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ELECTROMECHANICAL FILTER ASSEMBLY

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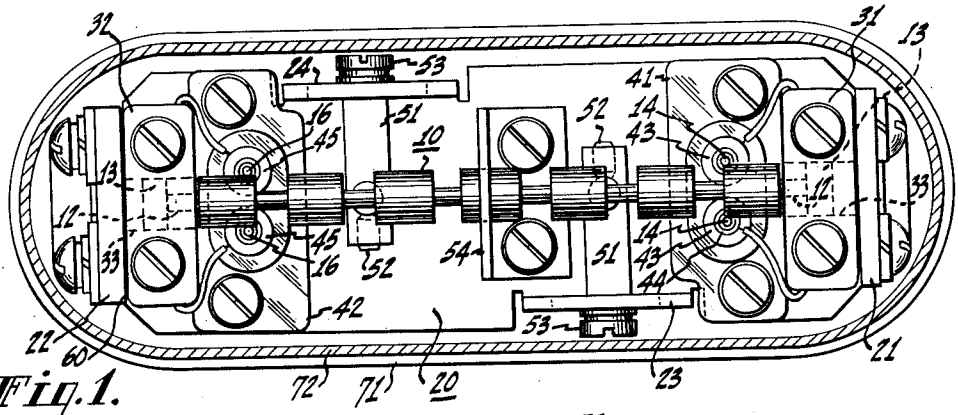

Fig. 1.

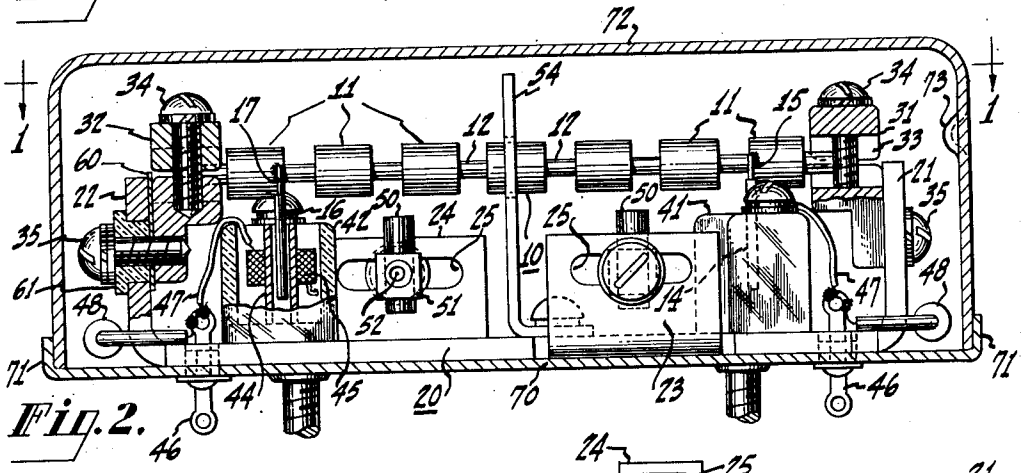

Fig. 2.

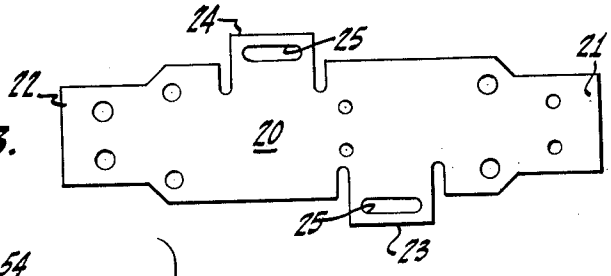

Fig. 3.

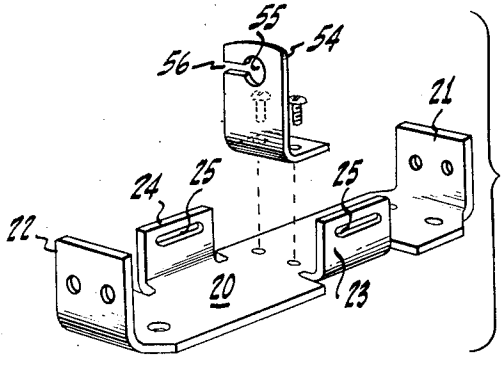

Fig. 4.

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ELECTROMECHANICAL FILTER ASSEMBLY

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5 Claims. (Cl. 333—71)

The invention relates to electromechanical filters, and has for an object to provide an improved assembly for electromechanical filters.

Briefly, the assembly of the invention comprises a chassis formed of a stamped metal blank that is substantially longer than it is wide. The chassis has integral with it a first end tab at one end, a second end tab at the other end, a first side tab at one side near the first end tab, and a second side tab at the other side near the second end tab. The tabs are bent upward so that their respective surfaces form right angles with the main surface of the chassis, and the chassis is fastened to a base with the tabs extending away from the base. First and second filter supports or clamps, each having an opening therein, are fastened on the first and second end tabs respectively so that the openings are axially aligned. An electromechanical filter comprising a plurality of cylindrically shaped resonators, interconnected by couplers and having a mounting slug fastened in axial alignment at each end, is positioned in the openings of the clamps. First and second coils are mounted on the chassis near and between each of the end tabs respectively, and magnetostrictive transducers are tangentially fastened at diametrically opposite points on the end resonators of the filter and coupled to the coils. Means for magnetically biasing the transducers are fastened to each of the side tabs. It is preferred that the stamped metal blank be made from non-magnetic material, such as brass, and the base from a magnetic material such as steel so that the entire assembly may be magnetically shielded and protected by a steel outer cover which is placed over the assembly and hermetically sealed to the base.

The invention is explained in detail in connection with the accompanying drawing, in which:

Fig. 1 shows a plan view of one embodiment of the assembly with the outer cover shown in cross section;

Fig. 2 shows a side view, partly in cross section, of the embodiment shown in Fig. 1;

Fig. 3 shows a plan view of the chassis used in the assembly, before the tabs are bent; and

Fig. 4 shows an exploded perspective view of the chassis after the tabs are bent and illustrates the brace which is adapted to be fastened to the chassis.

In the drawing, the same reference numerals are used to refer to the same components in the different figures.

In Figs. 1 and 2, there is shown an electromechanical filter **10** comprising a plurality of cylindrically shaped resonators **11** which are interconnected in axial alignment by smaller diameter, cylindrically shaped couplers **12**. A mounting slug **13** is fastened to each end of the filter **10** by a mounting coupler **12** so that the mounting slugs **13** are in axial alignment with the resonators **11**. Such a filter may be ground by a profile grinding operation from a single piece of magnetostrictive material such as an alloy of iron and nickel. While the filter **10** shown comprises seven resonators **11**, more or less resonators may be used, depending upon the degree of selectivity desired. The resonators **11** are designed to operate in

the torsional mode, and they may be excited by an input signal applied to a first pair of magnetostrictive transducers **14**. This first pair of transducers **14** is tangentially fastened by fine wires **15** at diametrically opposite points on one end resonator **11**. Output signals may be derived from the filter **10** by a similar second pair of magnetostrictive transducers **16** which is also tangentially fastened by fine wires **17** at diametrically opposite points on the other end resonator **11**. The transducers **14**, **16** are positioned parallel to each other and extend in the same direction from their respective points of mounting. The transducers may be made of rod-shaped magnetostrictive material such as ferrite. When the filter **10** is in operation, the pair of transducers **14** serving as input transducers are made to longitudinally contract and expand in the opposite sense respectively in response to input signals, so that a couple is produced in the one end resonator **11**. This couple causes all of the resonators **11** to vibrate in the torsional mode. The torsional vibrations in the resonators **11** cause longitudinal vibrations in the pair of transducers **16** serving as the output transducers, and an output signal is derived from the output transducers in response to these longitudinal vibrations.

The assembly for the electromechanical filter **10** comprises a chassis **20** which is stamped or punched from a rectangular sheet of brass that is substantially longer than it is wide. Integral with the chassis **20** are a first end tab **21** at one end, a second end tab **22** at the other end, a first side tab **23** at one side near the first end tab **21**, and a second side tab **24** at the other side near the second end tab **22**. The side tabs **23**, **24** are provided with elongated slots **25**, and various mounting holes are provided in the chassis and the tabs, as shown. The chassis **20** with its tabs, before they are bent, is shown in Fig. 3. Each of the tabs is bent so that its surface forms substantially a right angle with the surface of the chassis **20**. In this way, the chassis **20** with its integral tabs may be easily formed. A completed chassis **20**, with its tabs bent as described, is shown in Fig. 4.

The electromechanical filter **10** is mounted on and fastened to the chassis **20** by a first support clamp **31** and a second support clamp **32**, each of which is metallic and has a cylindrically shaped opening **33** that is adapted to receive and clamp the mounting slugs **13** of the electromechanical filter **10**. Means, such as the screws **34**, are provided to tighten the clamps **31**, **32** around their respective mounting slugs **13** and prevent the mounting slugs **13** from vibrating. The first clamp **31** is fastened to the first end tab **21**, and the second clamp **32** is fastened to the second end tab **22** by some means such as the mounting screws **35**. The clamps **31**, **32** are positioned on the inner or facing surfaces of their respective end tabs **21**, **22** so that the openings **33** are in axial alignment. First and second coil blocks **41**, **42**, made of some insulating material such as polystyrene, are fastened to the chassis **20** near and between the first and second end tabs **21**, **22** respectively. A first pair of serially connected coils **43**, each of which is wound about a cylindrically shaped coil form **44**, is embedded in the first coil block **41**, and a second pair of serially connected coils **45**, each of which is also wound about a coil form **44**, is embedded in the second coil block **42**. As shown in Figs. 1 and 2, the coils **43**, **45** are spaced and physically dimensioned so that when the electromechanical filter **10** is mounted and fastened, each of the transducers **14**, **16** passes through one of the coil forms **44** and is electrically coupled to a respective one of the coils **43**, **45**. The coils **43**, **45** are connected to insulated terminals **46** on the chassis **20** by lead wires **47**. These terminals **46** pass through the chassis **20** to provide external connections for the coils **43**, **45**. If desired, electrical damping resistors **48** may be coupled to each pair of coils **43**, **45**, as

shown in Figs. 1 and 2. The first and second pairs of transducers 14, 16 are magnetically biased by biasing magnets 50, each of which is held fastened to an adjustable bracket 51 by some means such as the set screws 52. The brackets 51 in turn are fastened to their respective side tabs 23, 24 by some means such as the screws 53 which pass through the slots 25 in the side tabs 23, 24. This arrangement permits the bias magnets 50 to be moved up or down in their brackets 51, and permits the brackets 51 to be moved toward or away from their respective transducers 14, 16. Also, the brackets 51 may be rotated.

A metallic brace 54 for protecting the electromechanical filter 10 against extreme transverse shocks without interfering with the operation of the filter 10 is fastened to the chassis 20 midway between the end tabs 21, 22. A perspective view of the brace 54, and its position on the chassis 20, is shown in Fig. 4. The brace 54 has a transverse circular opening 55 that has a diameter slightly greater than the diameter of the resonators 11 which it surrounds. Thus, the brace 54 provides a limit beyond which the central portion of the filter 10 cannot be deformed. If this limit is less than the elastic limit of the filter material, the filter 10 will be protected against permanent deformations. The opening 55 in the brace 53 has a slot 56 on one side to permit a coupler 12 to be passed through it. This facilitates assembly by permitting the brace 54 to be mounted or removed without disturbing the filter 10.

One of the clamps 31, 32, preferably the clamp 32 nearest the transducers 16 which serve as the output transducers, is electrically insulated from its end tab 22 by a strip 60 of electrically insulating material. This arrangement provides only one ground connection for the electromechanical filter 10, namely through the other end tab 21. This arrangement reduces magnetic coupling between the first and second pairs of coils 43, 45 and sharply steepens the edges or slopes of the band-pass characteristic of the filter. The screws 35 for fastening the insulated clamp 32 to its end tab 22 are also insulated by a sleeve 61 of electrically insulating material.

The brass chassis 20 is welded to a metallic base 70 comprising a flat sheet of steel having dimensions slightly greater than those of the chassis 20, and having its edges bent upward as shown in Figs. 1 and 2 to provide a flange or a rim 71. If the base 70 is used, the insulated terminals 46 also extend through it. The entire assembly may be protected from dust and moisture by a metallic cover 72 which is placed over the assembly and soldered or fastened to the rim 71 of the base 70. A small dimple 73 may be put in the cover 72, filled with solder and drilled with a small hole to provide means for filling the assembly with an inert gas and hermetically sealing it.

In embodiments of the invention successfully built and tested, the chassis and tabs, the clamps 31, 32, the brackets 51, and the brace 54 were made of brass. The base 70 and cover 72 were made of steel. The use of brass for the interior components eleminates the adverse effect on the bias magnets 50 which would result from magnetic interior components and allows the filter 10 to be properly terminated, which in turn gives a good response over the passband of the filter. The use of a steel cover 72 and base 70 provides magnetic shielding for the filter 10, which in turn protects the filter from stray external magnetic fields.

The invention claimed is:

1. An electromechanical filter assembly comprising a metallic base, a chassis formed of a sheet of metal that is substantially longer than it is wide and that has integral therewith a first end tab at one end thereof, a second end tab at the other end thereof, a first side tab at one side thereof near said first end tab, and a second side tab at the other side thereof near said second end tab, each of said tabs being bent upward so that their respective surfaces form a right angle with the surface of said chassis, means for fastening said chassis on said base with said tabs extending in the same direction away from said base, first and second clamps each having an opening therein, means for fastening one of said clamps on each of said end tabs respectively on the facing surfaces thereof so that said openings are axially aligned, an electromechanical filter comprising a plurality of cylindrically shaped resonators interconnected by couplers and having a mounting slug fastened thereto at each end thereof and in axial alignment therewith, said electromechanical filter being positioned between said end tabs with said mounting slugs positioned in said openings of said clamps, coils mounted on said chassis between said end tabs, magnetostrictive transducers tangentially fastened at diametrically opposite points on the end resonators of said electromechanical filter and coupled to said coils, and means fastened to each of said side tabs and coupled to said transducers for magnetically biasing said transducers.

2. An electromechanical filter assembly comprising a metallic base, a chassis formed of a sheet of metal that is substantially longer than it is wide and that has integral therewith a first end tab at one end thereof, a second end tab at the other end thereof, a first side tab at one side thereof near said first end tab, and a second side tab at the other side thereof near said second end tab, each of said tabs being bent upward so that their respective surfaces form a right angle with the surface of said chassis, means for fastening said chassis on said base with said tab extending in the same direction away from said base, first and second clamps each having a cylindrically shaped opening therein, means for fastening one of said clamps on each of said end tabs respectively on the facing surfaces thereof so that said openings are axially aligned, means for electrically insulating said first clamp from said first end tab and for electrically connecting said second clamp to said second end tab, an electromechanical filter comprising a plurality of cylindrically shaped resonators interconnected by couplers and having a mounting slug fastened thereto at each end thereof and in axial alignment therewith, said electromechanical filter being positioned between said end tabs with said mounting slugs positioned in said openings of said clamps, first and second coils mounted on said chassis near and between said end first and second tabs respectively, magnetostrictive transducers tangentially fastened at diametrically opposite points on the end resonators of said electromechanical filter and coupled to said coils, and means fastened to each of said side tabs and coupled to said transducers for mechanically biasing said transducers.

3. An electromechanical filter assembly comprising a steel base, a chassis formed of a brass stamping that is substantially longer than it is wide and that has integral therewith a first end tab at one end thereof, a second end tab at the other end thereof, a first side tab at one side thereof near said first end tab, and a second side tab at the other side thereof near said second end tab, each of said tabs being bent upward so that their respective surfaces form right angles with the main surface of said chassis, and each of said side tabs having an elongated slot therein in the longitudinal dimension of said chassis, means for fastening said chassis on said base with said tabs extending in the same direction away from said base, first and second clamps each having a cylindrically shaped opening therein, means for fastening one of said clamps on each of said end tabs respectively on the facing surfaces thereof with said openings axially aligned, means for electrically insulating said first clamp from said first end tab and for electrically connecting said second clamp to said second end tab, an electromechanical filter comprising a plurality of cylindrically shaped resonators interconnected by couplers and having a mounting slug fastened thereto at each end thereof and in axial alignment therewith, said electromechanical filter being positioned between said end tabs with said mounting slugs positioned in said openings of said clamps, a first pair of magnetostrictive transducers tangentially mounted at diametrically opposite points on one end resonator of said electro-

mechanical filter near said first end tab, a second pair of magnetostrictive transducers tangentially mounted at diametrically opposite points on the other end resonator of said electromechanical filter near said second end tab, said transducers being positioned parallel with each other and extending in the same direction from their points of mounting toward said chassis, a first pair of serially connected coils mounted on said chassis and coupled to said first pair of transducers respectively, a second pair of serially connected coils mounted on said chassis and coupled to said second pair of transducers respectively, a brace mounted on said chassis between said first and second pairs of coils, said brace comprising a metallic plate having a circular opening therein of a diameter larger than the diameter of said resonators, said brace being positioned so that one of said resonators is positioned in said opening without touching said brace, and an adjustable bias magnet fastened to each of said side tabs by means of said slots and coupled to said transducers for biasing said transducers.

4. An electromechanical filter as defined in claim 3, wherein said coils are embedded in coil blocks which are positioned on said chassis between said end tabs, said coil blocks being made of an electrically insulating material.

5. A mounting assembly for an electromechanical filter, comprising a steel base, a chassis formed of a brass stamping that is substantially longer than it is wide and that has integral therewith a first end tab at one end thereof, a second end tab at the other end thereof, a first side tab at one side thereof near said first end tab, and a second side tab at the other side thereof near said second

end tab, each of said tabs being bent upward so that their respective surfaces form right angles with the main surface of said chassis and each of said side tabs having an elongated slot therein in the longitudinal dimension of said chassis, means for fastening said chassis on said base with said tabs extending in the same direction away from said base, first and second clamps each having a cylindrically shaped opening therein, means for fastening one of said clamps on each of said end tabs respectively on the facing surfaces thereof with said openings axially aligned, means for electrically insulating said first clamp from said first end tab and for electrically connecting said second clamp to said second end tab, means including a first pair of serially connected coils mounted near said second end tab on said chassis for applying signals to said electromechanical filter, means including a second pair of serially connected coils mounted near said first end tab on said chassis for deriving signals from said electromechanical filter, a brace mounted on said chassis between said first and second pairs of coils, said brace comprising a metallic plate having a circular opening therein that is axially aligned with said openings in said clamps, and adjustable bias magnet fastened to each of said side tabs by means of said slots for biasing said electromechanical filter, and a steel cover positioned over said assembly and fastened to said base.

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