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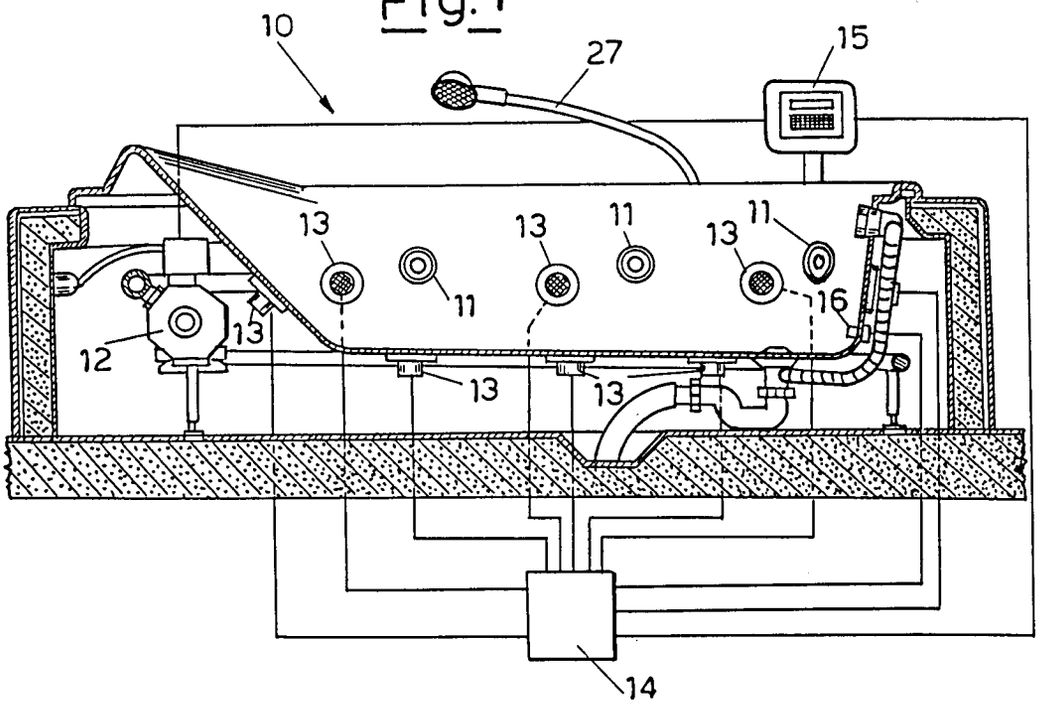
(54) Improved hydromassage bath.

(57) A hydromassage bath comprises, disposed on the surface of the bath, a plurality of nozzles (11) which emit jets of water and a distributed plurality of transducer elements (13) which emit ultrasonic waves, thereby making it possible to achieve various combined operating modes of hydromassage with jets of water and ultrasounds, offering a high degree of well-being for the user.

Fig.1



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This invention refers to an innovative bath having ultrasonic hydromassaging means.

It is well-known that there are baths comprising a hydromassage system achieved by recirculating water sucked up from the inside of the bath, mixed with air and returned to the bath through nozzles to impinge upon immersed parts of the body of the user and create ample areas of turbulence around them.

The general scope of this invention is to provide an innovative hydromassage bath which practically and effectively provides a micromassaging action produced by generation of ultrasonic waves.

This scope is achieved, according to the invention, by providing a hydromassage bath comprising, in combination, disposed on the surface of the bath, a plurality of nozzles which emit jets of water and a distributed plurality of transducer elements which emit ultrasonic waves.

The innovative principles of this invention and its advantages compared to the known technique will be more clearly evident from the following description of a possible exemplificative embodiment applying such principles, with reference to the accompanying drawings, in which:

- figure 1 shows a schematic longitudinal cross-sectional view of a hydromassage bath applying the innovative principles of the invention;
- figure 2 shows a schematic longitudinal cross-sectional view of an ultrasonic transducer usable in the bath of figure 1.

With reference to the figures, figure 1 shows a schematic view of a bath, generically indicated by reference 10, advantageously comprising a known hydromassage system composed of apertures 11 for intake and emission of water, mixed with air, disposed between the intake and delivery of a pump 12. A system of this kind, together with its control circuits, is easily imaginable by the expert in the field and therefore will not be further described or shown herein. The bath further comprises the conventional accessories such as drain, overflow, etc. The bath can be advantageously made of plastic material, for example, composite material, with supporting structure made of metal tubes, as will be obvious to the expert in the field.

Innovatively, facing on to the inner surface of the bath are ultrasonic transducers 13 which emit ultrasounds in the internal volume of the bath. The transducers, for example of the piezoelectric type, are disposed in such a way as to be submerged when the bath is filled and are advantageously distributed so as to generate a generically uniform ultrasonic intensity in the water in the bath.

For example, they can be evenly distributed along the lateral wall of the bath and if necessary on the bottom of it.

To operate, the transducers are connected to a pilot circuit 14, which generates pilot voltages with a suitable pattern. The circuit 14 is also advantageously connected to a control panel 15, for example with a keyboard and associated display, which enables the user to control the various functions of the bath, such as modulating the power emitted by the transducers and obtaining information on its operation, with emission of optic and/or acoustic signals. The control circuit 14 can be a known generator of electric signals of suitable frequency. The control panel is also of substantially known technique, for example with a suitably programmed microprocessor, and can control both the ultrasonic massage system and the conventional hydromassage system. Both the pilot circuit 14 and the control circuit 15 are per se well know to the expert in the field and will therefore not be further described or shown herein, since they are easily imaginable by the expert, especially in the light of the following operative description.

Advantageously, the bath is also fitted with an ultrasonic microphone 16 connected to the control circuit to detect the ultrasonic waves emitted by the transducers. The control circuit can thus modulate the power emitted by the transducers in relation to the signals picked up by the microphone element. For example, the microphone 16 can perform a safety function as well as that of checking the operation of the ultrasonic system. In fact, the control circuit can shut off the generator and warn the user in the event of irregular operation of the system whenever the microphone fails to detect a level of ultrasounds above a threshold which is pre-established as being the minimum for efficient operation of the system (for example due to breakdown of the generator or because the bath is not filled with a sufficient amount of water to cover the emitters properly). Moreover, the control circuit can shut off the generator and warn the user of irregular operation of the system whenever the microphone detects a level of ultrasounds above a threshold which is pre-established as being the maximum level of ultrasounds permissible for its use.

The microphone 16 can be obtained either by means of a special device, or by making one of the ultrasound emission transducers work "backwards". In this latter case, it is possible to economize by using the transducer either as an emitter or as a microphone. Moreover, it is also possible to use several transducers 13 cyclically either as emitters or as microphones, so as to measure the ultrasonic level in various areas of the bath, for example in order to have an idea of the spatial power distribution of the ultrasounds in the volume of water. On the basis of the values measured and correlated to the spatial power distribution the con-

trol circuit can thus modulate the power emitted by each transducer in order to obtain pre-established ultrasonic power distributions in the water.

Figure 2 shows a possible embodiment of a transducer 13.

The transducer comprises a casing 17 having a rim 18 radially protruding at its front ultrasonic emitting end.

The rim 18 is received, with interposition of a gasket 19, in a complementary housing 20 made in the wall 21 of the bath, so that the front end is substantially flush with the wall of the bath, while the casing of the transducer protrudes rearwardly through a hole at the rear of the housing 20 and is locked by a ring nut 22.

Disposed in the casing 17, close to its front end, is the ultrasound emitting element, for example composed of a known piezoelectric element 23, connected to the device 14 by means of a cable 26. The emitting element can be protected by a screen 24 made of material transparent to ultrasounds. To the rear of the emitting element 23 the casing 17 can be filled with shielding material 25 to prevent unnecessary diffusion of ultrasounds towards the rear.

In use, it is sufficient to fill the bath with water at least to a level covering the apertures 11 and the transducers 13 and start up the functions of the bath by means of the control panel 15.

For example, one key of the keyboard starts up the conventional hydromassage, while a second key starts up the ultrasound system. Advantageously, by means of the control panel it is possible for example to set the duration of the conventional hydromassage as well as that of the ultrasound micromassage and the operating mode.

Operating mode is understood for example as being the possibility of adjusting the operating frequency and/or intensity of the transducers.

It has been reported that the best results are obtained by offering the possibility of regulating the emission of the ultrasounds between 0.2MHz and 5MHz, in particular between 0.5MHz and 3MHz.

As can be easily imagined by the expert in the field, this can be easily obtained by appropriately selecting the transducers, so that they can function in the desired frequency range, and by providing a generator supplying power to the transducers which has an output frequency that can be regulated between 0.2MHz and 5 MHz, in particular between 0.5MHz and 3MHz. The regulation for example can either be continuous or achieved according to fixed steps. Fixed step regulation can be advantageous in order to simplify the use of the device. In fact, each frequency that can be selected can be indicated by its use (for example, relaxing, bracing massage,. etc.) instead of by its actual frequency value, thereby making the apparatus easier to use.

The emission power can be regulated by steps, in the same way as the frequency, between a maximum and minimum value.

It has been found that it is preferable to have a power density range in ultrasonic emission ranging from 0.1W/cm^2 to 3W/cm^2.

The emission power is obviously divided among the various transducers. For example, in the event of four transducers it is preferable to have a maximum power value for each transducer not exceeding 0.5W/cm^2.

The emission from the various transducers can also be regulated in order to obtain particular ultrasonic power density conditions in different areas of the bath (for example, higher in the area of the legs or the chest, etc.), also by using the feedback of the microphone 16, as described above. Similar adjustments can be made to the conventional hydromassage system in order to carry out combined treatments (pre-programmed in the control device 15 or carried out directly by the user).

As far as the type of of ultrasonic emission is concerned, it has been found that control of the transducers by the device 14 can be advantageously intermittent instead of continuous, for example by alternating emission periods and non-emission periods with a ratio ranging from 1/10 to 1/2, in particular in the region of 1/5. For example, it is possible to achieve emission periods ranging from 0.1 to 5ms and non-emission periods ranging from 2 to 10ms.

Advantageously, the emission periods can have a duration in the region of 1ms and the non-emission periods can have a duration in the region of 5ms.

At this point it will be clear that the intended scopes have been achieved, by providing an innovative hydromassage bath which combines a macromassage with jets of water mixed with air, as in the case of conventional hydromassage baths, with an ultrasonic micromassage which can be adjusted both in terms of distribution within the bath and in terms of power and frequency of the ultrasounds.

A combination of this kind has been found to be highly effective in obtaining a far greater relaxing and bracing action than can be obtained in normal baths with just the conventional hydromassage, the user receiving a massage produced by the stream of water as well as a massage produced by the component of ultrasonic waves conveyed by the water itself.

The foregoing description of an embodiment applying the innovative principles of this invention is obviously given by way of example in order to illustrate such innovative principles and should not therefore be understood as a limitation to the

sphere of the invention claimed herein.

For example, the bath can also comprise a localized ultrasonic hydromassaging device (in figure 1 schematized in reference 27) of the type described in the co-pendent patent application on behalf of the same Applicant.

Moreover, the ultrasonic emission elements can be incorporated in the apertures 11, so as to limit the number of holes in the bath and reduce the assembling operations.

In the event of the bath being made entirely or partially of material transparent to ultrasounds, the transducers can obviously be fitted on the external wall of the bath with their ultrasound emitting face directed towards the inside of the bath through the thickness of the bath itself.

Claims

1. Hydromassage bath comprising, in combination, disposed on the surface of the bath, a plurality of nozzles (11) which emit jets of water and a distributed plurality of transducer elements (13) which emit ultrasonic waves.

2. Hydromassage bath as claimed in claim 1, characterized by the fact that the transducer elements (13) are disposed at least along lateral walls of the bath.

3. Hydromassage bath as claimed in claim 1, characterized by the fact of comprising a microphone element (16) for detecting ultrasonic signals inside the bath, control means (14, 15) being connected to said microphone element (16) to modulate the power transmitted to the various transducer elements (13) in relation to the intensity of signals detected by the microphone element.

4. Hydromassage bath as claimed in claim 3, characterized by the fact that the control means (14, 15) interrupt the power emission of the transducer elements on detection of a signal of intensity below a pre-established value.

5. Hydromassage bath as claimed in claim 3, characterized by the fact that the control means (14, 15) emit a warning signal on detection of a signal from the microphone element (16) of intensity below a pre-established value.

6. Hydromassage bath as claimed in claim 3, characterized by the fact that the microphone element is obtained from an element which also consists of a transducer element.

7. Hydromassage bath as claimed in claim 6, characterized by the fact that the control means (14, 15) alternately connect at least some of the transducer elements (13) as microphone elements to detect signals correlated to the spatial distribution of the ultrasounds in the bath.

8. Hydromassage bath as claimed in claim 1, characterized by the fact of comprising electronic control means (15) to manually control the modulation of the emission power and/or frequency of the transducer elements.

9. Bath as claimed in claim 1, characterized by the fact that the transducer elements (13) emit ultrasonic waves with a frequency ranging from 0.2MHz to 5MHz.

10. Bath as claimed in claim 9, characterized by the fact that the transducer elements (13) emit ultrasonic waves with a frequency ranging from 0.5MHz to 3 MHz.

11. Bath as claimed in claim 1, characterized by the fact that the transducer elements (13) emit ultrasonic waves with a power density below $3W/cm^2$.

12. Bath as claimed in claim 11, characterized by the fact that the transducer elements (13) emit ultrasonic waves with a power density above $0.1W/cm^2$.

13. Bath as claimed in claim 1, characterized by the fact that the transducer elements (13) are controlled to emit ultrasonic waves, alternating emission periods and non-emission periods with a ratio ranging from 1/10 to 1/2.

14. Bath as claimed in claim 13, characterized by the fact that the ratio is in the region of 1/5.

15. Bath as claimed in claim 13, characterized by the fact that the emission periods range from 0.1 to 5ms and the non-emission periods range from 2 to 10ms.

16. Bath as claimed in claim 15, characterized by the fact that the emission periods have a duration in the region of 1ms and the non-emission periods have a duration in the region of 5ms.

17. Bath as claimed in claim 1, characterized by the fact that each transducer element (13) comprises a casing (17) tightly secured in correspondence with a passage in the wall of the bath.

18. Bath as claimed in claim 17, characterized by the fact that the casing (17) comprises a rim (18) radially protruding at its front ultrasound emission end, and a rear ring nut (22) screwed onto it to tightly secure the rim and the ring nut to opposing faces of the wall of the bath in correspondence with the passage.

19. Bath as claimed in claim 18, characterized by the fact that the rim (18) is received in a complementary housing (20) made in the wall of the bath, so that the front end of the casing (17) is substantially flush with the internal surface of the bath.

20. Bath as claimed in claim 17, characterized by the fact that the casing has its anterior end facing towards the inside of the bath, close to the anterior end being disposed an ultrasound emitting element (23) posteriorly to which is disposed an ultrasound screening material (25) to prevent diffusion of the ultrasounds towards the rear of the casing.

Fig.1

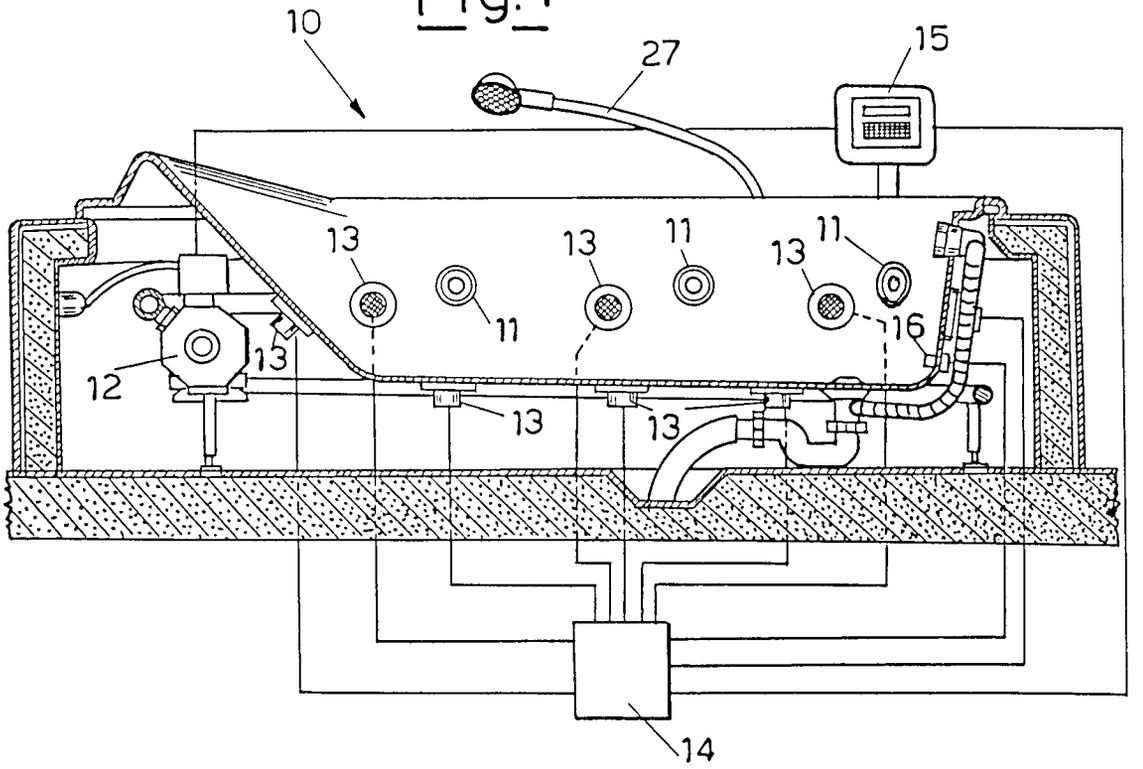
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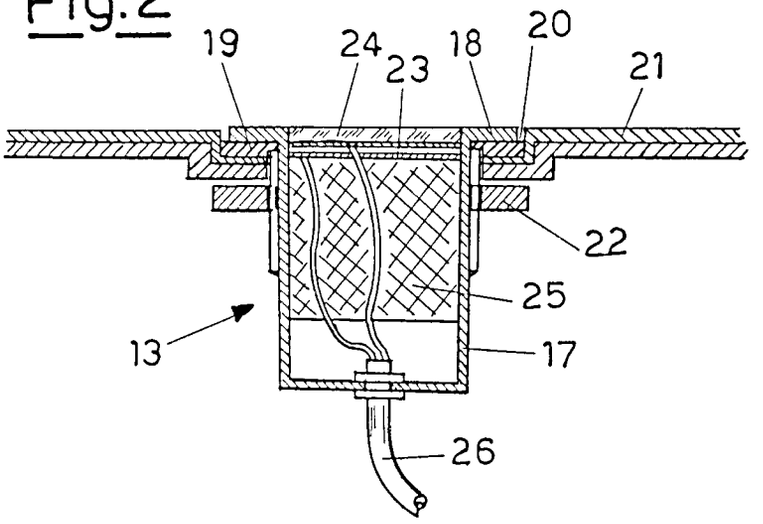
Fig.2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