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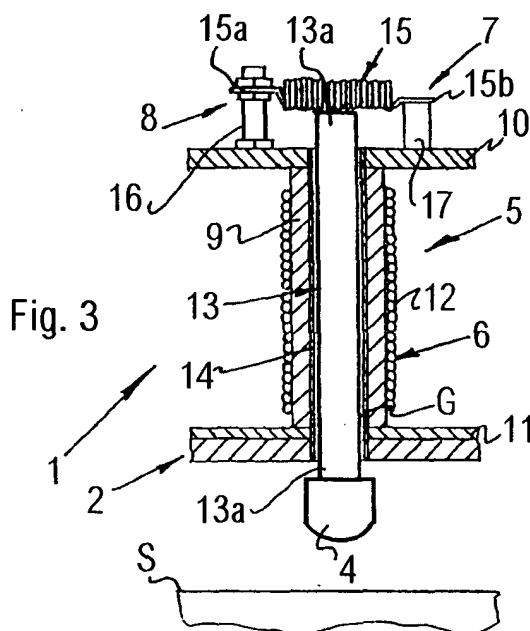
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(54) **Generator of simulated walking for phonometric measurements in the building industry**

(57) A generator (1) of simulated walking for phonometric measurements in the building industry comprises a frame (2) provided with ground support means (3), at least one hammer (4), which is associated with said frame and is slidingly moveable in a direction substan-

tially perpendicular to the ground between a configuration that is raised in relation to the ground and a configuration of impact with the ground, and automated electromagnetic actuating means (5) of said hammer between said raised configuration and said impact configuration e vice versa.



EP 1 475 164 A2

Description

[0001] The present invention relates to a generator of simulated walking for phonometric measurements in the building industry.

[0002] Phonometry is the branch of technical acoustics that studies the manner of measuring and evaluating sounds and noises; with particular reference to the building industry, phonometry is applied to measure and evaluate, amongst other things, the noise or sound-proofing of dwellings.

[0003] In general, it must be decided whether a disturbing noise entering a dwelling introduces a noise that exceeds normal tolerance limits.

[0004] Numerous factors influence the noise of dwellings and numerous variable factors intervene in the definition of so-called normal tolerance limits; the former include, for example, building technique, town planning, the distribution of the rooms and so on, the latter include for example the area (residential, industrial, rural etc) in which the dwelling is located, the time of emission of the noise (daytime, at night, etc), the type of noise (continuous, pulsed, monotonous, etc.), the manner of propagation of the noise (airborne, through solids or structural, etc.).

[0005] Owing to the complexity of the subject, different legislation and standards exist that establish the manner and instruments for measuring noise and set the maximum limits for permitted sound levels.

[0006] In general, a phonometric datum is recorded, through appropriate calculations the equivalent sound level is determined and it is ascertained whether the latter complies with the set maximum limits.

[0007] To record the corresponding photometric datum for pulsed noises transmitted through solids or structurally, such as those due for example to the footsteps of people or to objects falling on the floors of a dwelling and which, through the floors thereof are transmitted to the rooms of the dwelling underneath, appliances known as "generators of simulated walking" and measurers of sound level or phonometers are used.

[0008] The generators of simulated walking are rested on the floor of a dwelling and the noise generated by them in the dwelling underneath is recorded by the phonometer located therein.

[0009] The phonometers essentially comprise a microphone, an amplifier and a display of the recorded datum expressed in dB.

[0010] Known generators of simulated walking essentially consist of a frame that is provided with feet resting on the floor and that supports a plurality of hammers that are arranged in line and perpendicular to the floor and are associated with automated actuating means that is suitable for making them fall, starting from stationary from a predefined fall height, and for lifting them up again to the fall height, in sequence and at preset intervals of time from one another.

[0011] The automated actuating means of known

generators of simulated walking is electromechanical and essentially comprises a shaft rotated by an electric gearmotor and is provided with a plurality of transverse cams or arms, each of which is suitable for lifting and dropping a respective hammer.

[0012] These known generators of simulated walking have drawbacks, which include the fact that between the components of the electromechanical automated actuating means of the hammers and the hammers themselves shocks and impacts occur that generate disturbing vibrations that, through the resting feet with which the frame is provided, are discharged on the floor, being thereby superimposed on the noise generated by the falling hammers; such vibrations affect the purity of the generated noise, thus introducing an error in the measurement carried out and increasing the uncertainty of the detected photometric datum.

[0013] Another drawback of known generators of simulated walking consists of the fact that they do not allow precise adjustment and setting of the height of fall of the hammers, the time intervals between the impact and the lifting of each hammer and the frequency of the pulses generated by the succession of impacts of the individual hammers, as a result, the uncertainty regarding the phonometric measurements that are measurable therewith increases.

[0014] A further drawback of known generators of simulated walking consists in the fact that between the different components of the electromechanical automated actuating means of the hammers and between them and the hammers wear through rubbing, shocks and impact occurs, which requires very frequent, inconvenient and costly maintenance and/or replacement.

[0015] An object of this invention is to eliminate these drawbacks of known generators of simulated walking by devising a generator of simulated walking for phonometric measurements in the building industry that enables the disturbance vibrations to be eliminated that are discharged on the floor, to reduce the uncertainty of phonometric data measurable therewith and to precisely adjust and set the height of fall of the hammers, the time interval between the impact and the lifting of each hammer and the frequency of the pulses generated by the succession of the impacts of the single hammers.

[0016] Other objects of this invention comprise devising a generator of simulated walking that is subject to limited wear and enables maintenance and/or replacement of its components to be reduced and simplified.

[0017] Another object of the present invention is to perform the preceding tasks using a simple structure that is relatively easy to implement, that is safe to use, operates effectively and has a relatively limited cost.

[0018] These tasks and objects are achieved by a generator of simulated walking for phonometric measurements in the building industry, comprising a frame provided with ground resting means, at least one hammer, that is associated with the frame and that is slidably moveable in a direction substantially perpendicular to

the ground between a configuration that is raised in relation to the ground and an impact configuration on the ground, and the automated actuating means of said hammer between said raised configuration and said impact configuration and vice versa, characterized in that said automated actuating means is of the electromagnetic type.

[0019] Further characteristics and advantages of the invention will become clearer from the detailed disclosure of a preferred but not exclusive embodiment of a generator of simulated walking for phonometric measurements in the building industry, illustrated by way of non-limiting example in the attached tables of drawings in which:

Figure 1 is a view of a generator of simulated walking according to the invention in a possible work configuration for a phonometric measurement in a dwelling;

Figure 2 is a schematic view of the generator of simulated walking of Figure 1;

Figure 3 is a schematic section view of a hammer of the generator of simulated walking of Figure 1 in a arrest phase in raised configuration;

Figure 4 is a schematic section view of a hammer of the generator of simulated walking of Figure 3 in a fall phase in impact configuration on the floor;

Figure 5 is a schematic section view of a hammer of the generator of simulated walking of Figure 3 in a return ascent phase towards the raised configuration;

Figure 6 is a schematic section view of a hammer of the generator of simulated walking of Figure 3 at the end of a return ascent phase in raised configuration;

Figure 7 is a schematic side view of Figure 4.

[0020] With particular reference to these figures, 1 indicates a generator of simulated walking for phonometric measurements in the building industry.

[0021] The generator 1 comprises a frame 2 provided with floor S rest means comprising, for example, feet 3, one or more hammers 4, in particular five and arranged in line, which are associated with the frame 2 and which are movably supported sliding in a direction substantially perpendicular to the ground S between a configuration that is raised in relation to the ground S and an impact configuration on the ground, and an automated actuating means 5 of the hammers 4 between their respective ascent and impact configurations and vice versa.

[0022] The automated actuating means 5 is of the electromagnetic type and comprises at least one electromagnet 6 associated with a respective hammer 4, voltage supply means to the electromagnets 6 and an electronic circuit for the control and actuation of the electromagnets 6 and of the supply means; the supply means and the electronic circuit are not shown since they are known per se.

[0023] The electronic circuit essentially comprises an electronic control unit, an on/off switch for each electromagnet 6, and a timer for each electromagnet 6 and is suitable for adjusting the time interval that elapses between the respective raised and impact configurations and a plurality of auxiliary timers suitable for adjusting the time intervals that elapse between the actuation of the single hammers 4 according to a preset sequence.

[0024] Stabilisation means 7, for example of magnetic or electromagnetic type, is provided for stabilisation of hammers 4 in the respective raised configuration, and recording means 8 of the height of the hammers 4 in relation to the ground S in their raised configuration that is associated with the stabilisation means 7.

[0025] Each electromagnet 6 comprises a tubular element 9 that is supported between a top plate 10 and a bottom plate 11, forming part of the frame 2, and which is arranged substantially perpendicular to the ground S; around the tubular element 9 at least an electric coil 12 is wound, comprising a wire, generally of copper, associated with the voltage supply means, and a core 13 in ferromagnetic material is slidably housed in a direction that is substantially axial to the inside of the tubular element 9.

[0026] Usefully, between the tubular element 9 and the core 13 a bush 14 can be interposed.

[0027] The tubular element 9, the frame 2 and, in particular, the first plate 10 and the second plate 11, and the bush 14 are made of non-magnetic material such as, for example, aluminium, brass, bronze, plastic or the like.

[0028] The core 13 comprises a cylindrical bar that has a lower end 13a that points towards the ground S and which is joined with the respective hammer 4 and an opposite top end 13b; between the tubular element 9 or the bush 14 and the core 13 corresponding coupling play G is defined, whilst the bottom end 13a and the top end 13b extend outside the tubular element 9.

[0029] The stabilisation means 7 is associated with the frame 2 and is arranged near the top end 13b of each core 13; in particular it may comprise an attraction element 15 of the respective core 13 that is substantially rod-shaped and is arranged above and transversely to the tubular element 9.

[0030] The attraction element 15 has a first end 15a joined to a first support 16 associated with the top plate 10 and a second end 15b opposite the first, that is free and rests on a second support 17 associated with the top plate 10; the second support 17 may be covered with a layer of rubber. In an alternative embodiment, which is not shown, the second end 15b of the attraction element 15 can be joined to the second support 17.

[0031] The attraction element 15 is usefully of the elastically deformable type, and it is made of ferromagnetic material and is advantageously arranged outside the tubular element 9 in which the respective core 13 is housed.

[0032] In the embodiment shown in the above figures

the attraction element 15 comprises a spiral spring with close turns, the first end 15a comprises in this case turns near the first support 16; however, alternative embodiments of the attraction element 15 and of the stabilising means 7 in general are not excluded.

[0033] The recording means 8 of the height of the hammers 4 comprises, for example, adjusting means of the height of the first support 16 and/or the second support 17 in relation to the frame 2, in other words in relation to the top plate 10, suitable for varying the corresponding distance between the attraction element 15 and the top end 13b of the respective core 13.

[0034] The adjusting means 8 may, for example, comprise a threaded stem defined below protruding from the bottom of the first support 16 and/or the second support 17 and which engages in a corresponding threaded hole defined in the top plate 10; nevertheless, different embodiments are not excluded.

[0035] The cores 13, and the attraction elements 15 and the hammers 4 are made of ferromagnetic material such as for example iron or steel or the like. The control unit is suitable for controlling the supply means and the electromagnets 6 for sequential actuation of the hammers 4 at preset time intervals 1 between the respective raised and impact configurations and vice versa, the time interval also being presettable for the return of each hammer 4 between the respective impact or raised configuration.

[0036] Finally, the generator 1 comprises usefully air-blowing means that is not shown that is arranged near each hammer 4 and which is suitable for sending an air jet at each hammer 4 in order to remove from it, and in particular from its impact surface with the ground S, any impurities, powders or fragments of the floor that may deposit themselves thereupon and which would invalidate the measurements.

[0037] In one possible embodiment, the blowing means comprises, for example, a ventilator (fan) located at each hammer 4.

[0038] According to a possible alternative embodiment, the blowing means comprises for example a central fan and an air-distribution conduit that is provided with an inlet port associated with the outlet of the central fan and with at least one outlet port located at each hammer 4.

[0039] The invention operates as follows:

The generator 1 is arranged on the ground S, comprising for example the floor P1 of a chamber V1 of a dwelling A1, resting on feet 3; on the floor P2 of a chamber V2 of a dwelling A2 underneath the first A1 a phonometer F (figure 1) is arranged.

The control unit actuates, regulates and deactivates the supply means of the electric coils 12 in such a way that the hammers 4 in sequence and at preset time intervals hit the ground S by falling freely starting from stationary from the respective raised configuration and hitting the ground in impact configuration,

and are recalled after a preset time interval from the impact configuration to the raised configuration.

Figure 3 shows a hammer 4 kept stationary in raised configuration at a preset height from the ground S. Figure 4 shows the impact configuration of the hammer 4 on the ground S after the free fall phase in which the control unit deactivates the voltage supply means at the respective electric coil 12.

Figure 5 shows the return ascent phase of the hammer 4 from the impact configuration to the stop configuration, in this phase the control unit actuates and regulates the supply means of the electric coil 12 in such a way that the electromagnetic field that is generated recalls the core 13 inside the tubular element 9; the force generated by the magnetic field is such as to lift up the hammer 4 so as to balance its weight force.

[0040] The thus recalled core 13 slidably oscillates along the tubular element 9; such oscillations are gradually lessened by the stabilisation means 7 that stop the core 13 in equilibrium in raised configuration.

[0041] Stabilisation of the core 13 is due in particular to the force of attraction that the attraction element 15 exerts on the core 13 and on the dissipation through attrition that is generated by rubbing between the core 13 and the tubular element 9 or the bush 14; this rubbing is due to the fact that owing to the outside arrangement of the attraction element 15 in relation to the tubular element 9, the core 13 tilts in relation to the latter, thereby eliminating, at least in certain points, the corresponding play G.

[0042] During the stabilisation phase, the attraction element 15 rotates around its first end 15a to then return to rest with its second end 15b on the second support 17.

[0043] If the second end 15b is joined to the second support 17, the attraction element 15, of the elastically deformable type, flexes and arches upwards and then returns to its undeformed configuration.

[0044] Once the core 13 has stabilised the hammer 4 is ready, stationary in its respective raised configuration (figure 6) for a subsequent free fall.

[0045] The blowing means keeps the impact surface of the hammers 4 clean.

[0046] The phonometer F detects the noise that is generated in the chamber V2 after repeated and successive impact blows of the hammers 4 on the floor P1, which blows simulate the noise due to the fall of objects or footsteps of persons on the floor P1.

[0047] It has in practice been found that the disclosed invention achieves the proposed objectives.

[0048] The generator of simulated walking according to the invention, in fact, owing to the use of automated means of the electromagnetic type for actuating hammers, eliminates the disturbance vibrations that are discharged on the floor, shocks and impacts between their various components being absent.

[0049] The generator of simulated walking according to the invention thus enables the uncertainty of the phonometric data that are measurable with it to be reduced; it furthermore enables precise adjusting and setting of the fall height of the hammers, the time interval between the impact and the lifting of each hammer and the frequency of the pulses generated by the sequence of the impacts of the individual hammers.

[0050] Lastly, the automated actuating means of the electromagnetic type is subject to limited wear and enables maintenance and/or replacement of its components to be reduced and simplified.

[0051] The invention that is thus conceived is capable of undergoing numerous modifications and variations that all fall within the scope of the inventive concept.

[0052] All the details are furthermore replaceable by other technically equivalent details.

[0053] In practice, the materials used and the shapes and dimensions may be of any type, according to requirements without thereby falling outside the protective scope of the following claims.

Claims

1. Generator of simulated walking for phonometric measurements in the building industry, comprising a frame provided with ground support means, at least one hammer, which is associated with said frame and is slidingly moveable in a direction substantially perpendicular to the ground between a configuration that is raised in relation to the ground and a configuration of impact with the ground, and automated actuating means of said hammer between said raised configuration and said impact configuration e vice versa,
characterised in that said automated actuating means is of the electromagnetic type.
2. Generator according to claim 1, **characterised in that** said automated actuating means comprises at least one electromagnet associated with a respective hammer, supply means of said electromagnet and an electronic control circuit of said electromagnets and of said supply means.
3. Generator according to one or more of the preceding claims,
characterised in that said electronic circuit comprises an electronic control unit, an on/off switch associated with each of said electromagnets and a timer associated with each of said electromagnets for the adjustment of the time interval that elapses between respective said impact and raised configurations.
4. Generator according to one or more of the preceding claims,

characterised in that it comprises stabilisation means of said hammers in said raised configuration.

5. Generator according to one or more of the preceding claims,
characterised in that said stabilisation means is of the magnetic or electromagnetic type.
6. Generator according to one or more of the preceding claims,
characterised in that it comprises recording means of the height of said hammers in relation to said ground in said raised configuration.
7. Generator according to one or more of the preceding claims,
characterised in that said recording means is associated with said stabilisation means.
8. Generator according to one or more of the preceding claims,
characterised in that each of said electromagnets comprises a tubular element in non-magnetic material that is associated with said frame and is arranged substantially perpendicular to said ground, at least one electric coil that is wound around said tubular element and which is associated with said supply means and a core in ferromagnetic material that is slidingly housed in a substantially axial direction in said tubular element and which has a bottom end facing said ground and is integrally associated with said respective hammer, and an opposite top end.
9. Generator according to one or more of the preceding claims,
characterised in that between said tubular element and said core corresponding coupling play is defined.
10. Generator according to one or more of the preceding claims,
characterised in that between said tubular element and said core a guide bush in non-magnetic material is interposed.
11. Generator according to one or more of the preceding claims,
characterised in that said core comprises a substantially cylindrical bar, in said raised configuration said bottom end and said top end extending outside said tubular element.
12. Generator according to one or more of the preceding claims,
characterised in that said stabilisation means is associated with said frame and is arranged near

said top end of each of said cores.

13. Generator according to one or more of the preceding claims,
characterised in that said stabilisation means comprises an attraction element of the respective core that is substantially rod-shaped and which is arranged above and transversely to said tubular element with a first end joined to a first support associated with said frame and a second end opposite the first and associated with a second support associated with said frame. 5
14. Generator according to one or more of the preceding claims,
characterised in that said second end of said attraction element is free and resting on said second support. 10
15. Generator according to one or more of the preceding claims,
characterised in that said second end of said attraction element is joined to said second support. 15
16. Generator according to one or more of the preceding claims,
characterised in that said attraction element is made of ferromagnetic material. 20
17. Generator according to one or more of the preceding claims,
characterised in that said attraction element is arranged outside said tubular element. 25
18. Generator according to one or more of the preceding claims,
characterised in that said attraction element is of the elastically deformable type. 30
19. Generator according to one or more of the preceding claims,
characterised in that said attraction element comprises a spiral screw. 35
20. Generator according to one or more of the preceding claims,
characterised in that said recording means comprises adjusting means of the height in relation to said frame of at least one between said first support and said second support suitable for varying the corresponding distance between said attraction element and said top end of the respective core. 40
21. Generator according to one or more of the preceding claims,
characterised in that it comprises air-blowing means arranged near each of said hammers. 45
22. Generator according to one or more of the preceding claims,
characterised in that said blowing means comprises at least one fan located at each of said hammers. 50
23. Generator according to one or more of the preceding claims,
characterised in that said blowing means comprises a central fan and an air-distribution conduit provided with an inlet port associated with the outlet of said central fan and with at least one outlet port located at each of said hammers. 55
24. Generator according to one or more of the preceding claims,
characterised in that said frame is made of non-magnetic material.
25. Generator according to one or more of the preceding claims,
characterised in that said non-magnetic material is of aluminium, brass, plastic or the like.
26. Generator according to one or more of the preceding claims,
characterised in that said ferromagnetic material is iron, steel or the like.
27. Generator according to one or more of the preceding claims,
characterised in that said hammers are made of steel or the like.
28. Generator according to one or more of the preceding claims,
characterised in that it comprises a plurality of said hammers, said electronic circuit being provided with auxiliary timers and being suitable for controlling said electromagnets and said supply means for the sequential actuation of said hammers at pre-set time intervals between the respective raised and impact configurations and vice versa.
29. Generator of simulated walking for phonometric measurements in the building industry, according to one or more of the preceding claims and according to what has been disclosed and illustrated for the specified objects.

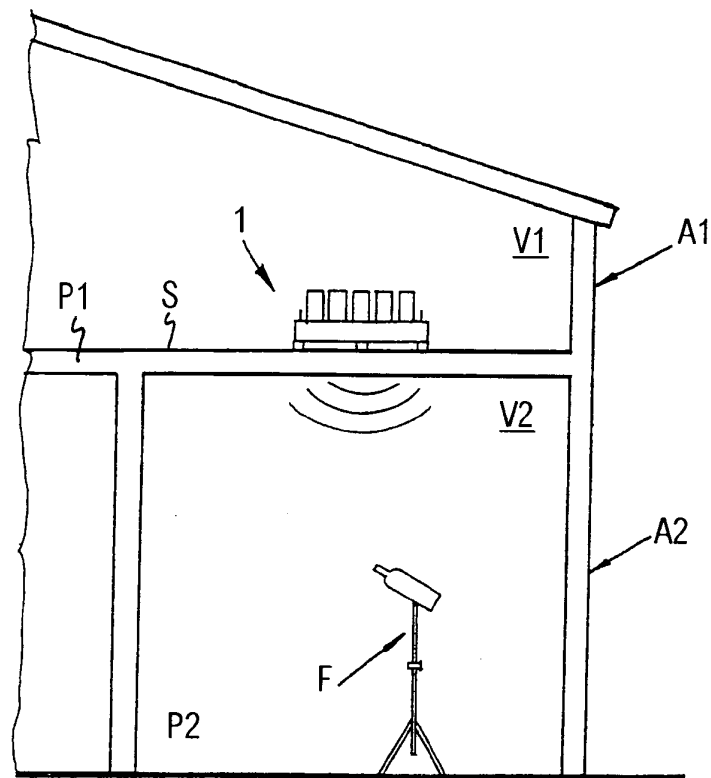


Fig. 1

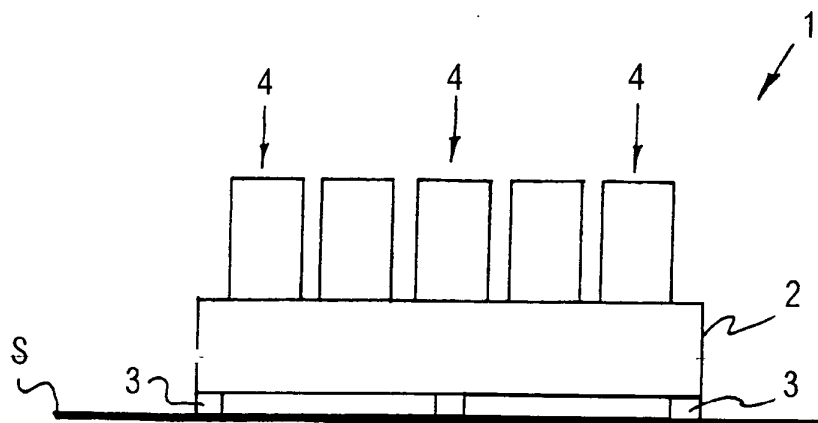


Fig. 2

