April 18, 1950 P. J. NEILSON 2,504,719

ELECTROMECHANICAL RESONATOR

Filed Oct. 30, 1946

Fig. 1.

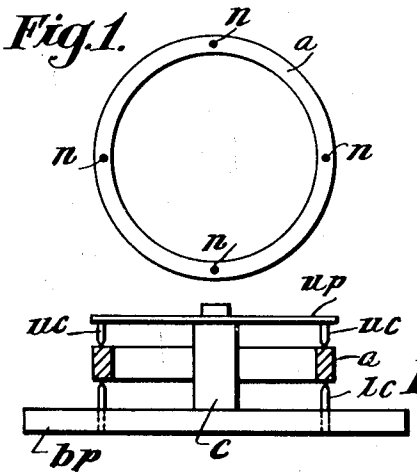


Fig. 1a.

Fig. 4.

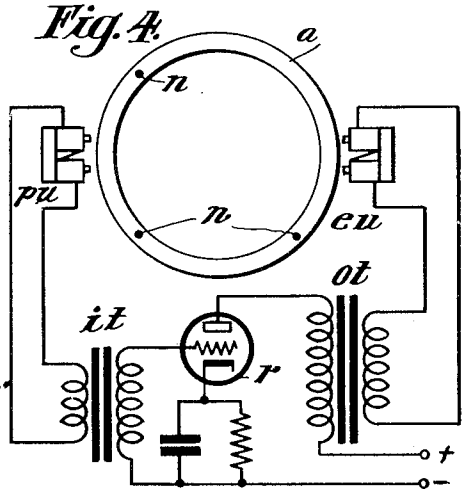


Fig. 2.

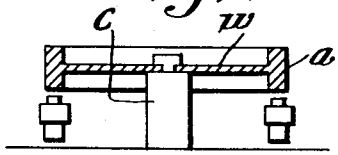


Fig. 3.

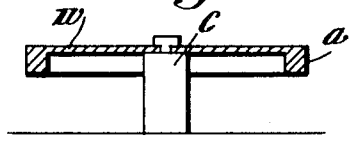
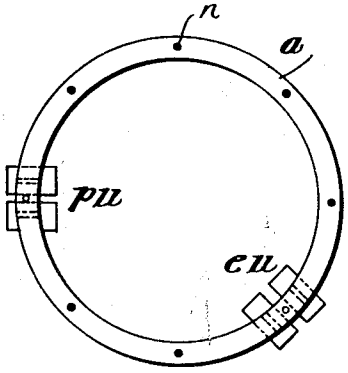


Fig. 5.



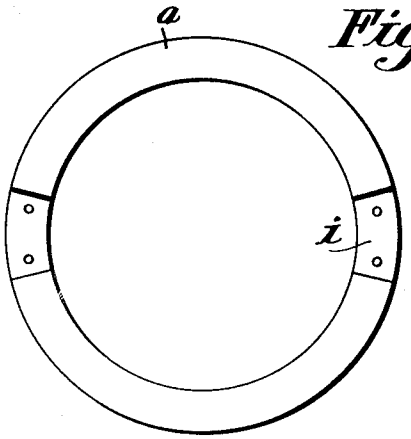


Fig. 6a.

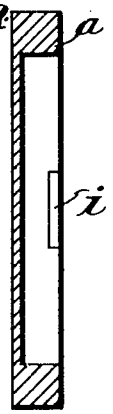


Fig. 6.

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ELECTROMECHANICAL RESONATOR

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8 Claims. (Cl. 171—209)

1

This invention relates to electro-mechanical resonators.

It is perhaps desirable that we should define roughly what, for the purpose of the following description and claims, we mean by the term "electro-mechanical resonator." For our present purpose, then, we may say that an electro-mechanical resonator is the combination of the mechanical analogue of an L/C circuit, hereinafter called the resonant device or simply device and means for exciting the device with oscillation energy of the appropriate frequency. It may constitute a filter circuit, an oscillation generator, an inter-stage coupling, and so forth.

There is a number of kinds of electro-mechanical resonators known in the art, each operating in its appropriate sphere of usefulness. Amongst known electro-mechanical resonators may be mentioned piezo-electric crystal operating at frequencies of approximately 50 kc./s. and upwards, magnetostrictive systems operating in the range of frequencies from approximately 10 kc./s. to approximately 50 kc./s., and tuning fork and reed systems operating in the range of frequencies from approximately 3 kc./s. downwards.

According to this invention an electro-mechanical resonator as defined includes as its resonant device a metallic annulus of or incorporating magnetic material, and electro-magnetic exciting and pick-up units.

The annulus may be supported by means of point contact members or of radial line contact members, in which case these members must be so situated as to occupy positions which, when the resonant device is to be excited at a desired frequency (fundamental or harmonic), will be nodes.

Alternatively and preferably, particularly when the resonant device has to resonate at one of its harmonic frequencies, the annulus may be constructed or provided with a thin interior web and supported at the center of the web. The annulus and web may be so constructed that together they form a shallow cup or that the web is centrally disposed between the two planar surfaces of the annulus.

The relative positions at which the exciting and pick-up devices are situated about the circumference of the annulus will, of course, depend upon the frequency (fundamental or harmonic) at which the electro-mechanical resonator is to operate. If they are situated at a distance equal to an integral number of vibration loops at the fundamental frequency, or in other terminology

2

if they are separated by a distance equal to an integral number of half wavelengths, the resonant device can be excited at its fundamental frequency. This provides a means for adjusting, to some extent, the harmonic at which the electro-mechanical resonator (if constituted as an oscillation generator) shall operate, or (if as a filter, or coupling circuit) the frequency which it shall pass.

The invention is illustrated in the accompanying drawing, wherein:

Fig. 1 shows a plan view of an annulus and manner of support;

Fig. 1*a* is an elevation of Fig. 1, partly in section;

Fig. 2 and Fig. 3 show alternative manner of support and alternative forms (for this manner) which the annulus may take;

Fig. 4 shows the electro-mechanical resonator constituted as an oscillation generator with the exciting and pick-up devices situated for operation at the fundamental frequency;

Fig. 5 shows where these devices might be situated for operation at a harmonic frequency;

Fig. 6 illustrates a plan view of one manner of construction of an annulus; and

Fig. 6*a* is a cross-section of Fig. 6.

In all the figures of the drawing, the annulus is indicated at *a*.

In Fig. 1, annulus *a* is supported between four lower and four upper contact members *lc* and *uc* (of which only two are visible), the positions of the four supporting points being indicated at *n*, which, of course, become nodes at the fundamental frequency. The four lower contacts project upwards from a base plate *bp* and the four upper ones depend from an upper plate of "spider" *up*. The upper plate or spider is supported on a column *c*.

In Figs. 2 and 3, annulus *a* is provided with a thin web *w*. In Fig. 2 the web *w* is centrally disposed between the planar surfaces of the annulus. In Fig. 3 it is so situated as to be coplanar with one of these surfaces. In both these figures the web is centrally supported on a column *c*.

In Fig. 4 is shown the circuit for an oscillation generator embodying the invention. An exciting unit *eu*, consisting of a winding surrounding a polarized core, is situated near to one of the vibration loops. This exciting unit is coupled to the anode circuit of a valve *r* (shown as a triode) by means of an output transformer *ot*. A pick-up unit *pu* (also consisting of a winding surrounding a polarized core) is situated near to another of the vibration loops, the two vibra-

tion loops being diametrically opposite to each other. The pick-up unit is coupled to the grid/cathode circuit of the valve by means of an input transformer *it*. It will be apparent that the resonant device including the exciting unit, annulus, and pick-up unit provide feedback from the anode to grid of the valve. The two units being situated at positions which are vibration loops at the fundamental frequency, the oscillation generator will operate at the fundamental frequency.

If, as indicated in Fig. 5, the exciting unit and the pick-up unit are so situated that they are separated from each other by distances which do not equal an integral number of vibration loops, or in other terminology of half wavelengths, at the fundamental frequency, the annulus will vibrate at some frequency other than the fundamental (such as 3F, 6F, 9F and so on) according to the relative positions of the units (F being the fundamental frequency).

The annulus may be of magnetic material, or, if it is of some material other than a magnetic one, it may be provided with insets *i* of magnetic material (see Fig. 6).

What is claimed is:

1. An electro-mechanical resonator arrangement including as its resonant device a metallic annulus incorporating magnetic material, a coaxial support column for said annulus, and electro-magnetic exciting and pick-up units adjacent different points on said annulus.

2. A resonator as claimed in claim 1, wherein the annulus is supported by means of point contact members secured to said support column.

3. A resonator as claimed in claim 1, wherein the annulus is supported radially outward from said support column by means of radial line contact members.

4. A resonator as claimed in claim 1, wherein the annulus is constructed or provided with a thin interior web and supported at the center of the web by said support column.

5. A resonator as claimed in claim 1, wherein

the annulus and a web are so constructed that together they form a shallow cup.

6. A resonator as claimed in claim 1, wherein the annulus and a web are so constructed that the web is centrally disposed between the two planar surfaces of the annulus.

7. An electro-mechanical resonator arrangement comprising a base, a support column secured to said base, a plate supported by said column, an annular magnetic resonant ring located coaxially with respect to said support column and positioned between said plate and said base, a plurality of point support members secured to said base and having points contacting a side of said ring, a corresponding number of point support members secured to said plate and contacting the other side of said ring.

8. An electro-mechanical resonator arrangement comprising a base, a support column secured to said base, a plate supported by said column, an annular magnetic resonant ring located coaxially with respect to said support column and positioned between said plate and said base, a plurality of point support members secured to said base and having points contacting a side of said ring, a corresponding number of point support members positioned in the same straight lines with said first mentioned point support members and contacting the other side of said ring.

PHINEAS JACK NEILSON.

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