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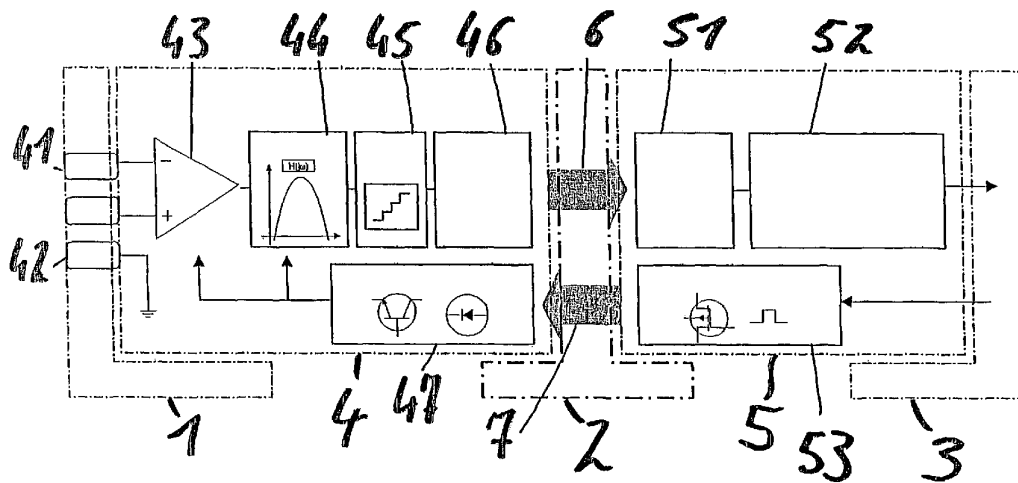
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[Fortsetzung auf der nächsten Seite]

(54) Title: SYSTEM CONSISTING OF A LINER UND A MYOELECTRONIC ELECTRODE UNIT

(54) Bezeichnung: SYSTEM AUS EINEM LINER UND EINER MYOELEKTRONISCHEN ELEKTRODENEINHEIT



(57) Abstract: The invention relates to a system consisting of a liner (2), which is disposed between an amputation stump (1) and a prosthesis shaft (3), and a myoelectric electrode unit (4, 5) for detecting myoelectric signals, said electrode unit (4, 5) comprising a measuring unit (4) disposed on the side of the liner (2) facing the amputation stump (1) and a receiving unit (5) disposed on the side of the liner (2) facing away from the amputation stump (1). Furthermore, the measuring unit (4) comprises a transmitter (46) for wireless transmission of the myoelectric signals to the receiving unit (5).

(57) Zusammenfassung: Die Erfindung betrifft ein System aus einem zwischen einem Amputationsstumpf (1) und einem Prothesenschaft (3) angeordneten Liner (2) und einer myoelektrischen Elektrodeneneinheit (4, 5) zur Erfassung myoelektrischer Signale, bei der die Elektrodeneneinheit (4, 5) eine Messeinheit (4), die auf der den Amputationsstumpf (1) zugewandten Seite des Liners (2) angeordnet ist, und eine Empfangseinheit (5), die auf der dem Amputationsstumpf (1) abgewandten Seite des Liners (2) angeordnet ist, aufweist und die Messeinheit (4) einen Sender (46) zur kabellosen Signalübertragung der myoelektrischen Signale an die Empfangseinheit (5) aufweist.

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Erklärungen gemäß Regel 4.17:

- hinsichtlich der Berechtigung des Anmelders, ein Patent zu beantragen und zu erhalten (Regel 4.17 Ziffer ii)
- Erfindererklärung (Regel 4.17 Ziffer iv)

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Translation

System consisting of a liner and a myoelectrical electrode unit

The invention relates to a system consisting of a liner positioned between an amputation stump and a prosthesis shaft, and a myoelectrical electrode unit for recording myoelectrical signals for controlling prosthesis on an amputation stump.

A myoelectrode serves for the acquisition and evaluation of a surface myogram, based on which motor driven elements of a prosthesis are controlled. The overall functionality of such a prosthesis, in particular an arm prosthesis, is therefore directly dependent on the quality of the myoelectrode. Active myoelectrodes are known in the prior art, which consist of lead electrodes for the lead of the electromyogram as well as of signal amplifying and signal processing elements.

The myoelectrodes previously produced in a closed plastic housing, consist of an input interface oriented to the amputation stump and an output interface orientated to the prosthesis. The input interface is formed by the metallic lead electrodes located on the surface of the housing. The output interface makes the amplified and processed electromyogram signal in analog or digital form available to the prosthesis.

In recent years there has been a development in prosthetic care technology of a so called liner-shaft technology. There, different from conventional prosthesis shafts, at first the patient draws a soft socklike unit, which is called liner, over the amputation stump. Subsequently, after having put on the liner, the patient puts on the prosthesis. The liner constitutes a bond between the amputation stump and the prosthesis, which on one hand improves the seat of the prosthesis shaft on the amputation stump and on the other hand increases the wearing comfort of the prosthesis. The liner is made of materials such as silicone or polyurethan and shows excellent adhesion characteristics on the amputation stump, which, in addition, are essentially improved by the airtight ending of the liner with the amputation stump.

The currently known cable attached myoelectrodes are not able to be used with the liner technology. Since these myoelectrodes are elastically suspended in the shaft, a

window would have to be cut into the liner for making contact between the lead electrodes and the skin on the amputation stump. This would result in a reduction of the adhesion characteristics between the liner and the amputation stump. In addition, the liner would have to be positioned on the amputation stump with extraordinary exactness in order that the window existing therein, is exactly lined up with the position of the myoelectrode in the prosthesis shaft.

The task of the invention is to provide a system with which the disadvantages known from the prior art technology can be avoided. This is accomplished, according to the invention, by a system with the features of claim 1, which provides a measurement unit arranged on that side of the liner facing the amputation stump, and a receiver unit, which is located on the side of the liner facing away from the amputation stump, the measurement unit having a sender for the wireless signal transmission of the myoelectrical signals to the receiver unit. Thus, it is possible, on the one hand, to benefit from the advantages of the liner technology relating to wearing comfort and adhesion properties and, on the other hand, to utilize a prosthesis with myoelectrical control. Thus, a telemetric myoelectrode is available consisting of two units, the one of which is attached inside of the liner facing the skin of the amputation stump, and its receiver unit, which is located between the liner and the prosthesis shaft, preferably mounted on the prosthesis shaft.

The invention provides also that in the measurement unit an amplifier for amplifying the myoelectrical signals, an analog-digital converter for digitizing the signals as well as a coding unit for coding the signals are arranged in order to transmit in wireless manner the amplified, digitized and encoded signal via a transmission unit to the receiver unit disposed outside of the liner. The receiver unit forwards the received electromyogram signal for further processing into the prosthesis' interior. The measurement unit can be mounted stationary on the inner side of the liner, for example by fusing in or glueing in order to allow the liner being put on without any problem. The measurement unit as a watertight capsule in a flat design is preferably integrated directly in the liner. Thus, the telemetric myoelectrical method allows the use of a closed liner inside of the prosthesis shaft, which separates the mechatronic components of the prosthesis from the amputation stump.

In order to design a measuring unit that is free from wear and maintenance, an induction coil and a device for converting electromagnetic alternating fields, respectively, is arranged therein so that own energy sources such as accumulators can be avoided. Then, the energy transmission occurs via an electromagnetic alternating field which is generated in the receiver unit so that a telemetric energy transmission is performed.

In addition to the transmission of myoelectric signals through electromagnetic waves provision is made that the sender is designed in optical technology and the receiver in the receiver unit is an optical sensor in order to enable an optical signal transmission. A light emitting diode with high efficiency grade can be included in the measurement unit, which sends the digitized binary signal of the lead electrodes by an ON/OFF-modulation of the luminosity to the receiver unit, which is positioned beyond the liner.

The signal transmission can also occur via frequency modulated load modulation. Therewith the transmission of the power supply is coupled with the transmission of the electromyogram signal. In doing so, the measurement unit detunes the resonant circuit, which is used for transmitting the operational energy. The detuning is modulated with the binary signal flow. That detuning is detected in the receiver unit and demodulated.

The signal transmission can also occur via amplitude modulated load modulation coupling the transmission of the power supply with the transmission of the electromyogram signal. In doing so, the measurement unit dampens the resonant circuit, which is used for transmitting the operational energy. This dampening is modulated with the binary signal current. This dampening is detected and demodulated in the receiver unit.

It is also provided that the signal transmission is performed by an amplitude modulated carrier. In doing so, a carrier generated in the transmitter is modulated with the binary data flow is modulated. The carrier is transmitted to the receiver unit

via an own electromagnetic coupling, independent from the energy supply, and is demodulated there.

In the following an exemplary embodiment of the invention is explained in detail using the figures annexed.

Fig. 1 - shows the allocation of the amputation shaft, liner and prosthesis;

Fig. 2 - shows a schematic configuration of the electrode unit on the amputation stump and the liner; as well as

Fig. 3 - a detailed illustration of the functional units of the electrode unit.

Figure 1 shows the principal configuration of a prosthesis 3 on an amputation stump 1, in which a liner 2 is arranged between the amputation stump 1 and the prosthesis shaft 3. The liner 2, which is made of silicone, polyurethane or other, preferably to the amputation stump adhesive and protective, materials, is individually adapted to the amputation stump 1 and put on before putting on the prosthesis shaft 3. The liner 2 is relatively soft and forms a bond layer between the skin of the amputation stump 1 and the inner cladding of the prosthesis shaft 3.

In order to enable a control of movable components of the prosthesis shaft 3, for example in the finger area, signals of muscle activities are recorded by a myoelectrode, which is not shown. The so-called surface myogram is derived and after processing the signals, these signals serve for controlling the mechatronic components.

Figure 2 shows a cross section of a schematic configuration of an electrode unit, which consists of a measurement unit 4 and a receiver unit 5. The measurement unit 4 is located between the surfaces of the amputation stump 1 and the liner 2 on the skin surface of the amputation stump 1. Lead electrodes 41 and a grounding electrode 42 rest directly on the skin surface of the amputation stump 1 and record

myoelectrical signals. These signals are processed in the measurement unit 4 and are lead wirelessly via a transmitting unit through the liner 2 to a receiver unit 5 arranged beyond the liner 2. The signal transmission is performed wirelessly by means of optical signals or alternatively via amplitude modulation of electromagnetic signals.

In order to provide the measurement unit 4 with energy, an electromagnetic alternating field 7 is directed to the measurement unit 4 such that, for example, current is induced via an inductance coil.

The signal transmission 6 can be performed also via frequency modulated or amplitude modulated load modulation. In doing so, the transmission for the power supply 7 is coupled with the transmission 6 of the electromyogram signal. The measurement unit 4 detunes a resonant circuit, which is used for the transmission 7 of the operational energy for the measurement unit 4. The detuning is modulated with the binary signal flow and can be detected and demodulated by the receiver unit 5. Alternatively, the signal transmission 6 can be performed also via an amplitude modulated load modulation.

In the receiver unit 5 there are arranged devices for signal processing and receivers, which processes the signals and transmit them preferably via cable 8 to the mechatronic components of the prosthesis 3. The receiver unit 5 is preferably arranged on the inner side of the prosthesis shaft 3.

In figure 3 the configuration of the measurement unit 4 and the receiver unit 5 is shown. The lead electrodes 41 and the grounding electrode 42 are allocated directly to the amputation stump 1. From the lead electrodes, the signal is directly fed via an operation amplifier 43 to a filter 44, from which it is transmitted via an analog-digital converter 45 to a coding, modulating and transmitting unit 46. This coding, modulating and transmitting unit 46 transmits telemetrically a signal flow 6 through the liner 2 to a receiver module 51, in which the signal is demodulated and decoded. From the receiver module 51 the demodulated, decoded signal flow is fed to a

corresponding signal processing unit 52 for further signal processing, from which it is transmitted via a cable, not shown, to elements inside of the prosthesis shaft 3.

The receiver unit 5 is attached to the inner side of the prosthesis shaft 3, while the measurement unit 4 is attached to the inner side of the liner 2. Preferably, the measurement unit 4 and the receiver unit 5 are configured in such a way that they are aligned and face each other. Thus, a good telemetric signal transmission is ensured. The signal transmission 6 can be performed both optically and electromagnetically.

In order to provide the filter 44, the analog-digital converter 45, the coding unit and the transmitter 46 as well as the operational amplifier 43 with energy, a power supply unit 57 is constructed with a rectifier, in which the electromagnetic alternating fields emitted by the inverter unit 53 are converted. Thereby an electromagnetic coupling between the measurement unit 4 and the receiver unit 5 is formed which is used for the transmission 7 of the operational energy.

Patent Claims

1. System consisting of a liner (2) arranged between the amputation stump (1) and a prosthesis shaft (3), and a myoelectrical electrode unit (4, 5) for recording of myoelectrical signals, for which the electrode unit (4, 5) has a measurement unit (4), which is located on that side of the liner (2) facing the amputation stump (1) and a receiver unit (5), which is located on the side of the liner (2) facing away from the amputation stump (1), and the measurement unit (4) has a sender (46) for wireless signal transmission of the myoelectrical signals to a receiver (51) in the receiver unit (5).
2. System pursuant to claim 1, **characterized in that** an amplifier (43) is arranged in the measurement unit (4) for amplification of the myoelectrical signals.
3. System pursuant to claim 1 or 2, **characterized in that** an analog-digital converter (45) is arranged in the measurement unit (4) for digitizing of the myoelectrical signal.
4. System pursuant to one of the previous claims **characterized in that** a coding unit (46) is arranged in the measurement unit (4) for coding of the signal to be send.
5. System pursuant to one of the previous claims **characterized in that** an induction coil and a rectifier unit (47) is arranged in the measurement unit (4) for the energy supply of the measurement unit (4).
6. System pursuant to one of the previous claims **characterized in that** the measurement unit (4) is attached to the liner (2).
7. System pursuant to one of the previous claims **characterized in that** the measurement unit (4) is in a watertight encapsulation.

8. System pursuant to one of the previous claims **characterized in that** the receiver unit (5) has a device (53) for creation of electromagnetic alternating fields and an induction coil for energy transmission.
9. System pursuant to one of the previous claims **characterized in that** the receiver unit (5) is attached on the prosthesis shaft (3).
10. System pursuant to one of the previous claims **characterized in that** the sender (46) is designed as optical sender and that in the receiver unit (5) an optical sensor (51) is arranged.
11. System pursuant to one of the previous claims 1 to 9, **characterized in that** the measurement unit (4) and the receiver unit (5) create a resonant circuit and the signal transmission (6) occurs via frequency or amplitude modulated load modulation.
12. System pursuant to one of the claims 1 to 9, **characterized in that** the signal transmission (6) occurs through amplitude modulation of a carrier signal created in the sender (46), which is demodulated by the receiver (51) accordingly.

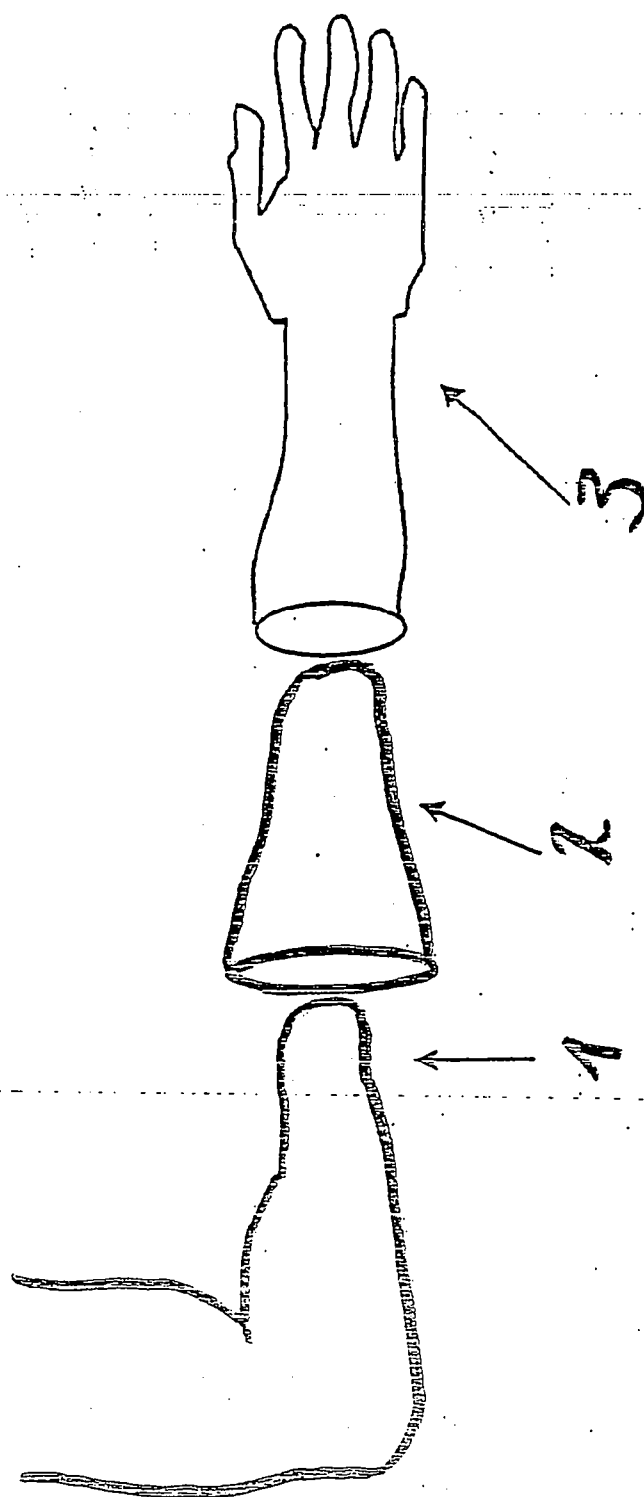


Fig. 1

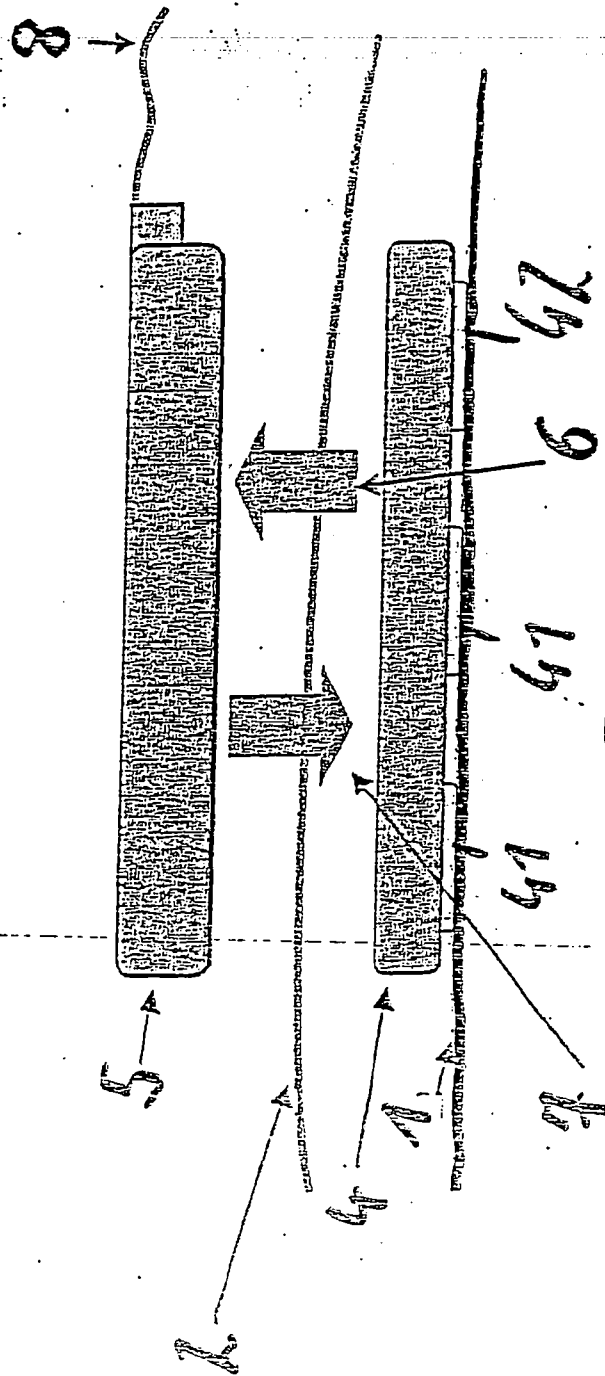


Fig. 2

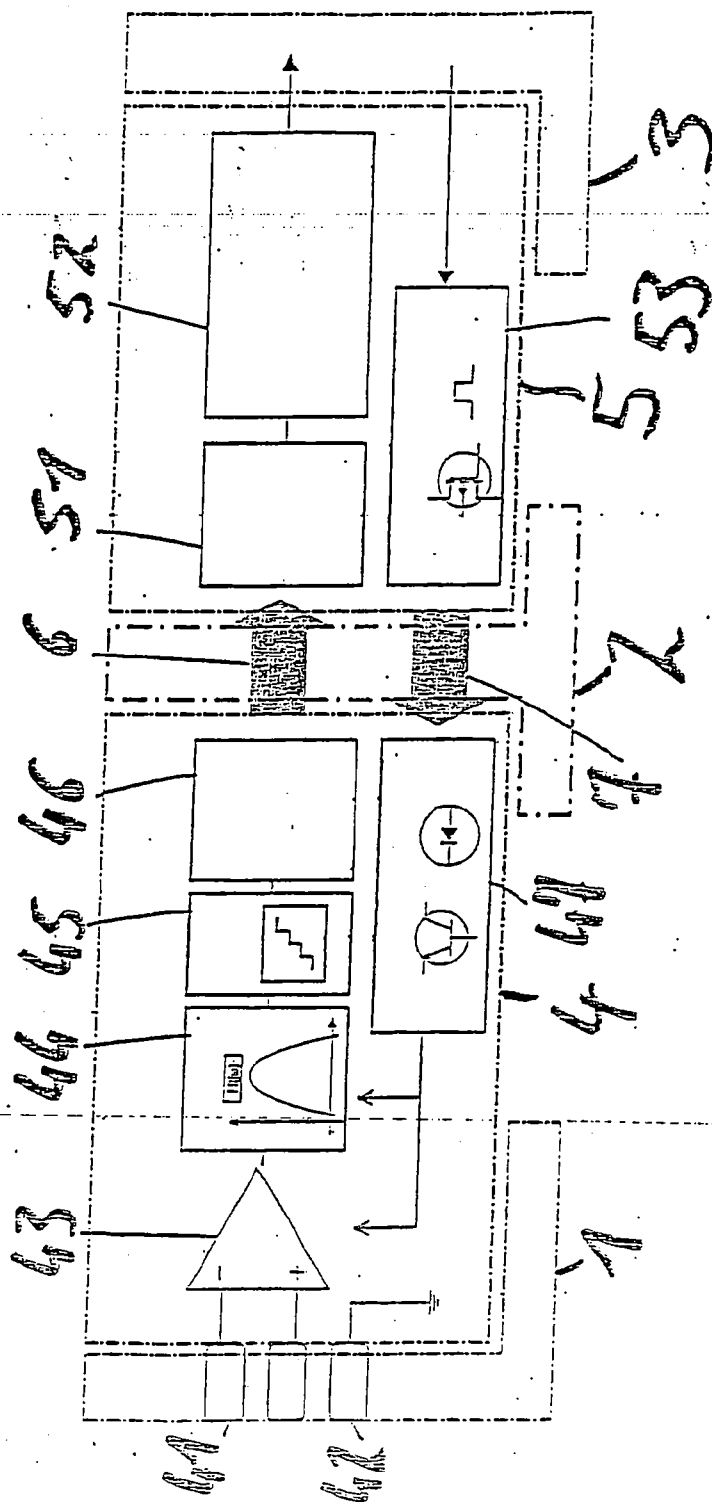


Fig. 3