

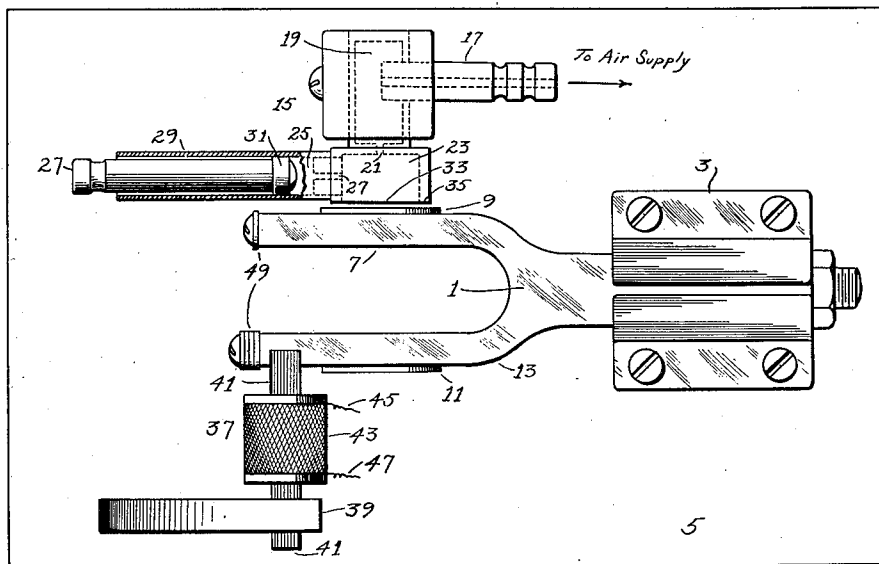
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# AIR DRIVEN TUNING FORK

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## AIR DRIVEN TUNING FORK

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The present invention relates to a method and means by which a tuning fork, or the like, may be used to produce electrical oscillations of a frequency suitable for synchronizing rotating or vibratory apparatus used particularly in conjunction with facsimile and television systems. While the invention will herein be described particularly in its relationship to facsimile and television systems, it is to be distinctly understood that the invention is not limited thereto but may likewise be applied to other uses where it is necessary and desirable to supply electrical oscillations of a predetermined and constant frequency value for all purposes.

As a preliminary object of our invention, we have sought to develop a method and means by which tuning forks and the like may be driven without any substantial mechanical restraint.

Still a further object of our invention is to provide a method and means for driving tuning forks, and the like, in which there is a total absence of electrical or mechanical connections for producing vibrations therein, and in which an air drive is supplied for vibrating the fork.

Still another object of our invention is to produce a driving means for tuning forks, and the like, in which the air is supplied through a chamber broadly resonant to the fork frequency. By providing a chamber broadly resonant to the fork frequency rather than exactly corresponding to the fork frequency, it will be seen that such a drive does nothing more than improve the general efficiency of the entire arrangement rather than actually control the frequency of vibration.

Still another object of our invention is to produce an arrangement for driving tuning forks, and the like, in which there is high efficiency, and an arrangement in which the output energy produced by converting the mechanical vibrations of the fork into electrical oscillations will appear as a sine wave substantially free from harmonics.

Still another object of our invention is to provide a means for producing constant frequency oscillations in which substantially no

adjustments are required from day to day to maintain a constant frequency.

Still other objects of our invention are to provide a method for driving tuning forks and the like, which is simple in its arrangement and construction, a system which is compact, easily installed, conveniently operated, cheaply installed, readily set up and fool-proof in operation.

Still other and ancillary objects of our invention will become apparent and at once suggest themselves to those skilled in the art to which the invention relates by making reference to the accompanying drawing of which the single figure thereof illustrates in a diagrammatical manner a preferred embodiment of a fork driving means of the character above set forth.

Now referring more particularly to the invention and to the modification set forth by the accompanying drawing, a tuning fork 1 is rigidly mounted from a supporting bracket 3 held and supported by a base member 5 of any desired type and description. Upon one tine 7 of the fork 1, we have mounted a disk member 9 for a purpose to be hereinafter further set forth. In order that the weight of the disk member 9 may be balanced accurately, we have provided a second disk member 11 carried and supported from the other tine 13 of the fork 1, although this disk forms no part of the particular drive system herein set forth only in so far as the general efficiency of the arrangement is concerned.

Adjacent the tine 7 carrying the flat disk member 9, we have provided a resonant air chamber, generally designated 15, to which air at a predetermined pressure (2 pounds per square inch, for example,) is supplied from an intake tube 17 connected to an air supply (not shown). Air entering the intake tube 17 is directed through an opening through this tube into a chamber 19 which may be made broadly resonant to the fork frequency by moving the intake tube 17 in or out of the air chamber 19 in any desired manner. For convenience of illustration, an adjustment of the tube 17 has not been illustrated on the drawing, but it is to be understood that that tube may be threaded into the air chamber 19

so that as it is screwed in or out the volume of air space provided in the chamber 19 is decreased or increased in proportion.

As air leaves the chamber 19 through the small opening 21, it enters a second air chamber 23 which connects with still another air chamber 25 through a small opening 27. The two air chambers 23 and 25 together constitute a second air chamber which is broadly resonant to the natural frequency of the fork. As was described in connection with the adjustment of the tube 17 with respect to the air chamber 19, we may also adjust the resonant period of the combined air chambers 23 and 25 by means of a plunger 27 capable of being moved in or out of the sleeve portion 29 forming an extension of the air chamber 25. The plunger 29 is provided with a packing 31 to prevent the escape of air therefrom when air is forced into the air chambers 23 and 25 upon leaving the chamber 19 through the opening 21.

There is provided a relatively large opening 33 at the end of the air chamber 23 adjacent the disk 9 carried by the tine 7 of the fork. This large section of the outlet of the air chamber 23 is ground accurately to be flat and opposed to the outer ring of the disk of the fork. The purpose of this construction is to give a fairly long path from the air in the center of the chamber to the outer air. If this path is made relatively long, it is not necessary for the tine of the fork to approach the chamber as closely in order to cut down the escape of the air. We have found this to be a very important feature of the construction since if the disk is set very close to the air chamber, which would be necessary with a small covering ring of the air chamber and the disk in opposition to each other, the closer the two would have to be brought together to cut off the air sufficiently with the induced vibrations of the fork.

With the orifice 21 made extremely small, the air entering is of such a small amount that a definite reflection of the air occurs where this air enters. For best action, it is found that the orifice 21 should be located near the back of the air chamber so that the air enters the chamber in puffs to reinforce the vibrations in the air chamber.

It will be seen if the disk on the fork tine 7 is placed too close to the air chamber that it will, as the fork 1 begins to vibrate due to the puffs of air projected thereagainst, move over to such a position as to touch against the mouth of the air chamber. Several methods may be provided for overcoming this effect, the first of which is to place the disk fairly near the base of the fork, as has been shown, so that the movement thereof is relatively small, and by making the mouth of the air chamber larger to compensate for the increased pressure necessary to drive the fork in this position, and a second method would

be to provide a wider lip portion 35 at the mouth of the air chamber so that it is unnecessary to have the disk as close to the mouth as previously and still get sufficient control of the air escape, and this likewise provides somewhat of an air cushion to prevent excessive vibrations of the fork. Such precautions are not sufficient on very low frequency forks with large amplitudes. For such a type of fork, it is advantageous to add a rubber buffer near the end of the tine (not shown). This does not begin to function unless the vibration exceeds a definite amount, and if soft rubber is used for such a stop on the disk 9 provided on the fork tine 7, this will not interfere materially with a good sine wave vibration of the fork.

As a means for picking up the mechanical energy developed through the vibration of the fork, we have provided an electromagnetic pickup system generally designated as 37, and may preferably consist of a double coil arrangement (only one of which is shown) in which a permanent magnet 39, preferably of the horseshoe type, is provided to energize laminated pole pieces 41 arranged above and below the outer tine 13 of the fork 1. These pole pieces should preferably be placed at a position about half way from the end of the fork tine to the location of the vibration disks so that the change in the flux produced herein by the tine moving in and out is approximately linear with movement of the fork. The air drive and buffer, if necessary, are placed upon what we may term the inner tine 7 of the fork, and the outer tine 13 then is provided with a magnetic pickup. Surrounding the laminated pole pieces 41, we have provided an electromagnetic pickup coil 43 to which conductors 45 and 47 are connected for the purpose of utilizing the energy developed therein through changes of flux produced in the pole pieces 41 by vibration of the fork.

Also mounted upon the ends of the fork tines 7 and 13, we have provided washers or other equivalent weights 49 for the purpose of compensating for variations in fork length or weight so that even vibration of the fork is produced at all times. It is preferable to mount the fork in a container to which a thermostat of well known type is attached so that variations in temperature, which would tend to affect the fork frequency, may be compensated and thus the fork is capable of producing constant frequency vibrations for long periods of time without any substantial attention being paid thereto.

Other arrangements of the drive system herein set forth will at once suggest themselves to those skilled in the art to which our invention has been directed, and we, therefore, believe ourselves to be limited in what modifications we may make only in so far as

the spirit and scope of the hereinafter appended claims necessitates.

Having now described our invention, what we claim and desire to secure by Letters Patent is the following:

1. A drive means for tuning forks and the like including means for projecting air at predetermined uniform time intervals upon one of the tines of a tuning fork and thereby producing vibrations from said tuning fork at the natural period thereof.

2. A drive means for tuning forks and the like including means for projecting air at predetermined uniform time intervals upon one of the tines of a tuning fork and thereby producing vibrations from said tuning fork at the natural period thereof, and means associated with the other tine of said tuning fork for picking up impulses corresponding to the vibrations of the fork and converting the same into electric pulses of a frequency corresponding to the fork frequency.

3. In a synchronizing system, a tuning fork having a flattened surface on one of the tines thereof, an air chamber adjacent said flattened surface, means for supplying air at a predetermined pressure to said air chamber, means for adjusting the resonant period of said air chamber as regards air supplied thereto to a period substantially corresponding to the natural frequency of the said tuning fork, means provided by said air projected from said resonant chamber against the flattened portion of said fork tine for producing vibrations in said tuning fork.

4. In a synchronizing system, a tuning fork having a flattened surface on one of the tines thereof, an air chamber adjacent said flattened surface, means for supplying air at a predetermined pressure to said air chamber, means for adjusting the resonant period of said air chamber as regards air supplied thereto to a period substantially corresponding to the natural frequency of the said tuning fork, means provided by said air projected from said resonant chamber against the flattened portion of said fork tine for producing vibrations in said tuning fork, and means associated with the other tine of said fork for converting vibrations produced in said fork by said air drive into electric currents of a frequency corresponding to the natural frequency of the said fork.

5. A drive means for tuning forks and the like including means for projecting air at predetermined uniform time intervals upon one of the tines of a tuning fork, and thereby producing vibrations from said tuning fork at the natural period thereof, and electro-magnetic pick-up means associated with the other tine of said tuning fork for picking up impulses corresponding to the vibrations of the fork and converting the same into electric pulses of a frequency corresponding to the fork frequency.

6. A system for producing synchronous vibrations which includes a tuning fork having a flattened surface on one of the tines thereof, an open-ended air chamber adjacent the said flattened tine of said fork, means for supplying air at a predetermined pressure to the said resonant air chamber, means for varying the resonant period of said air chamber to said impressed air for making said chamber broadly resonant to the fork frequency, and means provided by the air issuing from said chamber for producing mechanical vibrations in said tuning fork.

7. A system for producing synchronous vibrations which includes a tuning fork having a flattened surface on one of the tines thereof, an open-ended air chamber adjacent one of the tines of said fork, means for supplying air at a predetermined pressure to the said resonant air chamber, means for varying the resonant period of said air chamber to said impressed air for making said chamber broadly resonant to the fork frequency, means provided by the air issuing from said chamber for vibrating said fork, and means associated with the other tine of said tuning fork for converting mechanical vibrations produced in said fork into electric currents of a frequency corresponding to the fork frequency.

8. In a synchronizing system, a tuning fork having a flattened surface on one of the tines thereof, an air chamber adjacent said flattened surface, means for supplying air at a predetermined pressure to said air chamber, means for adjusting the resonant period of said air chamber as regards air supplied thereto to a period substantially corresponding to the natural frequency of the said tuning fork, means provided by said air projected from said resonant chamber against the flattened portion of said fork tine for producing vibrations in said tuning fork, and an electro-magnetic pick-up associated with the other tine of said fork for converting vibrations produced in said fork by said air drive into electric currents of a frequency corresponding to the natural frequency of the said fork.

9. A system for producing synchronous vibrations which includes a tuning fork having a flattened surface on one of the tines thereof, an open-ended air chamber adjacent one of the tines of said fork, means for supplying air at a predetermined pressure to the said resonant air chamber, means for varying the resonant period of said air chamber to said impressed air for making said chamber broadly resonant to the fork frequency, means provided by the air issuing from said chamber for vibrating said fork, and an electro-magnetic pick-up associated with the other tine of said tuning fork for converting mechanical vibrations produced in said fork into electric currents of a frequency corresponding to the fork frequency.

10. A system for producing electrical oscillations of constant frequency for synchronizing purposes and the like which includes a tuning fork, a flattened disk surface positioned on each tine thereof, an open-ended resonant air chamber adjacent the disk on one of said tines, means for supplying air to said resonant chamber, means provided by the air supplied to said resonant chamber for forcing the tine of the said fork away from the said chamber and thereby producing vibrations in said fork, and means associated with the other tine of said fork for converting mechanical vibrations produced in said fork into electrical oscillations of a frequency corresponding to the frequency of the said fork.
11. A system for producing electrical oscillations of a predetermined frequency value which includes a tuning fork, an open-ended resonant air chamber adjacent one of the tines of said tuning fork, means for supplying air at a predetermined pressure to said air chamber, means for varying the natural period of said air chamber for making the said period approximately correspond to the natural period of vibration of the tuning fork, means provided by said open-ended air chamber adjacent the said tine of said tuning fork for producing mechanical vibrations in said fork, and means associated with the other tine of said fork for converting the mechanical vibrations produced therein into electrical oscillations of a vibrational frequency corresponding to the natural frequency of said fork.
12. A system for producing electrical oscillations of constant frequency for synchronizing purposes and the like which includes a tuning fork, a flattened disk surface positioned on each tine thereof, an open-ended resonant air chamber adjacent the disk on one of said tines, means for supplying air to said resonant chamber, means provided by the air supplied to said resonant chamber for forcing the tine of the said fork away from the said chamber and thereby producing vibrations in said fork, and electromagnetic pick-up means associated with the other tine of said fork for converting mechanical vibrations produced in said fork into electrical oscillations of a frequency corresponding to the frequency of the said fork.
13. A system for producing electrical oscillations of a predetermined frequency value which includes a tuning fork, an open-ended resonant air chamber adjacent one of the tines of said tuning fork, means for supplying air at a predetermined pressure to said air chamber, means for varying the natural period of said air chamber for making the said period approximately correspond to the natural period of vibration of the tuning fork, means provided by said open-ended air chamber adjacent the tine of said tuning fork for producing mechanical vibrations in said fork, and means associated with the other tine of said fork for converting the mechanical vibrations produced therein into electrical oscillations of a frequency corresponding to the natural frequency of said fork.
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