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54 **Ultrasonic laundry washing machine.**

57 A laundry washing machine comprising a washing tub (3) and a rotatable drum (5), both made of a metallic material, and ultrasonic generator devices (10) of a conventional type associated to respective emitter elements (11) adapted to emit ultrasonic waves to thereby assist in the washing of the laundry.

According to the invention the emitter elements (11) are attached to the inner wall surface of a window (9) in a door (8) of the machine at positions whereat they are covered by a washing liquid supplied to the tub (3), and directed towards the interior wall surfaces of the drum. The elements (11) are connected to the associated generator devices (10) by means of flexible electric conductors (14). This machine ensures efficient and uniform washing of the laundry.

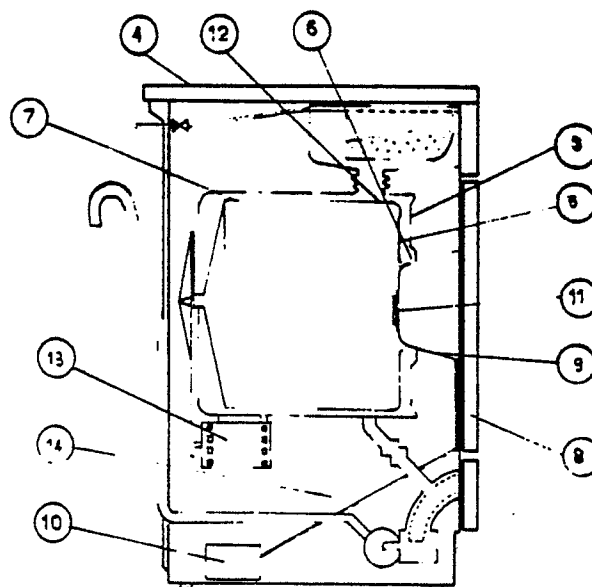


FIG. 1

**EP 0 261 363 A1**

### Ultrasonic Laundry Washing Machine

The present invention relates to a laundry washing machine provided with ultrasonic generator devices for assisting the washing of the laundry.

A known laundry washing machine of this type is described in FR-PS 1,011,575, according to which the washing of the laundry is carried out by means of ultrasonic waves produced by generator devices in the form of suitable piezoelectric transducers disposed within the tub of the machine, the tub also containing the laundry to be washed and the washing liquid with a detergent dissolved therein.

The results of the washing operation carried out with a machine of this type are barely satisfactory, however, because the laundry remains stationary during the washing operation, and the action of the vibrations of the ultrasonic waves on the laundry is by itself insufficient for efficiently and uniformly removing dirt from the fabric of the laundry.

Also known, for instance from US-PS 468,550, are laundry washing machines making use of the combined action of ultrasonic vibrations and mechanical agitation of the laundry for removing the dirt from the fabric of the laundry in a more efficient and uniform manner. In particular, a machine of this type is provided with a washing tub containing a rotatable drum on a vertical axis, and a member of elements of a non-magnetic material associated to respective ultrasonic generators of the magnetostrictive type, said elements being sealingly mounted in the bottom wall of the tub so as to project partially into the tub in proximity to the bottom wall of the drum. After the laundry has been charged into the drum and the tub filled with a washing liquid, the washing of the laundry is carried out in a machine of this type by energizing the ultrasonic generator devices and simultaneously rotating the drum at a reduced speed.

Although laundry washing machines of this type are capable of ensuring satisfactory results of the laundry washing operation, they still suffer from the disadvantage of not permitting optimum transmission of the ultrasonic waves from the respective elements to the laundry immersed in the washing liquid, due to the presence of the metallic bottom wall of the drum.

As a matter of fact, this metallic bottom wall permits only part of the ultrasonic waves to penetrate into the interior of the drum through the holes formed in the bottom wall itself for the passage of the washing liquid contained in the tub into the drum, while the imperforate portions of the bottom

wall reflects the remaining part of the ultrasonic waves back onto the respective elements, so that this part of the ultrasonic waves does not contribute to the efficiency of the washing operation.

It is therefore an object of the invention to eliminate the disadvantages and shortcomings of the above discussed laundry washing machines in a conventional laundry washing machine of the front-loading type designed to carry out the laundry washing operation with the assistance of ultrasonic waves in an efficient manner for any type of laundry. These and other objects are attained according to the invention in a laundry washing machine provided with a laundering tub and a perforate rotatable drum, both of a metallic material and provided with mutually aligned access openings, the access opening of the tub being adapted to be closed by a door hinged to a front portion of the machine, the door being provided with a window, preferably made of glass or a conventional plastic material, and partially projecting into said tub and said drum in the closed position of the door, the machine being further provided with ultrasonic generator devices of a conventional type associated to respective elements adapted to produce ultrasonic waves for assisting in the washing of the laundry contained in the drum in the presence of a washing liquid in the tub.

According to the invention a laundry washing machine of the type defined above is characterized in that said elements are hermetically attached to the interior wall surface of said window at positions whereat they are covered by said washing liquid, and directed towards the interior wall surfaces of said drum, said elements being in addition connected to respective ones of said ultrasonic generator devices by means of flexible electric conductors.

The characteristics of the invention will become more clearly evident from the following description, given by way of example with reference to the accompanying drawings, wherein:

fig. 1 shows a diagrammatical sideview of a laundry washing machine according to an embodiment of the invention, and

fig. 2 shows an enlarged cross-sectional view of a detail of a modified embodiment of the invention.

With reference to fig. 1, there is shown a diagrammatic illustration of a laundry washing machine according to the invention, comprising a washing tub 3 made of metallic material and supported in a per se known manner in a substantially

rectangular housing 4, a drum 5 being mounted in tub 3 for rotation about a horizontal axis by means of an electric motor 13 of conventional construction.

Tub 3 and drum 5 are each provided with a respective access opening 6 and 7 alignment with one another, opening 6 of tub 3 being adapted to be closed by a door 8 hinged to a front portion of housing 4. Door 8 is provided with a window 9, preferably made of glass, a plastic material or any other non-metallic transparent material of conventional type, and projecting a certain distance into tub 3 and drum 5 in the closed position of door 8.

The present laundry washing machine is also provided with ultrasonic generator devices 10 in the form of piezoelectric transducers or other suitable electronic circuits of conventional type, said ultrasonic generator devices 10 being associated to respective elements 11 mounted in the machine in a manner to be described and serving the purpose of producing ultrasonic waves of a frequency of about 20 + 60 kHz to thereby assist in the washing of the laundry contained in drum 5 after the supply to tub 3 of a washing liquid having a detergent dissolved therein. The washing liquid is permitted to enter drum 5 through the perforate circumferential wall 12 thereof to be absorbed by the laundry contained therein. According to the invention elements 11, which in the present case are of cylindrical shape, but may of course also have any other geometric configuration, are attached to the inner wall surface of door window 9 and connected to respective ultrasonic generator devices 10 by means of flexible electric conductors 14.

In particular, elements 11 are disposed on window 9 at positions whereat they are completely covered by the washing liquid contained in tub 3, and oriented at different directions towards the interior wall surfaces of drum 5.

In this manner the ultrasonic waves generated by generator devices 10 and emitted by elements 11 are able to spread practically throughout the mass of the washing liquid and the laundry contained in drum 5 to ensure thorough washing of the laundry thanks to the multiple reflection of the ultrasonic waves by the metallic walls of drum 5. For obtaining a more uniform distribution of the ultrasonic waves throughout the interior of drum 5 to thereby ensure an even more efficient washing of the laundry, the inner wall surface of window 9 may additionally be provided with reflecting surfaces 15 (cf. fig. 2) in the form of thin sheets of metal or another reflecting material advantageously disposed between each element 11 and the inner wall surface of the window.

Such reflecting surfaces may of course also be attached to other areas of the interior wall surface of drum 5 for the purposes outlined above. Prior to the initiation of a selected washing programme, the tub of the machine is supplied with an amount of water having a detergent dissolved therein, to fill it up to a predetermined level at which all elements 11 are covered by the liquid for the reasons given above. Subsequently a not shown heater element of the laundry washing machine is energized to heat the washing liquid to a preselected washing temperature of up to about 90°C. At the same time ultrasonic generator devices 10 are energized for generating ultrasonic waves to assist in the washing of the laundry. Also at the same time motor 13 is energized for rotating drum 5 at predetermined intervals and at a reduced speed.

In this manner the laundry contained in drum 5 is continuously agitated at a slow rhythm, resulting in substantially uniform distribution of the ultrasonic waves over the whole surface of the fabric and thus in an efficient laundering operation.

In the laundry washing machine of the type described it is preferably possible to tune ultrasonic generator devices 10 to thereby vary the frequency of the ultrasonic waves in accordance with the type of fabrics to be laundered to thereby optimize the efficiency of the process.

On termination of the selected washing programme, ultrasonic generator devices 10 are deenergized and the laundry is rinsed in the conventional manner followed by a spin-drying step and the discharge of the liquid from the tub of the machine.

## Claims

A laundry washing machine comprising a washing tub and a perforate rotatable drum formed with respective access openings aligned with one another, the opening of said tub being adapted to be closed by a door hinged to a front portion of the machine, said door being provided with a window preferably made of glass or a conventional plastic material, and projecting a certain distance into said tub and said drum in the closed position of said door, the machine being additionally provided with ultrasonic generator devices of a conventional type associated to respective elements adapted to produce ultrasonic waves to assist in the washing of the laundry contained in said drum in the presence of a washing liquid in said tub, characterized in that said elements (11) are hermetically attached to the interior wall surface of said window (9) at positions whereat they are covered by said washing liquid, and directed towards the interior wall surfaces of

said drum (5), said elements (11) being connected to respective ultrasonic generator devices (10) by means of flexible electric conductors (14).

2. A laundry washing machine according to claim 1, characterized in that between each of said elements (11) and the corresponding interior wall surface of said window (9) there is optionally provided a reflecting surface (15) formed by a thin sheet of a metal or another suitable reflecting material.

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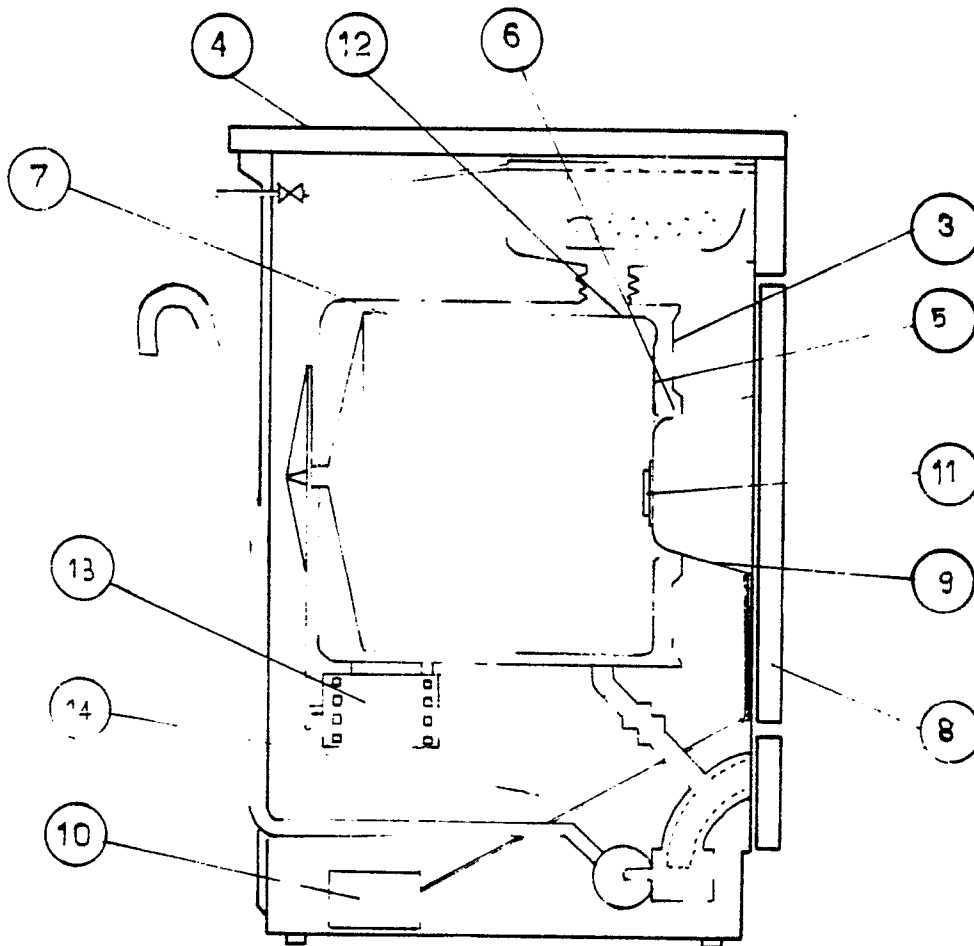


FIG 1

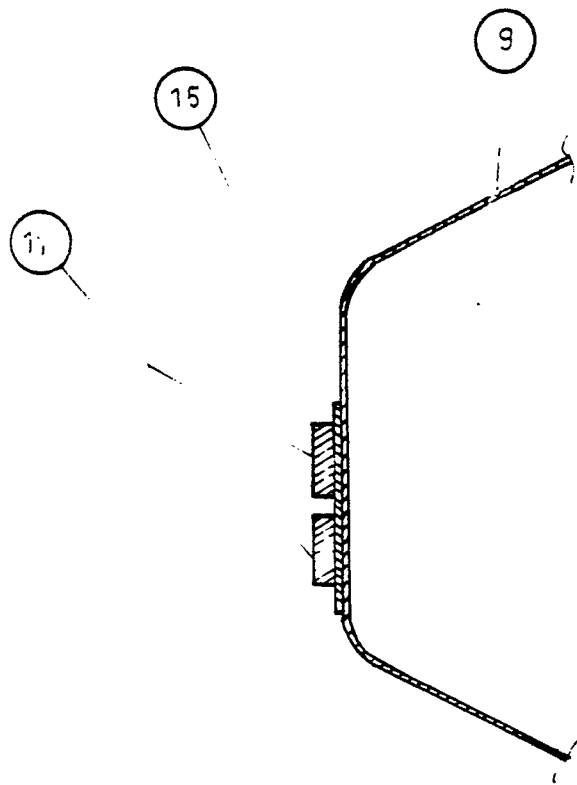


FIG. 2



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number

EP 87 11 1344

DOCUMENTS CONSIDERED TO BE RELEVANT															
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)												
D,A	US-A-2 468 550 (H.F. FRUTH) ---		D 06 F 19/00												
D,A	FR-A-1 011 575 (BAROT et al.) ---														
A	US-A-4 356 640 (C. JANSSON) ---														
A	DE-A-2 261 275 (SAN GIORGIO ELETTRICI S.p.A.) ---														
A	DE-B-1 278 981 (SIEMENS ELECTROGERÄTE GmbH) ---														
A	GB-A- 628 415 (THE GENERAL ELECTRIC CO.) -----														
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)												
			D 06 F A 47 L B 08 B												
The present search report has been drawn up for all claims															
Place of search THE HAGUE		Date of completion of the search 30-11-1987	Examiner D HULSTER E.W.F.												
<table border="0"><tr><td>CATEGORY OF CITED DOCUMENTS</td><td>T : theory or principle underlying the invention</td></tr><tr><td>X : particularly relevant if taken alone</td><td>E : earlier patent document, but published on, or after the filing date</td></tr><tr><td>Y : particularly relevant if combined with another document of the same category</td><td>D : document cited in the application</td></tr><tr><td>A : technological background</td><td>L : document cited for other reasons</td></tr><tr><td>O : non-written disclosure</td><td>.....</td></tr><tr><td>P : intermediate document</td><td>&amp; : member of the same patent family, corresponding document</td></tr></table>				CATEGORY OF CITED DOCUMENTS	T : theory or principle underlying the invention	X : particularly relevant if taken alone	E : earlier patent document, but published on, or after the filing date	Y : particularly relevant if combined with another document of the same category	D : document cited in the application	A : technological background	L : document cited for other reasons	O : non-written disclosure	.....	P : intermediate document	& : member of the same patent family, corresponding document
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