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DEVICES FOR THE PRODUCTION OF ULTRA SOUNDS

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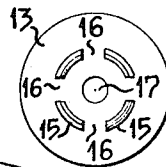
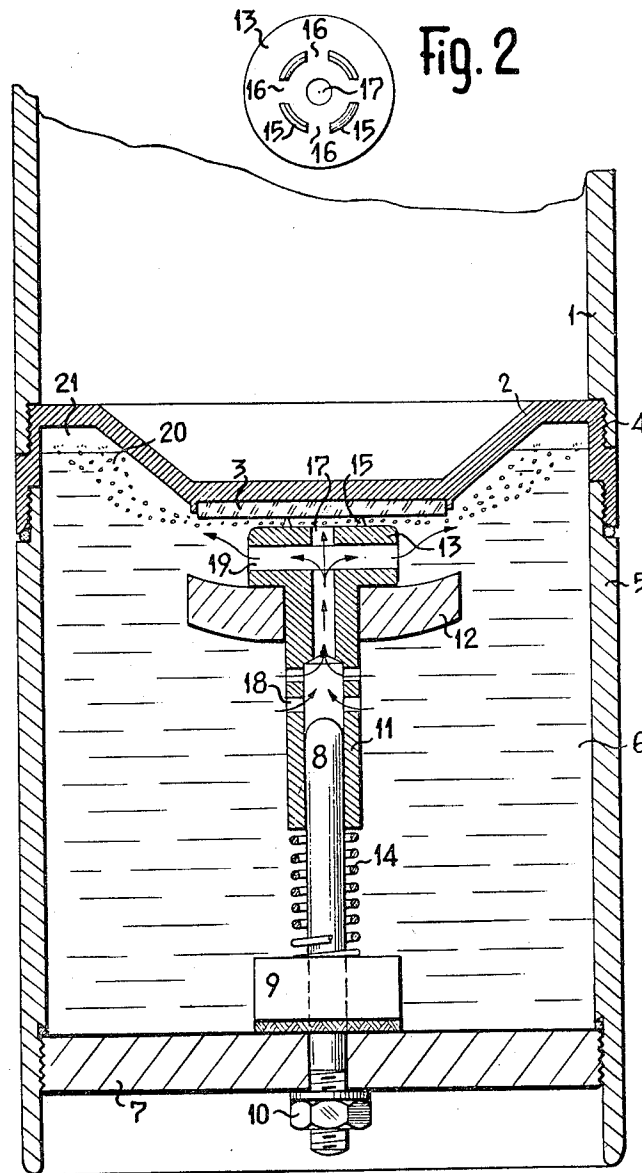


Fig. 2

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DEVICES FOR THE PRODUCTION OF ULTRA SOUNDS

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Devices are already known for the production of ultra sounds, comprising a receptacle of which the bottom is provided with a quartz adapted to emit ultra sounds into a liquid which is above said bottom, the receptacle being provided underneath said bottom, with a chamber fitted with a dielectric liquid which washes the lower face of the quartz, an electrode being located in said chamber parallel and in proximity to the lower face of the quartz.

In these devices, the ultra sounds are propagated in the dielectric liquid, which is generally constituted by oil or paraffin, producing the formation of bubbles in the latter. Said bubbles are deleterious, as they collect under the lower face of the quartz, where they are subjected to the very high electric field of excitation of the quartz. This field produces an ionisation in the interior of the bubbles, which may lead to an explosion of the bubbles and the destruction of the quartz. In order to obviate this disadvantage, it has been necessary, up to the present, to limit the power of the excitation of the quartz to a relatively low value, in such a manner as to avoid the formation of too large a number of bubbles. Even when the explosion of the bubbles does not produce the destruction of the quartz, it entrains other disadvantages, particularly that of oxidising the oil and to give rise to carbonaceous residues. These latter remain in suspension in the oil and finish by rendering it conductive. It is therefore necessary, periodically, to clear the chamber of oil and to re-fill it with fresh oil.

The present invention has for its subject a device for the production of ultra sounds tending to remedy the above-mentioned disadvantages by reason of the fact that means are provided for creating a circulation of dielectric liquid along the lower face of the quartz and to remove from the latter the bubbles which have a tendency to form in said liquid under the influence of ultra sounds.

One form of construction of the subject of the invention is shown diagrammatically and by way of example in the accompanying drawings, wherein:

Fig. 1 is a vertical section of a receptacle of which the bottom is provided with a quartz.

Fig. 2 is a plan view of an excitation electrode for the quartz.

The receptacle 1 shown, comprises a removable bottom 2 provided with a quartz 3 adapted to emit ultra sounds into a liquid, not shown, and located above the bottom in the interior of the receptacle 1. Said bottom 2 has a threaded periphery 4 enabling it to be screwed to the lower part of the receptacle 1. The quartz 3 is secured to the bottom 2 by adhesion, by means of a polymerisable resin.

The plain portion of the bottom 2, to which the quartz is glued, has a thickness equal to half a wave-length of the vibrations emitted by the quartz, or a multiple thereof, account being taken of their velocity of propagation in the material forming the bottom 2. Said latter may, for example, be of stainless steel.

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An insulating cylindrical wall 5 is screwed to the bottom 2 so as to form a chamber 6 filled with a dielectric liquid, for example oil. Said oil washes the lower face of the quartz 3. The bottom of the chamber 6 is formed by a plate 7 of insulating material screwed to the lower portion of the wall 5 and provided with a central orifice through which a rod 8 passes. Said latter has a part 9, of much larger diameter, and it is screwed at its end so as to enable it to be secured by means of a nut 10. On said rod 8 slides a sleeve 11 carrying a deflector 12 and an electrode 13 arranged parallel and in proximity to the lower face of the quartz 3. A spring 14 surrounds the rod 8 and presses the electrode 13 against the quartz. The upper face of said electrode 13 has an annular projection 15, adapted to bear against the lower face of the quartz so as to hold the electrode at the desired distance from the face of the latter.

Fig. 2 is a top view of said electrode and shows that the projection 15 is interrupted by four passages enabling the oil to circulate along the lower face of the quartz. Further, the electrode 13 has a passage 17 which opens opposite said face and communicates with orifices 18 provided in the sleeve 11 and leading into the oil chamber at a lower level. The electrode is also provided with a transverse passage 19 connected to the orifices 18.

During the operation of the device, considerable power of excitation may be applied to the quartz, as the bubbles which are formed in the oil cannot remain under the lower face of the quartz. In fact, by reason of the differences in density of the oil heated by the ultra sounds in proximity of the quartz 3 and that which is fresher and is located in the oil chamber on a level with the orifices 18, a circulation of oil is produced in the direction of the arrows in the drawing, so that the bubbles are driven from the lower face of the quartz by said oil circulation and cannot collect together under the quartz. The bubbles are then collected in an annular space 20 formed by the bottom 2 in the oil chamber and located at a higher level than the quartz. The chamber 6 is not completely filled with oil, so that the bubbles creep to the surface in the annular space 20. The air cushion 21, located above the oil, enables the latter to expand, by reason of changes in temperature, without risk of applying too high a pressure in the chamber 6. By reason of the evacuation of the bubbles in proportion to their formation, it is possible to transmit to the quartz a force substantially much higher than in known arrangements. The exciting tension of the quartz is applied between the electrode 13, through the medium of the rod 8, and the bottom 2 of the reservoir 1.

The ultra sounds produced by the quartz 3 are naturally transmitted throughout the whole of the oil chamber, so that bubbles can be formed at different points thereof. The deflector 12 is provided for preventing the bubbles formed in the lower part of the oil chamber, from reaching the lower face of the quartz.

In order to permit of producing the maximum of ultra sound energy in the receptacle 1, the distance between the lower face of the quartz and the upper face of the electrode is equal to a quarter of the length of a wave of the ultra sounds generated, their speed of propagation in the dielectric liquid being taken into consideration, plus a product of a whole number starting at zero, through half the length of the wave of ultra sounds in said liquid. In other words, when this wavelength in oil is regarded as λh , the distance between the electrode and the quartz may be equal to $0.25 \lambda h$, $0.75 \lambda h$, $1.25 \lambda h$ and so forth.

Further the face of the deflector which is turned towards the quartz may also form a reflector for the ultra

sounds which pass at the side of the electrode; in order that the reflexion effect is the best, it is also necessary that the distance separating the upper face of the reflector from the lower face of the quartz is equal to one quarter of the length of wave of the ultra sounds generated, taking into consideration their speed of propagation in the oil contained in the chamber 6, plus a multiple of the half length of wave in the oil.

Further, in order to avoid a residual portion of the ultra sounds, due to unavoidable deflections, being transmitted through the deflector 12 so as to penetrate into the lower portion of the chamber 6, it is also possible to provide this thickness equal to a quarter of the wavelength of the ultra sounds generated, taking into account their speed of propagation in the material of which the deflector is formed, plus a product of a whole number, from zero, multiplied by the half length of wave of the ultra sounds in said material.

On the other hand, for reducing, as far as possible, the bubbles in the dielectric liquid, it is of advantage to subject said latter to ultra sounds of high power, in an open receptacle, before its introduction into the chamber 6. It is also of advantage to subject said liquid to a thermal treatment similar to that of oil for a transformer, in order to eliminate every trace of humidity.

The receptacle shown also has a supplementary advantage by reason of the fact that the chamber 6 is closed hermetically by the bottom 4 and forms with this a removable assembly capable of being secured to the lower part of the receptacle 1. In fact, this assembly may be replaced by another one provided with a quartz having other characteristics for example for obtaining ultra sounds of a different frequency. It is also possible to provide a number of bottoms each having a different quartz and capable of being secured at will to the same receptacle, in a particularly simple manner, according to the effect it is desired to obtain by means of the ultra sounds.

I claim:

1. An electro-mechanical device for transducing from electrical energy to acoustic energy propagating in a dielectric acoustic liquid, comprising, a receptacle having a bottom, a quartz having a lower face and an upper face, said upper face bearing against said bottom, means forming a chamber filled with dielectric liquid and connected to said bottom which constitutes the upper wall thereof, and an electrode assembly having its upper end located beneath said lower face of the quartz and immersed in the dielectric liquid in said chamber, said electrode assembly having circulating passages for causing convection currents of the dielectric liquid to continuously disperse bubbles laterally from beneath said quartz.

2. A device according to claim 1, wherein said bottom is formed to provide an annular space in the chamber containing said dielectric liquid, said space being located at a higher level than said quartz and adapted to collect the bubbles formed in said liquid.

3. A device according to claim 1 wherein said chamber is closed hermetically by the bottom carrying said quartz and forms therewith an assembly capable of being detachably secured to the lower part of said receptacle.

4. A device according to claim 1, wherein said electrode assembly as a passage opening axially and radially beneath the lower face of the quartz, said passage communicating, with said chamber of dielectric liquid, whereby circulation of said liquid will take place by reason of the differential in densities of the liquid heated by the ultra

sounds in proximity of the quartz and of the fresher liquid in the lower part of said chamber.

5. A device according to claim 1, wherein said electrode assembly is spring urged against said quartz, the upper end of said electrode having at least a projection adapted to bear against the lower face of said quartz for maintaining said electrode at the desired distance from said quartz to provide lateral circulating space beneath the quartz.

6. A device according to claim 1, wherein, the distance between the lower face of the quartz and the upper end of the electrode assembly is equal to a quarter of the length of the ultra sounds generated, consideration being given to their speed of propagation in said dielectric liquid, plus a product of a whole number from zero, and the half length of wave of said ultra sounds in said liquid.

7. A device according to claim 1, wherein the electrode assembly includes a deflector adapted to direct the course of bubbles formed in the dielectric liquid, so as to prevent said bubbles from reaching the lower face of said quartz.

8. A device according to claim 1, wherein, the electrode assembly includes a deflector whose upper side is turned towards said quartz to constitute a reflector for the ultra sounds, the distance separating said side from the lower face of said quartz being equal to a quarter of the length of wave of the ultra sounds generated, consideration being given to their speed of propagation in the dielectric liquid, plus a multiple of the half length of wave in said liquid.

9. A device according to claim 1, wherein, the electrode assembly includes a deflector whose thickness is equal to a quarter of the length of wave of the ultra sounds generated, consideration being given to their speed of propagation in the material of which said deflector is formed, plus a product of a whole number, starting from zero, by half the length of the ultra sounds in said material.

10. An electro-mechanical device for transducing from electrical energy to acoustic energy propagating in a fluid acoustic medium, comprising, a receptacle having a bottom wall whose outer face is formed with a frusto-conical medial portion, a quartz on the outer face of said bottom wall, means forming a dielectric chamber fitted to said bottom wall, and an electrode assembly located in said chamber, said assembly including a conductor rod and a head portion, the latter having a sleeve fitting over said conductor rod, a plurality of spaced projections carried by the head of the electrode assembly and bearing against said quartz to provide fluid circulating space beneath the quartz, said head and sleeve having communicating axially and radially disposed passages for establishing circulation of the fluid acoustic medium above the end of the rod, a deflector carried by the outer portion of the sleeve, and a spring for urging said electrode assembly in a direction to maintain the projections on said head against the quartz whereby bubbles arising from the electrode will be laterally dispersed from the quartz and upwardly into an air space formed in the dielectric chamber above the fluid therein by the marginal portions of the said frusto-conical portion of the receptacle.

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