

DEVICE FOR HYPERTHERMAL TREATMENT OF PRURITUS

DESCRIPTION

The invention relates to a device for hyperthermal treatment of itching by applying a treatment surface with a size between 1 cm² and 18 cm², whereby the treatment surface during the treatment phase is held at a temperature between 40° C and 65° C for 2 seconds to 12 seconds, preferentially 4 seconds to 6 seconds. The device according to the invention allows a significant relief of itching over large areas of the skin and an effective treatment of pruritus, chronic pruritus, dermatitis, allergies, and cnidarian stings.

Background and state of the art

Itching (Pruritus) is a subjectively unpleasant sense perception relating to the skin or mucous membrane. It can be limited to a local area or concern the entire body.

Frequently itching is accompanied by a burning, stabbing, or swarming feeling, which the affected person often attempts to moderate by scratching, scraping, rubbing hard, pressing, kneading, or rubbing. Consequently pruritus often leads to other pathological states of the skin, such as scars due to scratching, open wounds, scab build up, and skin infections. The professional world assumes that pruritus is transmitted by pain receptors on the skin and is conducted to the brain through the vegetative nervous system. The causes of pruritus can be very varied. In addition to dry skin, lack of applying moisture, or allergies, pruritus can also arise due to external effects and skin irritations, such as mosquito bites or the result of contact with cnidarians. Pruritus may be a reaction to chemical, mechanical, or thermal irritants. It can be the result of outside irritation, such as the effects of chemical substances, such as histamines (mosquito bite), apamine (bee sting), allergic immune reaction, pressure, rubbing, heat, sunburn, hives, urticaria, and other skin reactions associated with pruritus. From a medical point of view, the causes span the gamut from basic diseases that lead to pruritus to a broad spectrum of dermatological and internal diseases.

These include skin diseases like eczema, neuro-dermatitis, urticaria, skin infections (e.g., candidiasis), xerodermia, parasites (e.g., scabies), insect bites, allergies, metabolic diseases such as iron deficiency anemia or diabetes mellitus, infectious diseases, in particular AIDS, varicella, measles, herpes zoster, proctological diseases such as hem-

orrhoids or a analeczema, kidney diseases such as uremia, liver diseases and liver insufficiency, or neoplasms, in particular mycosis fungoides and Hodgkin's disease. Pruritus may also be triggered and spread by hormonal causes, such as menopause, side effects from taking medications, in particular carbamazepine, antibiotics, opiates (morphine), hydroxyethyl starch, captopril, and miconazole. Moreover, what is called senile pruritus is something that leads to unpleasant skin irritations among the elderly.

Chronic pruritus presents especially irritating itching, something that appears as an especially difficult symptom to treat, particularly with the underlying disease as noted above (Rothmann et al. 1941.). Pruritus is called chronic if it exists continuously for more than six weeks. The point prevalence of chronic pruritus amounts to up to 13.5% among the general population (Ständer et al. 2007) and up to 16.8% in the working population (Ständer et al. 2010). A composite appearance of new diseases should also be noted. In one year the incidence of pruritus amounts to 7% (Vogelgesang et al. 2012).

In addition to the physical and psychological burden on those persons affected, the medical costs and time-out of work due to especially chronic pruritus constitute an important socio-economic burden on society. The further development of treatments is therefore highly relevant.

Basically, treatment of the underlying disease is the essential approach for ongoing treatment for pruritus. If the cause is known, there might be for example, a specific treatment of the dermatosis, avoidance of the identified contact allergen, discontinuance of a medication, or a specific internal, neurological, or psychiatric treatment, or even an operation (e.g., in the case of a tumor), Chances for improving the condition of the pruritus are very good if there is an effective treatment of the underlying disease. However, the cause of the pruritus is often unknown or hardly treatable. The diversity and complexity of the possible causes also make difficult treatment that is calibrated to the cause.

A whole range of medications and cosmetic products are known for treatment of the symptoms of the itching. Thus diethyl ether oils, including menthol, thymol, and camphor, can give short-term cooling. Skin care products such as creams or lotions can also develop a pain relieving effect by increasing the moisture content of the skin. In addition, antihistamines provide helpful treatment possibilities, such as the administration of dimetindene Dimetindenmaleat or mepyramine. Mepyramin Other medications

include topical glucocorticoids, anesthetics, zinc salves, calcineurin inhibitors, and capsaicin.

Nonetheless, in the medication treatment of pruritus, one must note that these may lead to side effects, especially in combination with medications for the treatment of the underlying disease. Moreover, the broad array of patients presents a therapeutic challenge in the case of pruritus, ranging from children to pregnant women to patients with multiple diseases. Treatment of pruritus by medication often does not have the desired success, or involves side effects. For these reasons the development of alternative therapies for treating pruritus is necessary that are not based on the administration of medications.

It is known from the state of the art that application of heat to insect bites reduces the triggering of itching. EP 1231875 B1 describes a device for a local, thermal treatment, in particular of mosquito bites. The device has a heating plate with a size of about 0.2 cm², which is brought to a temperature of between 50° C and 65° C while the heating plate is in contact with the insect bite. While the device is good for the reduction of the itching due to smaller insect bites, it cannot be used on larger areas of skin irritation occurring in the case of chronic pruritus or pruritus due to contact with cnidaria. For these diseases, the state of the art involves conventional medical treatments with the disadvantages noted above.

From US 6 245 093 B1 a device for hyperthermal treatment of skin diseases and itching at the affected locations on the skin is known, which reveals in an embodiment a treatment surface made of metal with a size of about 5 cm². This is heated homogeneously monitored on a broad heating element monitored by a control and a temperature sensor at a temperature of 46 °C - 69 °C for a heating period of 0 seconds – 3 seconds. However, there is none described for the treatment of itching for the preferred treatment duration of 4 seconds – 6 seconds. For treatment areas that are smaller than 7 cm², nerve cells that are especially responsible for the regulation of itching cannot be specifically addressed. Through the use of only one heating plate, despite the larger surface, advantageous temperature distributions of the treatment surface for the treatment of pruritus cannot be achieved. In order to prevent burns, the use of mercury to prevent overheating of the treatment surface, which in certain circumstances has a slow reaction time, and through the lack of an additional safety fuse, there is no safety mechanism against overheating that satisfies a high standard. There is likewise no evidence for especially preferred metals as treatment surfaces. Thereby within the materials like

those discussed there are great differences with regard to the significant extent of the ability to conduct heat and tolerance by the skin. Especially well-suited, researched ceramics have not been used. There is also no explicit warning signal in the form of an acoustic warning tone and/or a lit optical signal device that can quickly, unambiguously, and reliably warn the user in particular of too high temperatures of the treatment surface.

EP 2 206 483 A1 describes a device using heat and cold for cosmetic purposes. The heat can be transferred via one or several partially goldplated surfaces. The treatment surface amounts to a maximum of about 2 cm^2 and is formed by several balls made of minerals. This device can also be used to cool locations on the skin. This device, which is not designed to treat pruritus, is particularly unsuitable for the hyperthermal treatment of pruritus in particular because of the long periods of application of the heat that has been created of at least 30 seconds. The mineral balls can be heated, and they distribute the heat on the skin. For this purpose, separate heating elements are placed on the balls and/or directly on the skin. However, these cannot be controlled to achieve an especially advantageous distribution of the temperature. The low heat conductivity of the minerals is disadvantageous for success of the treatment and for the functionality.

WO 2006/063202 A2 reveals a device for hyperthermal treatment of a plurality of skin irritations, including suffering from contact with jellyfish or itching. The device is heated through at least one electrical heating element, and uses a sensor and an electric control. The use is described of heating pulses of up to 3 seconds at a temperature of $70^\circ\text{C} - 400^\circ\text{C}$. The treatment surface is very small at about 1 cm^2 . The high treatment temperatures, however, are not suitable for the specific treatment of pruritus through the regulation of the immune system and through the activation of nerve cells and receptors. The heating pulses of typically less than 1 second are also not suitable for an effective treatment of pruritus. The small treatment surface is not useful for treating skin pain over large surfaces. Adjusted dimensioning of a capacitor responsible for the supply of current to the heat element is used as a passive safety mechanism, which limits the heat energy given off per discharge cycle. However, through rapidly successive cycles over a long period of time dangerously high heating energies can be given by the treatment surface. A safety fuse is not available, a condition that allows a dangerous continuous reheating, which is more difficult to prevent with a fuse because of the special type of construction. An advantageous ceramic treatment surface is not envisaged that has the capacity to conduct heat and that is tolerated by the skin.

Task of the invention

The task of the invention is to prepare a device that eliminates the disadvantages of the state of the art. In particular a device should be prepared that is appropriate for the treatment of large surface pruritus and chronic pruritus, is highly effective, and is safer in contrast to known devices and methods.

Abstract of the invention

The task of the invention is solved by a device according to the independent claim. The dependent claims relate to preferred embodiments of the invention.

In one preferred embodiment, the invention relates to a device for hyperthermal treatment of pruritus, including:

a) a treatment surface

and

b) a control device to regulate the temperature of the treatment surface

whereby

the size of the treatment surface is between 1 cm² und 18 cm²; the control device can regulate a treatment temperature between 40° C and 65° C; and the treatment temperature can be maintained in a treatment phase for a duration of 4 seconds to 6 seconds

To relieve the itching, the device according to the invention is preferentially laid on the skin areas of the patient to be treated. As soon as a device with the treatment surface contacts the affected skin locations, the control device can undertake regulation of the temperature of the treatment surface. To this end, the treatment surface initially in a heating up phase is brought to a treatment temperature of between 40° C und 65° C. It is preferred that the heating up phase be kept short. It is preferred that the heating-up phase last no longer than 10 seconds, and especially preferred not more than 2 seconds. After the completed heating-up phase, the temperature of the treatment surface preferentially is kept at the pre-set treatment temperature. The treatment temperature preferentially corresponds to a constant temperature, which lies in the noted area of between 40° C and 65° C. This treatment temperature is preferentially maintained at a constant level during the treatment phase. It can however be also preferred for the treatment temperature not to be held constant. For example, the treatment surface can also be brought on a temperature slope to a maximum temperature in the area of the

treatment temperature between 40 ° C and 65° C. Additionally, it can be preferred that the temperature is reduced to a temperature below the area of the treatment temperature in order subsequently to raise it. The treatment phase preferentially denotes the time period in which the temperature lies in the range of the treatment temperature of 40° C to 65° C. Preferentially the treatment phase lasts between 2 seconds and 12 seconds, especially preferentially between 4 seconds and 12 seconds, and particularly preferentially between 4 seconds and 6 seconds. It is especially preferred that the treatment phase designate a continuous duration. It can also be that the treatment phase is interrupted by the short term introduction of the temperature being ramped up.

The preferred variants relating to a treatment temperature that is not constant have surprisingly shown themselves as advantageous in some of the skin diseases leading to pruritus as compared to maintaining a constant treatment temperature. Among these skin diseases, preferentially this may involve diseases that are caused by allergies, neurodermatitis, psoriasis, eczema, urticaria, candidiasis, xeroderma, parasites, environmental factors, autoimmune diseases, pruritus senilis, pruritus hiemalis, aqueous pruritus, and dry skin. Especially preferred skin diseases are diseases that stem from kidney diseases, liver diseases, blood diseases, lymph system diseases, Hodgkin's disease, polychthaemia vera, iron deficiency, tumors, metabolic disturbances, hormonal diseases, thyroid gland diseases, hormonal fluctuations, diabetes mellitus, anorexia nervosa, gluten intolerance, nutritional deficiency, HIV infection, neurological diseases, and diseases due to infection. Obviously it is also possible that the skin diseases are caused by antibiotics, opiates, infection blockers, antimalarial products, psychopharmaceuticals, hormones, diuretics, cytostatics, high blood pressure medications, gold, blood clotting blockers, and retinoids. Thus it may be an advantage, for example, among the diseases noted above, to reach the maximum temperature for only a very short time through a rising temperature and subsequently to cool off somewhat through ramping down. Thereby custom set timed heating impulses can be given through the heating surface to the skin. The regulation of the heating surface to a temperature between 40° C and 65° C for a treatment phase between 2 seconds and 12 seconds, preferentially between 4 seconds and 12 seconds, especially preferentially between 4 seconds and 6 seconds, a heating impulse is generated that allows bringing a well defined amount of heat to the skin location in a controlled manner. The transfer of heat surprisingly leads to an overlay of the itching by other skin sensitivities dependent on the temperature. In contrast to the conventional methods of treating pruritus, which take aim at the itching sensitivity by regulating the pain receptors, the heat treatment according to the inven-

tion activates the free nerve endings of the C fibers. The C fibers in particular denote the slow conducting nerve fibers of the somatosensory system and are responsible for the perception of pain. Hereby in particular the free ends of the C fibers, which are also called the nociceptors, play an important role. The nerve endings of the fibers are activated by tissue hormones (e.g., histamine, serotonin, substance P). Mast cells in the vicinity of the nerve endings may also be involved by distributing the tryptase mediator to the process.

According to the invention, the knowledge is exploited via the surprisingly effective mechanism of the treatment to regulate the perception of sensitivity brought about by the fibers. In the state of the art, it is true that smaller heating plates are known for the treatment of insect bites. However, the person skilled in the art could not assume that heat treatment would be advantageous as well for large surface areas of the skin, such as in the case of chronic pruritus, allergies, or jellyfish bites. Thus the person skilled in the art would assume that the hyperthermal treatment of mosquito bites is based on inhibition of the insect poison, whereby the itching is relieved. The knowledge according to the invention of the effective mechanism discussed above leads however to a broader ranging application even on a large surface skin irritation. Hereby pruritus can be effectively relieved by various causes. Moreover, the design of a larger treatment surface constitutes a drastic change from the state of the art for the hyperthermal treatment of itching. Thus the person skilled in the art would assume that a positive relief of the itching in large surface treatment of the affected skin areas would involve negative side effects such as burning of the skin or hyperthermal pain sensitivity. It has been recognized that large surface areas affected by pruritus are surprisingly treated with a larger treatment surface of about 1 cm² to 18 cm², preferentially at least 2 cm², at least 3 cm², at least 4 cm², especially preferentially between 6 cm² to 9 cm², and very especially preferentially between 7 cm² and 9 cm². So for example, in the case of skin rashes, a comfortable and simple application of the heating surface to the affected skin areas may convert the itching feeling to a tolerable pain sensation through the application of heat. Secondary damage of the skin, such as creation of wounds due to strong scratching, can be effectively avoided in this manner. Devices in the current state of the art would find it necessary to treat large skin areas with multiple applications in various positions. Due to the time spread, however, the same effect could not be achieved in this manner.

It can also be preferred that a treatment surface of at least 7 cm² be applied. Three different receptor cells (sensory cells) may detect external chemical, mechanical, or physi-

cal irritations that trigger the sensation of itching. These sensory cells involve what are called open nerve endings, whose structures perceive irritations in the epidermis and the underlining dermis and whose axons conduct the signals of perceived irritations to the spinal cord. The non-myelinated fibers are of special significance in these sensory cells. Their reception structures are found partially at 0.1 mm under the surface of the skin. C fibers are divided into polymodal mechanical and heat sensitive fibers and mechanically insensitive C fibers, which however can also be stimulated by heat. C fibers perceive not only pruritogenetic stimulants, but also serve as nociceptors (heat receptors). It is shown in the literature that heat receptors as counter receptors can suppress the sensation of itching. The individual C fibers perceive irritants of a specific area of the skin, whereby a defined skin area is innervated by sensory cells. This region is called a receptive field. The receptive fields can partially overlap C fibers. Studies on human beings through what is called micro-mapping have surprisingly shown that the mechanically insensitive C fibers have receptive fields of up to 5 cm²; the C fibers that are mechanically sensitive are somewhat smaller, up to 2 cm² in size. Surprisingly it has been shown that the receptive fields can address both types of C fibers from a preferred size of the treatment surface of approximately 7 cm². At the preferred treatment size of between 7 cm² and 18 cm², the receptive fields of the various types of C fibers are surprisingly well covered, and in addition the effect of the horizontally outflowing heat is compensated for. Thereby itching, even in affected skin areas smaller than the treatment surface, can surprisingly be very effectively treated.

One may also preferentially use a treatment surface of a preferred size of 6 to 11 cm², especially preferred 7 to 10 cm², and very preferentially 8 to 9 cm², in particular 8.4 cm². Such a treatment surface can be used in an ideal size for the previously described affects in order to alleviate itching. Surprisingly it has turned out that such a treatment surface is very well suited to treat large surface skin pain with only one application.

In the sense of the invention, the "treatment surface" refers to that surface of the invention that is heated to the treatment temperature during treatment and that stands in direct thermal contact with the skin area. The treatment surface can present a connected surface. It can also be preferred that the treatment surface consists of several non-connected partial surfaces. The size of the treatment surface refers in each case to the total contact surface. In the case of a treatment surface that consists of several partial surfaces, the size of the treatment surface does not correspond to the outline of the surfaces that include the partial surfaces, but rather constitutes the total of the individual

partial surfaces. The outline surface corresponds preferentially to the convex shell of the partial surfaces according to the mathematical definition. In the case of the connected treatment surface, the size of the treatment surface equals the outline surface. A treatment optimally adjusted to the cause can occur with the selected sizes and geometries of the treatment surface, something that optimizes the efficiency and comfort and thus contributes to a long-lived treatment success.

It is especially preferred that the treatment surface be applied using at least one heating plate at the treatment temperature. For this purpose, the treatment surface preferentially lies in contact with the at least one heating plate, whose temperature can be set by the control device, whereby a setting of the treatment temperature on the treatment surface occurs through heating up the heating plate. In this way the heating surface can be heated in the most efficient manner. The treatment temperature preferentially always shows the particular temperature existing on the skin of the patient. In the sense of the invention, the control device preferentially is a processor or a processor chip that is configured to regulate the temperature of the heating plates according to pre-set values. The at least one heating plate is preferentially a construction component that is sufficiently known from the state of the art. It is preferred that the heating plate can be set up by setting the current at a desired temperature, but other means can also be used for preparing the heat. By a heating plate, that construction element is preferentially named that can be heated by the heating device through such methods as applying an electric current. It is however preferred that the heating plate not come into direct contact with the skin being treated. This results in greater safety as well as and optimize dispersal of the heat that is achieved by the consistency and geometry of the treatment surface. For this purpose, the heating plate is preferentially located above the treatment surface, and stands in direct or indirect thermal contact with the treatment surface. Above this, preferentially the heating plate is positioned toward the inside, and it is covered on the outside of the treatment surface under the heating plate. Direct thermal contact preferentially is called a direct contact, and the indirect thermal contact is a contact that is achieved with a heat conducting layer. It may also be preferred that this device have a single heating plate. However, it may also be preferred that the device contain several heating plates.

In an especially preferred embodiment of the invention, the size of the heating plate is at least 6 cm² and the heating temperature lies between 42° C and 53° C, and especially preferred between 50° C and 53° C.

It has been shown in a completely surprising manner that with the parameters noted above itching can be very considerably reduced, in particular on large skin surfaces. A combination of the treatment surface of at least 6 cm² with a heating temperature between 42° C and 53° C, and especially with the preferred heating temperature between 50° C and 53° C, permits an effect on the skin areas that quickly and effectively relieves the itching. It has been recognized that an especially strong overlay of sensitivity to itching can be achieved locally if the thermal and capsaicin receptors TRPV1 and TRPV2 are simultaneously activated.

TRPV1 is involved in acute heat induced pain in healthy skin, and for example, regulates sensitivity to heat at temperatures of 45° to 50 ° C. In especially strong painful heat irritations, which occur at temperatures of above 52° C, the TRPV2 is also activated. The activation threshold of TRPV1 lies between 40° C and 45° C, whereas that of TRPV2 lies between 50° C and 53° (Yao et al 2011, Somogyi et al. 2015, Cohen et al. 2014, Mergler et al. 2014).

While an initial understanding of the mode of working of the TRPV1 and TRPV2 receptors has been shown through current research results in the literature, their role in the sensitivity to itching irritants is unknown. Even with knowledge of the literature, a person skilled in the art would therefore not assume that precisely the activation of these receptors would facilitate an especially effective overlay of the sensitivity to itching. This is a surprising finding that has been achieved according to the invention. The preferred noted embodiment, which calls for temperature regulation of the treatment surface in a narrow range between 50° C and 53° C, surprisingly permits very effectively simultaneous activation of the receptors without triggering unpleasantly strong perceptions of pain in the people being treated. Experimental studies have shown the area of the activation threshold of TRPV2 to be an especially optimal area. Hereby a feedback mechanism presumably comes into play between the receptors, which very effectively overlays the itching without causing side effects. A person skilled in the art would not expect this for a treatment surface that is greater than 6 cm². Rather the person skilled in the art would assume that with a treatment temperature of 50° C – 53° C for a period of 2 seconds to 12 seconds, and all the more over the especially preferred time period of 4 seconds to 6 seconds, there would be strong skin irritations or pains up to slight burning. Instead, the preferred treatment of the skin areas lead to reduction of the sensitivity the itching, which surprisingly lasts for hours after the treatment. The long-lived effect of the preferred embodiment is at least partially traceable to immune regulation through the

transfer of heat. Thus not only is the pain sensitivity overlaying, but the local irritation of the skin is actively suppressed by regulation of the immune system. Therefore a single treatment may need lead advantageously to a long-lived recession of sensitivity to itching. However, it may also be preferred to conduct treatment several times over a period of time. Overlaying by the heat at intervals with a treatment phase of 2 seconds – 12 seconds or especially preferred 4 seconds to 6 seconds achieves an optimal effect on the signal paths of the pruritus without triggering undesired side effects.

It has surprisingly turned out, especially for the preferred treatment duration of 4 seconds – 6 seconds and the planned treatment temperature, especially for the especially preferred treatment temperature of 50° C – 53° C, that an unusually effective activation of the TRPV1 and especially of the TRPV2 receptors takes place. It was completely surprising that this specific choice of treatment temperature and treatment duration contributes very effectively to reduction of the itching. The C fibers as well, in particular their free ends, are ideally addressed by this preferred selection. It has surprisingly been shown that even for small treatment areas starting at 1 cm² of treatment surface, large receptive fields of C fibers can also be effectively addressed by the flow of heat occurring in the preferred range. It has been surprisingly shown that the treatment success is not correlated in anything like a linear fashion for the duration of treatment, but in particular is especially high for the preferred duration of treatment. An especially effective immunoregulation also takes place with the noted combination of treatment duration and treatment temperature. Thus surprisingly a synergistic effect through a treatment duration of 4 seconds – 6 seconds at the prescribed treatment temperature, in particular for a treatment temperature of 50° C – 53° C, can be explained through the cooperation of an especially effective activation in this selection of TRPV1 and TRPV2 receptors, through an ideal addressing of the C fibers, and through an especially strong immunoregulation. Surprisingly it has turned out that for this selection even for large treatment surfaces an unpleasant skin feeling and burning of the skin can be avoided, so that as a result a long-lived treatment success can be achieved.

A device for hyperthermal treatment of pruritus, including a control device for the regulation of the temperature of the treatment surface and a size of the treatment surface between 1 cm² und 18 cm², whereby the control device can regulate the treatment surface in a heating up phase to a treatment temperature between 40° C and 65° C, preferentially 50° C – 53° C, and the treatment temperature in a treatment phase can be maintained for a time period of 4 seconds to 6 seconds, has turned out to be surprisingly

advantageous for the treatment of pruritus, in particular according to the mechanisms presented here.

It can also be preferred that a treatment temperature between 40° C and 65° C, preferentially 50° C to 53° C, be maintained for a treatment duration of 4 seconds to 12 seconds. This preferred treatment duration leads to the conduction of heat to the skin, through which an ideal temperature in the various skin layers can be achieved through the mechanisms described above for the treatment of pruritus. Isotherms are formed in the various skin layers through this preferred treatment duration, which completely surprisingly have turned out to be ideal for the successful treatment.

10 In one preferred embodiment of the invention, the device is characterized in that the device consists of at least two heating plates, preferably at least four heating plates and very especially preferred at least six heating plates, which are in contact with the treatment surface and whose temperature can be set by the control device, whereby setting of the treatment temperature on the treatment surface occurs through heating of the heating plates. The presence of two heating plates, whose positioning is freely selectable, allows achieving an especially advantageous temperature distribution on the skin of the patient. So it can be preferred that the treatment surface is a connected surface to which the at least two heating plates can be attached, preferentially at least four, and especially preferentially at least six heating plates. Hereby it is possible to achieve an optimal temperature distribution.

It is preferred that the preferred at least two heating plates are separately controllable. This means preferably that each heating plate can be controlled individually from the regulation device, and can be set to individually adjustable heat temperatures. Hereby a temperature distribution optimized for treatment success can be set on the treatment surface. Surprisingly the treatment temperature is perceived as especially pleasant, so that the treatment does not have to be interrupted. Thereby it can be advantageous to achieve an especially homogeneous temperature distribution on the separately controlled heating plates, in which for example, external heterogeneities can be balanced through slightly different heat temperatures of the heating plates, which for example, occur because of the geometry of the heating plate or because of the differential heat outflow to various positions on the treated skin surface. It may also be desirable that a slightly heterogeneous temperature distribution is created intentionally on the treatment surface. According to the skin part to be treated, it may be set that only one correspond-

ing portion of the treatment surface is heated, so that as a result an efficient treatment can be undertaken for the patient that is as pleasant as possible.

For this purpose the distances between the heating plates can be adjusted. For example, it can be preferred that the heating plates are set up as a grill, whereby a distance
5 exists in each case between the heating plates that lies between 0.2 mm 10 mm, preferentially between 0.5 mm and 3 mm. For this, an especially effective temperature distribution can be generated. In this way the temperature distribution is not exactly homogeneous, but slightly elevated at the positioning of the heating plates, that is preferentially by less than 2° C. The temperature difference is preferentially given in comparison
10 to a low temperature of the treatment surface between the heating plates. Surprisingly such a small local heterogeneity with a temperature difference between 0.1° C to 2° C in comparison to the average treatment temperature leads to a particularly marked reduction of the itching. The spread notes preferentially a characteristic length of the cross-section of the heating plates. In the case of circular heating plates, the spread
15 preferentially corresponds to the diameter. In the case of square heating plates, one should preferentially understand the spread as the length of the sides of the square. It can be preferred that in order to reduce the effort for control, the device should not have more than 15 heating plates, preferentially not more than 12.

In particular it is preferred that one use at least two separately controllable heating
20 plates in connection with a treatment surface of at least 6 cm², preferentially at least 7 cm². In this way an optimized and rapid heating of the treatment surface and thereby preferentially a good reduction of the itching can be effected.

It can however also be preferred that the preferred at least two heating plates can be controlled jointly. Through this preferred variant, an especially simple, cost-effective,
25 and robust control can be realized.

It is preferred that at least approximately 0.84 heating plates be used per cm² of treatment surface. For a treatment surface of 6 to 11 cm² at least 5 heating plates are preferentially used, especially preferred for a heating surface of 7 to 10 cm² at least 6 heating plates, very especially preferred for a heating surface of 8 to 9 cm², and in particular
30 for 8.4 cm² at least 7 heating plates. Especially for a preferred embodiment for which the size of the heating plates lies between 0.05 cm² and 2 cm², preferentially between 0.1 cm² and 0.5 cm², it has been shown that in this way both an optimal temperature distribution during the treatment phase and an effective heating up can be achieved. It

has been shown that this preferred minimum number of heating plates per cm^2 is necessary to reach a heating up phase of 10 seconds, preferentially 2 seconds. It has also been shown that in this way an especially homogeneous temperature distribution during the treatment phase can be achieved. This leads to a particularly good treatment result.

- 5 In particular for a preferred treatment surface of at least 6 cm^2 , the preferred treatment temperature of $50^\circ \text{C} - 53^\circ \text{C}$ and the preferred treatment duration of 4 seconds – 6 seconds has turned out to be a minimum number of two heating plates, especially preferred of at least 5 heating plates is ideal in order to have a heating up phase of 10 seconds, preferentially 2 seconds. It has also been shown that in this way an especially
10 homogeneous temperature distribution during the treatment phase can be achieved.

It is preferred to use at least 6 heating plates in a preferred treatment surface of at least 7 cm^2 . It is preferred to use at least 7 heating plates in a preferred treatment surface of at least 8.4 cm^2 . Surprisingly it has been shown that in this way especially good treatment successes may be achieved.

- 15 It may also be preferred that at least two heating plates without any distance from one another be set up in a connected component. This has the advantage that there is a large surface component, which gives off heat over the entire surface formed by the connected surfaces of at least two heating plates. Simultaneously the individual heating plates can be controlled individually so that a custom set temperature distribution can
20 be created.

- However, it can also be preferred that the heating plates exist of several partial surfaces, which preferentially are congruent to the heating plates. Congruent means that it is preferred that the cover over partial surfaces of the treatment surfaces and the heating plates found over these are equal, so that the form and size of the partial surfaces correspond to the form and size of the heating plates. To this end, for example, the heating
25 plates may be coated or covered over with preferentially related materials for the treatment surfaces. It can however also be preferred that the partial surfaces extend beyond the heating plates, whereby it is preferred that the partial surfaces of the treatment surfaces do not touch one another on the contact level.

- 30 It is preferred that the treatment surfaces consist of several partial surfaces if for example, especially large skin surfaces need to be treated. For this purpose the partial surfaces can be set up in a way that they broadly diverge from one another in order to cover a large surface contour. For example, it can be preferred that the heating plates are

set up as a grill, whereby a distance exists in each case between the heating plates that lies between 0.2 mm 10 mm, preferentially between 0.5 mm and 3 mm. In laying the treatment surfaces on the skin areas, a stronger heterogeneous temperature distribution is achieved in comparison to a connected treatment surface, which can be advantageous in certain pruritus diseases. Furthermore, the total overlaid amount of heat is advantageously reduced within the contour surface by a point allocation of heat.

It is especially preferred that the heating plates be set to a temperature by the control device that leads to the desired treatment temperature on the treatment surface. So it can be preferred that the heating plates are set to a slightly elevated temperature in comparison to the planned treatment temperature. The difference of the temperatures reflects the expected temperature gradients between the heating plates and the outer side of the treatment surface.

In a preferred embodiment of the invention, the device is so characterized that the control device regulates the heating plates in a heating up phase to a heating temperature between 43° C and 54° C, and the heating temperature in the treatment phase can be maintained for a duration of 2 seconds to 12 seconds, preferentially between 4 seconds and 6 seconds. The heating temperature thereby preferentially corresponds to that temperature at which the heating plates preferentially can be maintained at a constant level during the treatment phase. Through such a regulation of the heating plates, the temperature of the treatment surfaces can be brought especially precisely to a range of 42° C – 53° C, with a corresponding duration of the treatment phase between 2 seconds to 12 seconds, preferentially between 4 seconds and 6 seconds. It can thereby be preferred that the heating plates be set at a temperature slight elevated over the desired treatment temperature in order to balance out any possible heat loss or temperature gradients. Furthermore, it can be preferred that the heating plates be set at a constant level at the same heat temperature. It can however also be preferred that the heating plates be set at various temperatures. It is thereby preferred that the heating plates be controlled and heated separately with the control device. In particular for embodiments with at least 6 or preferentially at least 8 heating plates, it has been shown that a surprisingly homogeneous temperature distribution to the treatment surface can be achieved if the heating plates on the edges are heated to a temperature slightly elevated over the heating plates in the middle. It is also adjustable to heat up the outer heating plates before the middle heating plates. The positioning of the edge and middle is obvious for the person skilled in the art when viewing the setup of the heating plates.

The middle heating plates are preferentially those heating plates that are surrounded by the outer heating plates. The heating plates found on the edges are not bordered by any other outer heating plates. A slightly elevated temperature means preferentially a temperature difference between 0.1°C and 2°C , especially preferred between 0.1°C and 0.5°C . With simultaneous control and switching off of all heating plates, it can occur that achieving the effective temperature of the total treatment surface occurs too late or that the user during use senses a strong heat peak, even though the treatment temperature on the entire treatment surface has not yet been reached.

In another preferred embodiment of the invention, the device is so characterized in that the treatment surface has a thickness between 0.2 mm and 5 mm, preferentially between 0.5 mm and 2 mm, especially preferred between 1 mm and 1.5 mm, and is made of a material that has the ability to conduct heat at 50°C between 20 W/mK and 400 W/mK, preferentially between 100 W/mK and 350 W/mK. The heat conductivity (also designated as the heat conducting number) preferentially characterizes the thermal properties of the material of which the treatment surface is made. The heat conductivity tells how high the amount of heat is that is conducted through the treatment surface when a temperature gradient is applied to it. In addition to the heat conductivity, the transport depends on the thickness of the treatment surface, the size of the treatment surface, and the temperature difference between the inner side of the treatment surface (contact with the heating plates) and the outer side of the treatment surface (contact with the skin). The heat conductivity is preferentially given as the relation between the transported heat output in watts (W) per temperature difference in Kelvin (K) and per meter (m). The heat conductivity may also preferentially be given as the relation between the transported heat output in watts (W) per temperature difference in millikelvins (mK). Since the heat conductivity can continue to be slightly changed depending on the temperature, the reference temperature here is given as 50°C . The thickness of the treatment surface also designates preferentially the extent of the treatment surface between the outermost surface, which contacts the skin, and the innermost surface, to which the heating plates are applied.

An especially therapeutically effective heat distribution to the skin results at a thickness of the treatment surface of between 0.2 mm and 5 mm, preferentially between 0.5 and 2 mm and especially preferentially between 1 mm and 1.5 mm, in combination with the preferred heat conductivity between 100 and 350 W/mK. In experimental trials, the parameters noted as preferred have shown themselves to be surprisingly advanta-

geous. A treatment surface designed in this way avoids a too rapid dispensing of the heat to the affected skin parts, whereby an unpleasant stabbing pain could be triggered. Consequently the heat distribution occurs in a time period that has sufficient impulses in order to effectively stimulate the receptors and to overlay any itching. The noted parameters therefore present an optimized selection that is not obvious to the person skilled in the art.

In a preferred embodiment, the treatment surface is made of ceramics or gold. It is especially preferred that the treatment surface be constituted of gold or a ceramic. The materials ceramics and gold for one thing fall in the experimentally shown preferred range of heat conductivity. In addition, these have shown themselves to be surprisingly useful for the treatment of dermatological itching. In particular the materials display an elevated perceived pain overlay in cases of chronic pruritus, allergies, or after contact with poisonous cnidaria. Thus it is surprising to the extent that the effect goes beyond the pure temperature effect given by thermally comparable materials. In addition, the materials are marked by a surprising anti-microbial function at the involved treatment temperature. This property has a special significance in the case of pruritus. In particular with chronic pruritus or large skin areas that are affected, patients tend to seek short-term, subjective relief through scratching, scraping, or vigorous rubbing. This can lead to compulsive behavior as a result of psychological reinforcement. Thereby microscopic wounds, traces of scratching, skin lesions, or even open wounds may pile up as a side effect of pruritus. The anti-microbial function of gold and ceramics displays long-term positive effects for recovery of the skin in addition to relieving the itching. Moreover, gold and ceramics show a surprisingly high biological tolerance, and the use of these materials in a device for treatment of predominantly dermatological diseases is especially marked when paired with an especially low outbreak of allergies. An especially preferred ceramic is aluminum nitride. To an especially large extent, this is characterized by an exceptional biological tolerance, a surprising anti-microbial function at the treatment temperature, and excellent thermal properties. In addition, a treatment surface made of aluminum nitride is especially strongly electrically insulated, so that increased safety can be assured during use.

In a further preferred embodiment of the invention, the device is so characterized in that the device is constituted of between 4 and 18 heating plates, preferred between 8 and 14 heating plates, and the size of the heating plates lies between 0.05 cm^2 and 2 cm^2 , preferentially between 0.1 cm^2 and 0.5 cm^2 . It is especially preferred that the heating

plates be circular, preferentially with a diameter between 3 and 10 mm. However, rectangular heating plates can also be preferred. In addition, it is especially preferred that the heating plates are set up as a grill, whereby a preferred distance between the heating plates lies between 0.2 mm and 10 mm, preferentially between 0.5 mm and 3 mm.

5 The setup of the heating plates leads to a surprisingly strong relief of the itching, whereby in particular an especially effective treatment for chronic pruritus, surface allergies, or jellyfish stings becomes possible. In addition, in the preferred dimensioning of the heating plates, there is a synergistic, positive effect, if these heat up a treatment surface that is formed as a whole, has a thickness between 0.5 mm and 2 mm, and is
10 made up of a material with a heat conductivity between 50° C between 20 and 400 W/mK, preferentially between 100 and 350 W/mK. There is an optimal heat overlay for this very exceptionally preferred embodiment. The heat conductivity, in connection with the thickness, determines not only the heat transport between the heating plates and the outer upper surface of the treatment surface, but also the temperature distribution
15 on the planes of the treatment surfaces. The noted parameters are characterized by an especially effective temperature distribution, which is sufficiently homogeneous to achieve an equal effect on the skin parts, but nevertheless achieves a slightly heterogeneous, point heat dispersal. Hereby a slightly elevated temperature lies on the position of the treatment surface directly below the particular heating plates, which preferentially is 0.1° C to 2° C higher than the average treatment temperature. This distribution
20 is surprisingly especially effective in reducing itching.

However, it may also be preferred that the device contains only one single surface heating plate. In a preferred embodiment this can be a heating plate with a large surface, meaning preferentially that the heating plate covers a surface of at least 50% of the
25 treatment surface. It can also be preferred that the heating plate essentially is congruent with the treatment surface. Essentially this means here that the surfaces are approximately equal. Information such as approximately, circa, nearly or synonymous terms preferentially designate a span of tolerance of less than +/- 10%, preferentially less than +/- 5%, especially preferentially less than +/- 1%. It can be preferred that the single
30 heating plate exists in the form of a heating spiral. A heating spiral means preferentially a heating plate whose path of the heating surface lies on a plane above the heating surface in a spiral shape away from the central point, or approximates this shape. This can also mean a heating plate with a shape that is set up to meander in a plane above the heating surface. By the shape of the path, the preferred meaning is a long surface

whose length is more than twice as long as its width. The use of a single heating plate can result in an especially simple construction of the device.

In a preferred embodiment of the invention, the device includes at least one temperature sensor to measure the temperature of the treatment surface and/or at least one heating plate, whereby the control device sets the temperature of the at least one heating plate based on measurement data from the temperature sensors. A temperature sensor is characterized preferentially by an electrical or electronic component that sends an electrical signal to the control device by measuring the temperature.

In the state of the art, a plurality of temperature sensors is known, such as semiconductor temperature sensors, resistance temperature sensors, hydroelectric materials, thermal elements, and quartz resonators. The control device is further characterized by being configured in a way that it can receive and evaluate the measurement values of the temperature sensors in order to regulate the heating plates. The regulation of the heating plates can preferentially occur with the application of an electrical current or an electric potential. It is especially preferred that the temperature sensor directly measure the temperature of the treatment surface, meaning that the temperature sensor is in contact with the treatment surface, whereby the temperature sensor can be found both on the inner side of the treatment surface and on the outer side of the treatment surface. In the case of a connected treatment surface, it can be preferred that several temperature sensors are attached on the treatment surface in order to allow an especially precise readout of the local temperature distribution. It can also be preferred that the temperature sensor does not contact and monitor the treatment surface, but does so to the heating plates. On the basis of knowledge of the material properties of the treatment surface, preferentially conclusions may be made regarding the temperature distribution of the treatment surface based on the measurement data from the heating plates. An evaluation of the temperature of the heating plates and of the temperature of the treatment surface allows a particularly precise regulation of the heating plates in order to assure an optimal temperature distribution and heat overlay. For this purpose it can also be preferred that individual heating plates be controlled separately, for example, to balance out a temperature gradient. It can however also be preferred that the heating plates be controlled jointly, so that temperature regulation occurs equally over all heating plates. In particular with reference to the many application possibilities of the device to treat various pruritus diseases, a temperature-based feedback regulation is appropriate to satisfy the various safety requirements. In the cases of treating skin areas with

lesions or in cases of treating children, it is of very great importance to set an exact treatment temperature and not to exceed a maximum value. A feedback control based on temperature measurements can also effectively avoid application errors. The use of at least one temperature sensor thereby increases not only the effectiveness, but also the safety and reliability of the device.

In a preferred embodiment of the invention, the device has a piece of software and/or hardware that shuts down for safety purposes when a maximum temperature is exceeded. This preferred embodiment allows an especially safe operation of the device. In contrast to the state of the art, a safety shutdown is greatly advantageous in the case of unequal larger treatment surfaces. Otherwise there may be system failures leading to skin damage precisely in the treatment of large surface skin areas. In addition, one should note the broad applicability of the device, which in addition to various sensitive parts of the skin also includes various patient groups such as children, seniors, and pregnant women. Shutting down the device by a piece of software and/or hardware through a safety shutoff at a maximum temperature may provide sufficient safety demands at the highest level. It is especially preferred that the safety shutoff be implemented by hardware, for example, by fuses or bimetallic strips, so that there is no necessity of actively using the control device when a maximum temperature is exceeded. It can moreover be preferred that there is also a software-based shut off. This is preferentially implemented by the control device, which evaluates the temperature data of the heating plates and/or the treatment surface and compares them with a maximum value.

It can also be preferred that the device include a temperature monitor implemented by hardware, which limits the maximum temperature of the treatment surface to a previously set maximum value. "Hardware implemented temperature monitor" designates preferentially a temperature control system for the treatment upper surface, which through the hardware can shut off electrical current supply of the heating plates on the treatment surface. In particular the "hardware implemented temperature monitor" preferentially permits a shut off of the electrical current supply of the heating plates when a maximum temperature is exceeded independent of regulation of the heating plates by the controlling device, for example, through a microprocessor. If the regulation of the heating plates for example, should be installed on the control device by private company software, it is preferred that the hardware implemented temperature monitor reliably limit the maximum temperature of the treatment surface in the case of a current outage or an erroneous application of the private software. Advantageously the hardware im-

plemented temperature monitor is set so that there does not have to be a permanent shutoff of the electric current supplied to the device. Rather the hardware implemented temperature monitor is designed in a way that the shutoff occurs when the temperature of the treatment surface exceeds a maximum temperature during the period when the electric current supplied to the heating plates is excessive. The current interruption by the hardware implemented temperature monitor is thereby advantageously reversible, meaning that as soon as the temperature of the treatment surface again falls under the maximum temperature, the heating plates can once again heat up. Such a hardware implemented temperature monitor can for example, be implemented through a bimetallic strip. It can also be preferred that such a hardware implemented temperature monitor include at least one temperature sensor to measure the temperature of the treatment surface and a comparator independent of the control system of the treatment temperature, whereby the comparator compares the temperature of the treatment surface with the maximum temperature, and when the maximum temperature is exceeded, stops the current supply to the at least one heating plate. A comparator means preferentially an electrical connection to compare two electrical potentials, whereby a binary comparison initially shows which of the two potentials is higher. Sufficiently various comparators known in the state of the art that are suitable to emit a binary initial signal from two analog potentials, indicating which of the initial potentials is higher. The Schmitt trigger is here named as an example of a comparator switch. It is preferred that a reference value for a voltage supplied by a voltage distributor be applied at one connection of the comparator. This reference value corresponds preferentially to the voltage value that the second temperature sensor would show when the temperature of the treatment surface equals the maximum temperature. Preferentially at the second connection of the comparator, the initial voltage of the temperature sensor is given, which is a function of the temperature of the treatment surface. An especially preferred temperature sensor for this purpose includes an NTC thermistor, meaning a heat conductor. This has a negative temperature coefficient, so that when the temperature rises, the resistance falls and a higher current flows. Cold conductors can also be used, meaning related PTC thermistors, which have a positive temperature coefficient so that when the temperature of the resistance rises, a lower electrical current flows. The application of a hardware implemented temperature monitor results in a device that has surprisingly low susceptibility to interruptions.

If the temperature of the treatment surface rises, the voltage value on the comparator controlled by the second temperature sensor moves to a reference value of the voltage

that corresponds to the maximum temperature. As soon as the temperature exceeds the maximum temperature, the initial signal on the comparator changes in a binary fashion. Preferentially the comparator is integrated into the electrical current supply of the heating plates. This means that before the temperature of the treatment surface reaches a maximum temperature, the comparator preferentially releases the supply voltage to the heating plates. However, as soon as the temperature is higher than the maximum temperature, the comparator connection disconnects and interrupts the supply of voltage to the heating plates. If the temperature of the treatment surface once again drops, the supply of voltage is preferentially again released by the comparator. In this way a reversible switching on and switching off of the heating plates occurs only for the time during which the temperature of the treatment surface exceeds the maximum temperature. Moreover, it can be preferred that the comparator be set off by the control device when the device is started up. Thereby the comparator is so configured in its set up that if the device is not started in an orderly fashion, the supply of voltage to the heating plates is interrupted. It was surprising that through this advantageous mechanism an especially simple and robust security that is resistant to outages due to overheating could be achieved

The preferred embodiment of the hardware implemented temperature monitor that is here described has shown itself in tests to be especially robust and reliable. As a result of the reversibility of the security shutoff and this simple mode of construction, the preferred embodiment is also characterized by low manufacturing and maintenance costs.

Likewise a hardware implemented temperature monitor in the described form, with the use of a comparator, is especially rapid, since comparators, in addition to their reliability, have a surprisingly rapid connectability. So for example, there are comparators with switch-on times of nanoseconds. Surprisingly it could be determined that by using comparators in switching on, their speed would allow construction of an especially effective mechanism protecting against overheating of the treatment surface.

In a further preferred, the device includes a fuse that shuts off the device if there is a short circuit or unregulated heating up. A fuse is preferentially a device to protect against excess current, whereby the flow of current is interrupted by the shutdown of a fusible element. Thereby a preset current cannot be exceeded because of the fusible element. A fuse effectively provides a short circuit, and can also prevent regulated overheating of the device. An unregulated overheating device is characterized preferentially by heating of the heating plates above the maximum temperature because of a

failure in the software or hardware. Such an unregulated overheating can for example, occur if the temperature sensors are defective or if a safety shutoff does not occur in an orderly manner. Additional hardware-based safety is secured by the fuse. With the help of a fuse, another technical characteristic can be prepared that increases the safety of the device, in particular with reference to the requirements for a complicated medical implementation.

The preferred combination of safety characteristics of a hardware implemented temperature monitor with a fuse allow a surprisingly reliable control of the temperature with the most cost-effective means based on phased in safety limitations, whereby the hardware implemented temperature monitor is reversible as a first safety stage, followed by a second safety stage where the fuse causes an irreversible, permanent disconnection of the supply of current to the device.

In another embodiment of the invention, the device is so characterized in that the treatment temperature during the treatment phase can be maintained in a range of $\pm 10\%$, preferred $\pm 5\%$, and especially preferred $\pm 3\%$. Through the preferred constant maintenance of the treatment temperature in the areas noted above, an especially precise and constant heat overlay can be safely maintained, so that as a result an optimal heat overlay on the involved skin locations is assured. Preferentially measurement data from the temperature sensors can be used and evaluated to maintain the noted parameters.

In another preferred embodiment of the invention, the device is so characterized in that the device has an optical display and/or a sound emitter, which by an acoustical and/or optical signal indicate the start of the heating up phase, reaching the treatment temperature, the duration of the treatment phase, and/or the end of the treatment phase. The optical display can preferentially occur through light diodes (LED), electrical lights, liquid crystal displays (LCD), or other known optical indicators. Preferentially a color code appears that is set to the function. For example, the heating phase can be indicated by an orange signal, the treatment phase by a red signal, and the end of the treatment phase by a green signal. The acoustical signal emission occurs preferentially through a loudspeaker that sends out especially short or long beeps.

The user at any time of the preparation or treatment phase learns about the status of the device through the optical and/or acoustical signal. Surprisingly, there occurs thereby an additional psychological effect that concentration on the emission of the signal

leads to an even stronger reduction of the itching. In addition, through the preferred embodiment, the user-friendliness, user safety, and patient compliance are extensively increased. In addition, the optical and/or acoustical signals permit the addition of other safety mechanisms. Thus the user can be quickly and meaningfully receive an indication if the maximum temperature is exceeded. Under “meaningfully receive”, one should understand that when the maximum temperature is exceeded, an optical signal lights up and/or an acoustic signal sounds. Hereby the user can remove the treatment surface from the skin before skin damage occurs. It has been shown that reaction to sensations of pain to protect oneself is significantly longer than is the reaction to an optical and/or acoustic warning signal. Warning signals also lead to a more effective and more rapid protection than is possible through the safety shutoff of the heating plates. It is especially preferred that an optical and/or acoustic warning signal be displayed when a preset treatment temperature is not achieved and/or there are deviations of the treatment temperature during the treatment phase that are greater than preferentially $\pm 5\%$ and very preferentially $\pm 3\%$.

In a preferred embodiment of the invention, the device is so characterized in that the treatment surface on the edge has a marking that lights up depending on the treatment cycle. An example of marking is preferred where the heat surface is edged all around with a light conductor. For example, this can be lit up during the heating up phase or during the treatment phase. It has been shown that an explicit lighting-up indicator of the position of the treatment surface leads to greater success of the hyperthermal treatment. Thus during the visual marking, a centered placement on the affected skin part is required, so that the heating impulse may be applied intentionally to these parts of the skin. Bandwidth marking allows non-problematic use even in the dark, for example, outside at night.

In another referred embodiment, the device includes a watertight housing. The housing preferentially has an outer covering of the device so that the covering in particular encloses the device control and other electronic components. It is preferred that the housing have a housing head in a housing handle, whereby the treatment surface preferentially lies on a lower section of the housing head. For control and tempering the treatment surface, the housing preferentially has an opening at the appropriate position. In the preferred embodiment, the housing is set up in such a way that all the openings are watertight, meaning, for example, possibly battery slots. For example, for this purpose sealing rings or appropriate gaskets can be used, for example, made of elastomers.

The person skilled in the art also is aware of many other technical possibilities for constructing a watertight housing. The watertight construction of the housing adds an additional safety element because in this way damage to the control device or other electronic components due to infiltrating fluids can be effectively prevented. The watertight housing also leads to prevention of corrosion and thereby a longer life expectancy of the device.

In particular the invention in this preferred embodiment with the lighted marking is suited for use under certain conditions, such as in expeditions in areas far from civilization or in hot and humid climate conditions.

10 In another preferred embodiment of the invention, the device is so characterized that the invention includes an energy supply unit and a voltage monitor, which monitors the voltage of the energy supply unit. In the sense of the invention the energy supply unit preferentially prepares the electrical energy for operating the device. Preferred energy supply units are batteries or accumulators. These make electrical energy available
15 mainly through supply of direct current. In the preferred embodiment, the voltage supplied by the energy supply unit is monitored using a voltage monitor. In the sense of the invention, a voltage monitor means preferentially an electrical connection that can measure the voltage of the energy supply unit and can trigger an action when the supply falls under a given limiting value. In the state of the art, many variants of voltage
20 monitors are known, whereby the person skilled in the art knows which voltage monitor is appropriate for which types of energy supply units, meaning in particular batteries or accumulators. It is preferred that in the case where the voltage monitor registers a drop in the voltage of the energy supply unit below a specific value, the monitor sends and interrupt request (*IRQ*) to the control device, which preferentially is a microprocessor. If
25 in the meantime a treatment cycle is run, meaning a heating up or a treatment phase, the *interrupt request* leads to breaking off the treatment cycle. This constitutes another safety mechanism. Thus it was determined that a low voltage supplied to the energy supply unit may lead to a failure of the control device, for example, of the microprocessor. In this case, it may come about that the temperature regulation of the treatment
30 temperature is performed erroneously by the control device, and there might be an uncontrolled heating up of the treatment surface. The voltage monitor can thereby additionally contribute to increasing the safety of the device, and a health hazard can be avoided, for example, in the case of a defective battery.

In a preferred embodiment the device is so characterized in that the control device includes a microprocessor. In the sense of the invention, a microprocessor is understood to mean preferentially a data processing device, that is, a processor that marks any small variations of a few mm and whereby preferentially all the basic units of the processor are located on a microchip or on an integrated circuit (IC). The microprocessor can preferentially also be a microcontroller, which in addition to the processor integrates other peripherals on the microchip and, for example, also has a data memory. It is further preferred that the microprocessor exist installed on a printed circuit board (PCB). In addition to the microprocessor, preferentially the heating plates and the temperature sensors are installed on the PCB. This preferred embodiment permits a very compact but still robust instruction of the device and an especially intelligent temperature regulation through the microprocessor. So the microprocessor is not only in a position to evaluate the measured temperature data and to translate these into control of the heating plates, but it can also rapidly and reliably consider other parameters, such as error reports and user input.

In one preferred embodiment of the invention, the device is so characterized that the microprocessor on which there is at least one heating plate and the at least one temperature sensor are installed on a printed circuit board (PCB), whereby the at least one heating plate and the temperature sensor are coated with a protective coating. In the sense of the invention, the preferred protective coating means a lacquer or a paint that is meant to protect the components of the PCBs from environmental effects. The protective coating has the preferred effect of electric insulation and is resistant to water. The property of the electrical installation may preferentially be quantified on the basis of the surface insulation resistance (SIR). The SIR can preferentially for example, be measured through leakage flows between the components of the circuit board. High resistance means good electrical insulation. Water-resistant means preferentially that even with high humidity or the infiltration of water, the coded electronic components remain intact and no short circuit results. Water resistance can, for example, also be tested by measuring the SIR under conditions of high humidity. In the state of the art, many types of protective coatings are known, which preferentially can be related. Examples are protective coatings made based on acrylic, silicon, or polyurethane. The application of a protective coating in the area of the heating plates and the temperature sensors gives effective protection from the buildup of deposits, so that erroneous measurements of the temperature sensors can be prevented. On one hand, this increases the precision with which the treatment temperature can be set, and on the other avoids any overheat-

ing of the treatment surface that might arise based on an erroneous measurement of the temperature.

The coating of the noted elements surprisingly results in reliable, additional temperature security of the device with especially simple and cost-effective technical means. An installation of the components on a PCB has surprisingly been shown to be especially advantageous for the coating of the components.

In a preferred embodiment of the invention, the device is so characterized in that the device has a data storage unit for storing the system data and/or error reports. The preferred system data include a counter for the treatment cycles, which preferentially separately counts the use of various types of treatment cycles. For example, if a short or long treatment cycle can be selected, then these are separately counted. Furthermore, the system data preferentially include a boot counter, meaning a counter for how often the device has been started and data on error reports with the current error status.

Preferentially the following error reports are stored: A "Reset" indicates that the voltage monitor has triggered a Reset. A "Watchdog" indicates that a watchdog reset has occurred in the private software, that is, a new start of the system because of a software error. Preferentially it may be determined in the error report in which program mode device was running before the onset of the error. A "Temperature too high" can indicate that the temperature measured on the temperature sensor is too high, or that the temperature sensor is defective. A "Temperature too low" can indicate that the temperature measured on the temperature sensor is too low, or that the temperature sensor is defective. A "treatment temperature reached" may indicate whether the desired treatment temperature has been reached or whether there was an error during the preheating phase.

Advantageously the stored system data and error reports can be used for the diagnosis and problem treatment of the device. Thus for example, the data can be read out if the customer sends in a defective device. Based on the data, it is possible to correlate the errors that occur, for example, "Temperature too high", with other system data on the number of treatment cycles or watchdog resets. Based on these data, one can continuously optimize the safety characteristics of the device, both during the development phase and afterwards. The possibility that the device includes storage of system data and error reports thereby permits the continuous improvement of the hardware and software components of the device based on meaningful data.

In another preferred embodiment, the device is so characterized in that private software is installed on the control device, which controls at least the temperature regulation of the treatment surface, whereby the private software includes a watchdog counter (WDC) that monitors whether the private software has been run. In the sense of the invention, preferentially private software means a software program, that is, it is understood as the instructions for a computer implemented method that lies embedded in the control device, preferentially in the microprocessor. That is, the private software includes preferentially software that is functionally connected with the hardware of the device, that is, in particular with the heating plates and temperature sensors. Preferentially the private software runs when the device starts, and takes over the monitoring and control functions of the hardware components of the device. Thereby the control device preferentially evaluates on the basis of the private software, for example, the measurement data of the temperature sensors and user inputs, in order to control the supply of current for the heating plates during the treatment cycle. In the sense of the invention, hardware implemented components mean preferentially components whose function is assured independently of the correct performance of the private software. As described above, the preferred temperature monitor is hardware implemented, so that its function, meaning a limitation of the maximum temperature, can occur independently of the correct performance of the private software on the control device. Even in a system failure of the private software, the hardware implement the temperature monitor can rapidly incorrectly limit the maximum temperature of the treatment surface.

In the especially preferred embodiment, the private software of the control device is monitored with a hardware implemented watchdog counter. In this case a time-out watchdog is especially preferred. Preferentially the time-out watchdog is activated by the private software before the start of the treatment phase. During the treatment phase, the private software sends out a signal to the time-out watchdog within a pre-set time interval in order to reset the watchdog. If the time-out watchdog is not reset, this preferentially results in a restart of the private software. The time interval preferentially is oriented to the time that is planned for performing temperature measurement and regulating the heating plates by the private software, and can, for example, amount to between 2 ms and 10 ms. Through such a time-out watchdog, advantageously it can be assured that at least during the treatment phase of the device, the private software functions correctly and that the temperature of the treatment surface is being monitored. Through a hardware implemented watchdog for monitoring the private software, preferentially, for example, using a time-out watchdog, it can thereby be assured that if the

private software does not function correctly and the preset time interval is not maintained, the treatment phase is stopped. Thereby another safety feature of the device is preferred in addition to the already noted preferred features, which in combination with the preferred hardware implemented temperature monitor takes care that any overheating of the treatment surface is excluded, even with incorrectly functioning private software. Then preferentially the fuse is available as a supplemental, additional safety step. This gradation of safety mechanisms results in a situation where the device is surprisingly long-lived and safe.

In another preferred embodiment, the invention relates to the use of a device to treat chronic pruritus, reduction of itching due to dermatitis, or after contact with poisonous cnidaria or plants, preferentially after contact with jellyfish. In addition, the device can be used for treating pruritus as a side effect of skin diseases such as eczema, neurodermatitis, urticaria, skin infections, xeroderma, parasites (e.g., scabies), metabolic diseases, or infectious diseases. Even in allergies to foods or medications, the device can effectively reduce itching. According to the invention, it has been learned that a hypothermic treatment with the preferred noted parameters for treatment temperature and the dimensioning of the treatment surface in the noted application areas lead to a surprisingly positive effect. For example, the device significantly more rapidly and more effectively prevents itching after contact with poisonous cnidaria than do conventional salves or creams. In the use of the device, it is preferentially laid on the skin areas. Then, after input from the user, an automatic regulation of the temperature of the treatment surface referentially occurs using the control device. Advantageously no physician has to be present, but rather the person can independently use the device. Because of the simple operation and the almost immediately felt reduction of itching, compliance is extraordinarily high. The marked compliance with therapy allows long-term treatment even of serious pruritus diseases. The compact size also permits flexible use. The device can be transported without problem and thereby also preventively taken along on trips in which there is an increased risk of allergies or jellyfish bites. The direct commencement of treatment is hereby made possible after occurrence of the initial symptoms of pruritus, and has a positive effect on the treatment success.

The invention will be further discussed on the basis of examples without being limited to these only.

Short description of the drawings

Fig. 1 Schematic side view of a preferred embodiment of the invention

Fig. 2 Schematic top view of a preferred treatment surface and set up of the heating plates

Detailed description of the drawings

5 Figure 1 shows a schematic side view of a preferred embodiment of the invention.. The housing (3) of the device preferentially is so constructed that it can be held in the hand in order to assure a simple and comfortable application. The preferred embodiment of the housing (3) with a handle is suitable in a particular manner so as to effortlessly reach various parts of the body with the treatment surface (1). The treatment surface (1)
10 is for this reason embedded on the underside of the housing in a front area.

Figure 2 shows a schematic view of a preferred treatment surface (1) and setup of the heating plates (5). For better understanding, the treatment surface (1) is presented only by its perimeter, so that the setup of the heating plates (5) found in the device is visible. In the especially preferred embodiment, the device 11 comprises heating plates (5) with
15 a diameter of about 6 mm. The treatment surface (1) is heated by the contacting heating plates (5) to the treatment temperature, and in this especially preferred embodiment is constituted of the ceramic aluminum nitride with a thickness of 1.3 mm. This especially preferred embodiment of the device can especially effectively reduce itching due to a number of diseases.

20 Reference is made to the fact that various alternatives to the described embodiments of the invention can be used in order to use the invention and to achieve the solution according to the invention. The device according to the invention and its use are not limited in their embodiments to the preferred embodiments given above. Rather, a plurality of variants of construction is conceivable that deviate from the solution that is shown.

25 The goal of the claims is to define the protected scope of the invention. The protected area of the claims is thereby oriented to cover the device according to the invention, the preferred uses, and equivalent embodiments.

PARTS LIST

- 1 Treatment surface
- 3 Housing
- 5 Heating plate

REFERENCES

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PATENT CLAIMS

1. Device for hyperthermal treatment of itching, comprising
 - a) a treatment surface (1)
 - and
 - b) a control device to regulate the temperature of the treatment surface (1)**so characterized in that**

the size of the treatment surface (1) is between 1 cm² und 18 cm², and the control device can regulate the treatment surface (1) in a heating phase at a treatment temperature between 40° C und 65° C, and the treatment temperature can be maintained in a treatment phase for a duration of 4 seconds to 6 seconds.
2. Device according to the prior claim
so characterized in that

the size of the treatment surface (1) is at least 6 cm², preferentially at least 7 cm², and the treatment temperature lies between 42° C and 53° C, especially preferred between 50° C and 53° C.
3. Device according to one of the prior claims
so characterized in that

the device is characterized in that the device is comprised of at least two heating plates (5), preferably at least four heating plates (5) and very especially preferred at least six heating plates (5), which are present with the treatment surface and whose temperature can be set by the control device, whereby the setting of the treatment temperature on the treatment surface (1) occurs through heating of the heating plates (5).
4. Device according to one of the prior claims
so characterized in that

the at least two heating plates (5), preferentially at least four heating plates (5), and especially preferred at least six heating plates (5) can be separately controlled and heated by the control device.
5. Device according to one of the prior claims
so characterized in that

the treatment surface (1) is a connected surface and/or the treatment surface (1)

consists of several partial surfaces, which preferentially are congruent to the heating plates (5).

6. Device according to the prior claim

so characterized in that

the control device can regulate the heating plates (5) in the heating phase to a heating temperature between 43° C and 54° C and can maintain the heating temperature in the treatment phase for a time period between 4 seconds and 6 seconds.

7. Device according to one of the prior claims

so characterized in that

the treatment surface (1) has a thickness of between 0.2 mm and 5 mm, preferentially between 0.5 mm and 2 mm, and especially preferentially between 1 mm and 1.5 mm, and is made of a material that can conduct heat at 50°C between 20 and 400 W/mK, preferentially between 100 and 350 W/mk.

8. Device according to one of the prior claims

so characterized in that

the treatment surface (1) is made of ceramics and/or gold.

9. Device according to one of the prior claims

so characterized in that

the device is constituted of between 4 and 18 heating plates (5) and preferentially between 8 and 14, and the size of the heating plates (5) lies between 0.05 cm² and 2 cm², preferentially between 0.1 cm² und 0.5 cm².

10. Device according to one of the prior claims

so characterized in that

the device is constituted of at least one temperature sensor to measure the temperature of the treatment surface (1) an/or at least one heating plate (5), and the control device sets the temperature of at least one heating plate (5) based on measurement data of the temperature sensor.

11. Device according to one of the prior claims

so characterized in that

the device has a safety shut off based on a software program and/or hardware that occurs when a maximum temperature is exceeded.

- 12.** Device according to one of the prior claims

so characterized in that

the device includes a fuse that turns off the device if there is a short circuit or unregulated heating.

- 13.** Device according to one of the prior claims

so characterized in that

the treatment temperature during the treatment phase can be maintained in a range of $\pm 10\%$, preferentially $\pm 5\%$, and especially preferentially $\pm 3\%$.

- 14.** Device according to one of the prior claims

so characterized in that

the device has an optical display and/or a sound emitter, which by an acoustical and/or optical signal indicate the start of the heating up phase, reaching the treatment temperature, the duration of the treatment phase, and/or the end of the treatment phase.

- 15.** Device according to one of the prior claims

so characterized in that

the device is constituted of an optical display or a sound emitter, which indicate by an optical and/or acoustical warning signal of not reaching a preset treatment temperature and/or deviations from the treatment temperature during the treatment phase that is greater than the preferred $\pm 5\%$ and very preferred $\pm 3\%$.

- 16.** The use of a device according to one of the prior claims to treat chronic pruritus, to reduce itching due to dermatitis, or after contact with poisonous cnidaria or plants, preferentially after contact with jellyfish.