a means of providing a tattoo device with both a base frequency and a higher frequency such that the operation of performing a tattoo may cause lower levels of pain and result in a better quality of tattoo for the customer.

Where a pulsatory material is used as a second oscillator, there may be one or multiple pieces of the material mounted to the needle. It is advantageous to maintain symmetry of the needle assembly, thus the pulsatory material may be mounted on multiple needle areas to avoid non-linear motion of the needle when in use. The pulsatory material provided may be of different shapes or sizes and may be present within the transducer or attached directly to the needle itself. An amplification structure, such as a horn may be used in conjunction with the needle assembly to increase or decrease the amplitude of the vibrations acting on the needle.

Figure 14 shows a block diagram of a possible arrangement of the full tattoo system. The transducer 56 is wired to a power supply 58 via an electrical generator unit 57a, the generator unit being controllable by the user so that the supply voltage may be varied. The generator unit 57a is a dedicated adaptable derive electronic control box which is able to track frequency and vibrational amplitude of the needle. In varying the supply voltage, the user may adjust the frequency of the needle vibration provided by the transducer 56. This has the

effect of lowering entry forces when the needle, shown here as 59 enters the skin. The trigger of the generator unit 57a is controlled by a foot pedal 61, as the user engages the foot pedal, the system becomes live. The generator unit 57a monitors changes in the transducer drive frequency and electrical impedance and
5 adapts to the changing conditions in real time. Figure 14 also shows the tattoo device 60 connected between the generator unit 57a and the transducer 56 and needle 59.

In another embodiment, the transducer may be wired to the tattoo device such
10 that it shares the power supply provided by the generator unit 57b.

Claims

1. A tattoo device comprising a housing, a needle, a first oscillator and a second oscillator, wherein the first and second oscillator are coupled to the needle to induce vibrations therein, characterised in that the first and second oscillators operate at different frequencies; and wherein the first oscillator operates at a frequency of from 1 to 1000 Hz.
2. The tattoo device according to claim 1 wherein the first oscillator operates at a frequency of from 5 to 250 Hz, preferably from 10 to 150 Hz.
3. The tattoo device according to claim 1 or 2, wherein the first oscillator is selected from a coil or pair of coils; a rotary oscillator; and a pneumatic oscillator.
4. The tattoo device according to any preceding claim wherein the second oscillator operates at a frequency of between 5 kHz and 200 kHz, preferably between 10 kHz and 100 kHz, more preferably between 25 kHz and 75 kHz such as around 40 kHz.
5. The tattoo device according to any preceding claim, wherein the needle is releasably connected to a remainder of the device.
6. The device according to any preceding claim wherein the second oscillator is a magnetic coil in communication with the needle.
7. The device according to any one of claims 1 to 5 wherein the second oscillator is a piezoelectric oscillator.
8. The device according to claim 7 wherein the piezoelectric oscillator is in the form of a single crystal coupled to the needle.
9. The device according to claim 8 wherein the piezoelectric oscillator is in the form of two or more crystals coupled to the needle.
10. The device according to any one of claims 7 to 9 further comprising a horn configured to amplify the oscillations of the second oscillator.
11. A method of applying a tattoo to a human or animal comprising:

- i) providing a needle having a sharps end;
- ii) vibrating the needle simultaneously at a frequency of from 1 to 1000 Hz and a second frequency of from 5 kHz and 200 kHz;
- iii) bringing the sharps end of the needle into contact with the skin of a human or animal so as to cause punctures therein;
- iv) applying ink to the punctures.

12. The method according to claim 11 wherein applying the tattoo comprises applying the tattoo cosmetically.

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