

5 PERSONAL COMPUTING DEVICES COMPRISING A RESONANT PANEL LOUDSPEAKER

10	<u>DESCRIPTION</u>
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15 **TECHNICAL FIELD**

The invention relates to personal computing devices and more particularly to lap-top and the like portable personal computers, e.g. so-called note-book computers and portable personal telephones incorporating loudspeakers.

20 BACKGROUND ART

Embodiments of the present invention use members of nature, structure and configuration achievable generally and/or specifically by implementing teachings of our International application WO97/09842. Such members thus have capability to sustain and propagate input vibrational energy by bending waves in operative area(s) extending transversely of thickness often but not necessarily to edges of the member(s); are configured with or without

anisotropy of bending stiffness to have resonant mode vibration components distributed over said area(s) beneficially for acoustic coupling with ambient air; and have predetermined preferential locations or sites within
5 said area for exciter means, particularly operationally active or moving part(s) thereof effective in relation to acoustic vibrational activity in said area(s) and signals, usually electrical, corresponding to acoustic content of such vibrational activity.

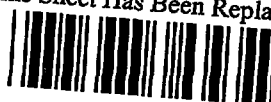
10 Members as above are herein called distributed mode acoustic radiators and are intended to be characterised as in the above PCT application and/or otherwise as specifically provided herein.

This invention is particularly concerned with acoustic
15 devices in the form of loudspeakers for personal computing devices, and with personal computing devices incorporating such loudspeakers.

DISCLOSURE OF INVENTION

The present invention is a lap-top or the like
20 portable computing device having a body comprising a keyboard and a lid hinged to the body and comprising a display screen, characterised by a resonant panel loudspeaker, preferably a distributed mode acoustic radiator loudspeaker, in or attached to the lid, and an
25 acoustic waveguide or horn directing an acoustic output from the loudspeaker in a desired direction. The desired direction will normally be towards the user of the portable computing device.

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The waveguide or horn may comprise a member movably mounted on the lid, e.g. for pivoting and/or sliding movement, from a closed or retracted position to an advanced or open position. An opposed pair of the
5 waveguides or horns may be provided, e.g. to provide multi-channel acoustic output. The waveguide(s) or horn(s) may comprise a plate-like member hinged to the lid.

The lid may be provided with one or more acoustically transparent apertures in its outer surface.

10 BRIEF DESCRIPTION OF DRAWINGS

The invention is diagrammatically illustrated, by way of example, in the accompanying drawings, in which:-

Figure 1 is a front perspective view of a first embodiment of lap-top computer according to the present
15 invention;

Figure 2 is a cross-sectional view of the lid of the laptop computer;

Figures 2a and 2b are respective enlarged scrap cross-sectional side views of alternative details in the
20 embodiment of Figures 1 and 2;

Figure 3 is a front perspective view of a second embodiment of laptop computer;

Figure 3a is a plan view of the lid of the laptop computer of Figure 3;

25 Figure 4 is a front perspective view of a third embodiment of laptop computer;

Figure 5 is a front perspective view of an embodiment of electronic personal organiser;

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Figures 5a and 5b are respective enlarged scrap cross-sectional side views of alternative details of the embodiment of Figure 5, and

Figure 6 is a rear perspective view of the embodiment 5 shown in Figure 5.

BEST MODES FOR CARRYING OUT THE INVENTION

Figures 1, 2 and 2a illustrate a lap-top personal computer (128) having a body (137) comprising a keyboard (138) and a lid (130) having a rectangular frame (1), e.g. of moulded plastics, supporting a visual display screen 5 (129) and which lid is hinged to the body for movement as indicated by arrow X, between a folded position in which the lid encloses the keyboard and an erect position in which the lid is substantially upright.

The lid (130) houses an opposed pair of loudspeakers 10 to adapt the computer for multi-media applications and the like, the loudspeakers each comprising a thin rectangular panel (2) forming a multi-mode acoustic radiator of the kind described in WO97/09842. Each loudspeaker panel (2) has a monolithic structure and is supported near to its 15 periphery on discrete resilient suspension elements (3) e.g. of an elastomeric material, which in turn are supported on the surrounding frame (1) via the display screen (129). A vibration exciter (9) is mounted on each panel at a predetermined position as discussed more fully 20 in our International application WO97/09842, to launch bending waves into each of the panels (2) to cause them to resonate to produce acoustic outputs. The exciters may be

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electrodynamic.

The lid (130) comprises an opposed pair of cover members (167,168) which together define the outer casing of the lid and are each shaped as a flat rectangular panel having a downturned peripheral rim extending round three adjacent sides, the fourth side being arranged to abut against the corresponding side of the opposite cover member. The cover members slide and hinge on the frame (1) in the directions indicated by arrows Y and Z respectively such that when extended from the closed position indicated at the left-hand side in Figure 2 to their operative position indicated in Figure 1 and the right-hand side in Figure 2, they are locked by friction or other means to form acoustic waveguides or horn structures whose apertures (169) are presented to the opposite sides of the lid. The horn expansion effectively begins over the region of the loudspeakers. The diffuse sound energy and nearly constant power with frequency of the loudspeakers means that relatively good matching is achieved between the horn and the speaker elements. Benefits include relatively high acoustic efficiency, improved low range response and a sound directivity which is beneficially directed towards the user with reduced leakage towards others. The relatively small effective acoustic sources represented by the horn apertures (169) also will improve the sense of stereo image localisation for the user.

It might also be possible to incorporate the multi-mode speaker units in the lid cover members (167,168) where

the radiation may then either be bi-directional and/or forwards directed via the horn structure.

As shown in Figure 2b it is possible to render the cover members (167,168) acoustically transparent by providing apertures (170) therein, the apertures being coverable by a sliding grille (17) to allow sound from the speaker to exit, or alternatively acoustically opaque when the grille is moved to cover the apertures, to direct the sound through and only through the horn element. The sliding grille would allow the user to open, or partially open and close the apertures to control the degree or mix of the horn effective component and the direct sound emitted via the grille.

Figures 3 and 3a show a second embodiment of laptop computer which is generally similar to that described above with reference to Figures 1 and 2. However the complexity of the waveguide or horn mechanism is simplified, as compared to the embodiment of Figure 1 and 2 so that opposed horn/waveguide elements are provided by the wedge shapes formed between flat plate elements (40) hinged by hinges (34) to the outer surface of a generally conventional lid (131) and the lid itself. In this embodiment, the elements (40) are or comprise multi-mode acoustic radiators of the kind described in WO97/09842 and excited by vibration exciters (9) mounted thereon. The hinges (34) may have friction or detent action to allow both predetermined and/or user-preferred angles for the waveguide elements. Additionally the lid casing itself may

be adapted to resonate according to distributed mode principles by control of effective area geometry and exciter position.

The embodiment of Figure 4 is generally similar to that of Figure 3, but in this case, the generally conventional lid case (131) of the laptop computer is provided with a single plate-like cover (40) hinged to the body (137), to form a wedge-shaped cavity to provide horn-like loading for a multi-mode speaker (2) located within the cover.

The plate-like cover (40) is formed with a rectangular frame (41) supporting a distributed mode acoustic radiator panel (2) which may be bi-directional or forwards directed according to the required acoustic efficiency and desired use. This plate-like cover may be single or multi-channel according to the properties of the plate and the location and number of exciters. Distributed mode speaker panels lend themselves to activation by multiple exciters due to the non-pistonic bending wave operation.

In the embodiment of Figures 5 and 6, the concept of the acoustic wave guide as described above is applied to distributed mode speaker(s) in the lid (150) of a personal digital assistant or personal data unit (158). The device (158) is generally similar to the laptop computer described above and comprises a body (157) having a keyboard (156) and a lid (150) hinged to the body and incorporating a visual display screen (129). The lid construction is similar to that described above with reference to Figures

2 and 2a or 2b, as indicated in Figures 5a and 5b, with the exception that in the present case the lid cover (155) is a fixed structure having a plate-like surface surrounded by a downturned peripheral lip and which carries a frame (1) supporting the display screen (129) with a resonant panel loudspeaker (2,9) resiliently mounted thereon. A pair of slots (159) are defined between opposite sides of the visual display screen (129) and the cover (155) which are coupled to an acoustic channel leading to the loudspeaker region and which directs sound towards the user. Optionally as shown in Figures 5b and 6, the lid casing may be perforated at (170) to allow sound to be radiated from the rear section, under the control of a movable grille (171). The diffuse radiation characteristic and bi-directional nature of the distributed mode speaker lends itself to the effectiveness of this application in the suggested mode of operation.

Where a personal data unit has audio modes of operation or may be combined with or associated with a mobile telephone, the relatively large distributed mode-type speaker installed in the lid provides a means for hands free communication and also will be effective for loudspeaking tele-conferencing.

The lid cover (155) may also be designed as an integrated distributed mode speaker or speakers if desired.

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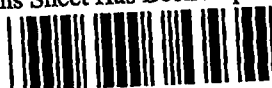


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CLAIMS

1. A personal computing device having a body comprising a keyboard and a lid comprising a display screen hinged to the body to cover the keyboard, characterised by a resonant
5 panel loudspeaker in or attached to the lid, and an acoustic waveguide or horn to direct acoustic output from the loudspeaker.
2. A personal computing device according to claim 1, characterised in that the waveguide or horn comprises a
10 member mounted on the lid.
3. A personal computing device according to claim 2, characterised in that the member is movably mounted on the lid from a closed or retracted position to an advanced or open position.
- 15 4. A personal computing device according to claim 2 or claim 3, characterised in that the member forms a lid cover.
5. A personal computing device according to any preceding claim, characterised in that the loudspeaker panel is
20 supported in the lid by means of a resilient suspension.
6. A personal computing device according to claim 5, characterised by a frame surrounding the panel and on which the panel is suspended.
7. A personal computing device according to claim 6,
25 characterised in that the display screen is supported on the frame and in that the loudspeaker panel is resiliently supported on the display screen.
8. A personal computing device according to any one of

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claims 2 to 7, wherein the cover is or comprises a resonant panel loudspeaker.

9. A personal computing device according to any preceding claim, characterised by an opposed pair of the waveguides
5 or horns.

10. A personal computing device according to any preceding claim, characterised in that the waveguide or horn comprises a plate-like member hinged to the lid.

11. A personal computing device according to any preceding
10 claim, characterised in that the lid is provided with one or more acoustically transparent apertures.

12. A personal computing device according to claim 11, characterised by a movable grille to adjust acoustic output through the apertures.

15 13. A personal computing device according to any preceding claim, characterised in that the resonant panel loudspeaker is integral with the lid.

14. A personal computing device according to any preceding claim, characterised in that the resonant panel loudspeaker
20 comprises a stiff lightweight panel having a monolithic structure.

15. A personal computing device according to any preceding claim, characterised in that the resonant panel loudspeaker is a distributed mode acoustic radiator.

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