May 21, 1957 E. F. PETERSON 2,793,009

MACHINE VIBRATOR

Filed Dec. 2, 1954 2 Sheets-Sheet 1

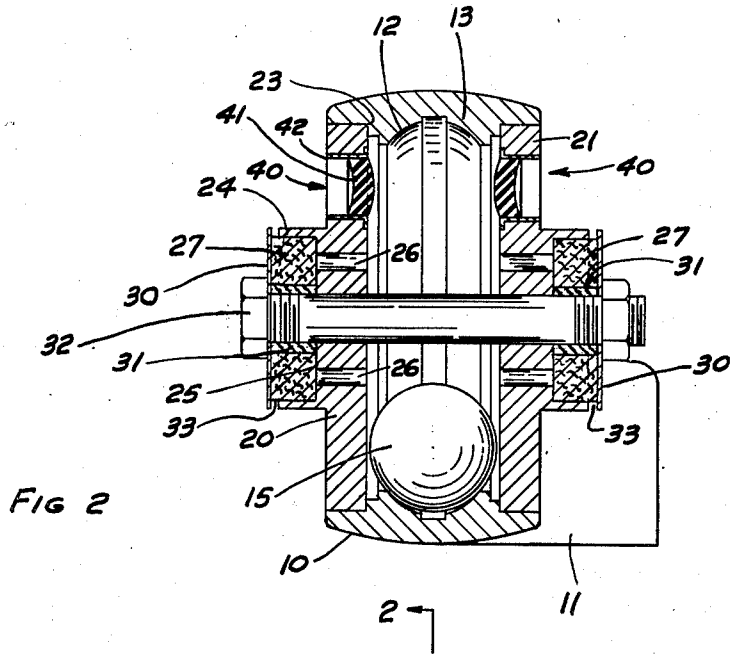


FIG 2

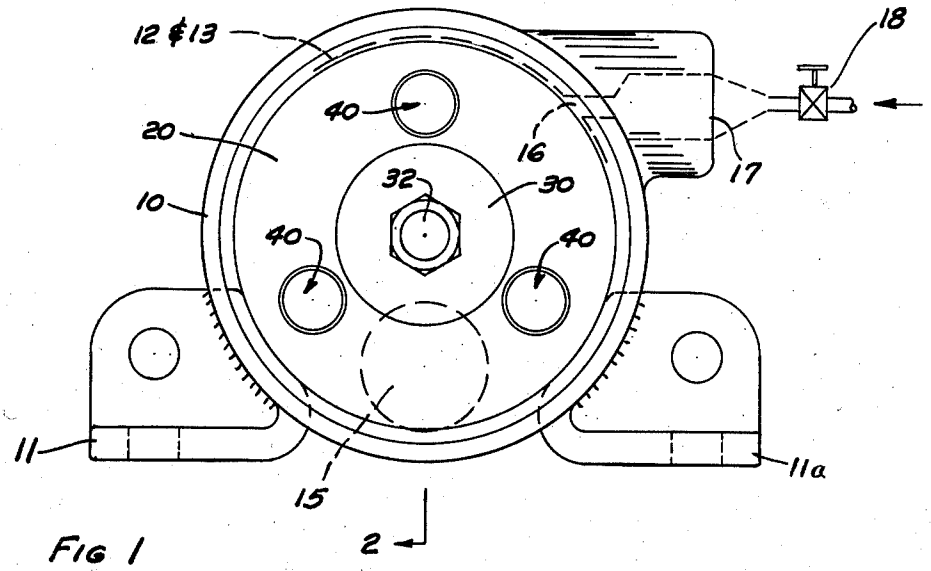


FIG 1

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MACHINE VIBRATOR

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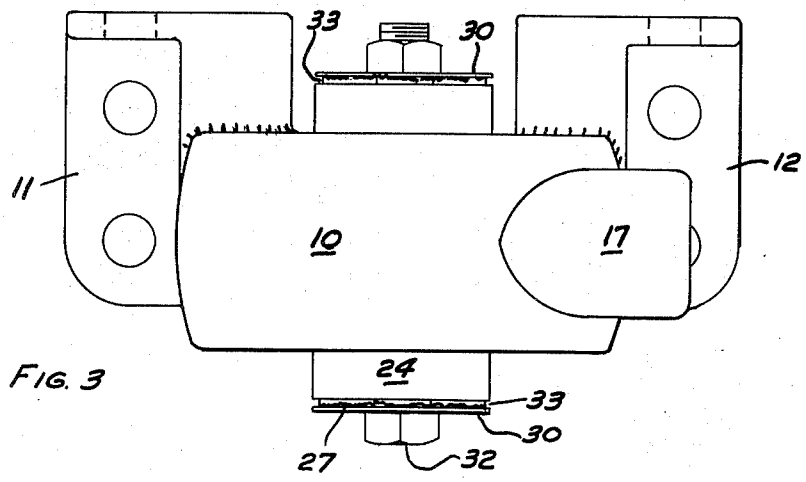


FIG. 3

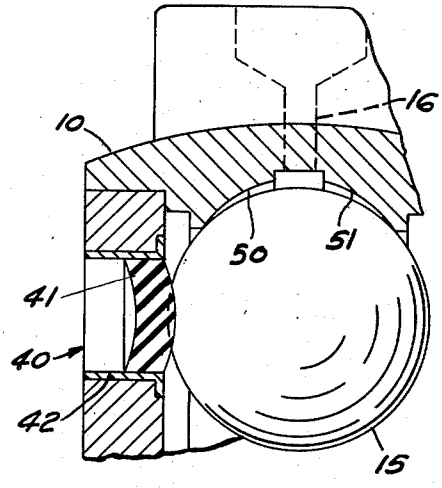


FIG. 5

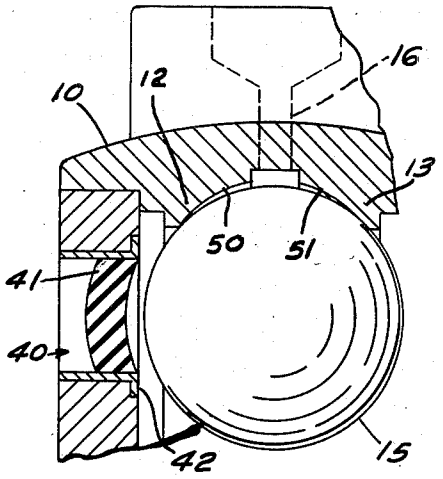


FIG. 4

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United States Patent Office 2,793,009 Patented May 21, 1957

2,793,009

MACHINE VIBRATOR

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Application December 2, 1954, Serial No. 472,690

15 Claims. (Cl. 259—1)

The present invention relates to machine vibrator and more particularly to a vibrator constructed in a new manner to obtain advantages in construction and operation of such a machine vibrator. This invention is in some respects an improvement over inventions of my prior Patents Nos. 2,480,603, 2,518,250, 2,528,319, and 2,535,596.

In the machine vibrator art it is desirable to have a vibrator that may be atached in any of several positions to vibrate machine elements to which the vibrator may be detachably secured. The vibrator is fed from a source of fluid, usually air under pressure, which is introduced tangentially of a generally circular cavity formed within an enclosed body, which jet of air may impinge upon a ball and start up air rotation within the body to drive the ball around an orbital or circular path. The path in this invention consists of a pair of facing curved tracks to be described below.

It has been found that where it is desirable to vibrate a machine for only short periods of time at many different times, that the spherical ball tends to roll around its track some time after the jet of air is turned off. This results in loss of time while the ball rolls to a stop. Accordingly it is one object of the present invention to provide means for automatically stopping the ball when the jet of air is turned off.

In some previous vibrators the use of air has been greater than actually required for driving the ball in the vibrator at the desired speed. Accordingly it is another object of the invention to provide a restricted outlet or exhaust means for a vibrator whereby a suitable positive pressure may be maintained at all times when the jet of air is supplied to the vibrator, which pressure may bleed off to co-operate with the ball stopping mechanism to permit the mechanism to perform its function, while keeping at a minimum the use of air for driving the ball during a period of vibration.

Certain parts of vibrators have been cast heretofore. It has been found that construction is simplified by providing as many parts as possible that are identical and usable in different sizes of vibrators, while still maintaining the desired features of operation such as pointed out above. Accordingly it is a still further object of this invention to provide a closure forming a cavity having raceways cast into one part thereof and having other parts to complete the closure to form the cavity.

It has been found that during prolonged use, the tracks or raceways tend to develop corrugations which gradually build up to render the vibrator less and less efficient. In vibrators that have a flat track or a close pair of tracks there is a further tendency to form a serpentine corrugation or groove, which further reduces the effectiveness of the device. As either type of corrugation builds up or spreads, the rate of deterioration of function becomes increasingly rapid. The two types of corrugation may further attain resonant conditions to each other to cause very rapid deterioration. Accordingly it is a further object of this invention to provide tracks of improved form to

greatly reduce the rate of build up of corrugations to prolong the useful life of a vibrator.

Other objects and advantages of the invention reside in the details of the construction and arrangement of parts, and will be either obvious or pointed out in the following specification and claims.

In the drawings, Fig. 1 is a side view of my invention;

Fig. 2 is a view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a view looking down upon Fig. 1; and,

Figs. 4 and 5 are partial sectional views showing details of construction and the action of the ball stopping means.

Referring more in detail to the drawings and first to Figs. 1, 2 and 3, a body **10** may have suitable mounting flanges **11** and **11**–*a* cast integrally with the exterior surface thereof and a pair of generally circular raceways or tracks **12** and **13** cast therein. It is to be noted that the material forming the mounting flanges **11** and **11**–*a* has a cross section at the surface of the body **10** that is no greater than the cross sections of the body. By such construction the tendency to cause defects in the material forming the tracks **12** and **13** is reduced to a minimum. Although the entire body may be cast it is to be understood that in its broader aspects, the device would work as well if it were fabricated of different parts than those to be described. However, it has been found that cast raceways **12** and **13** of suitable hardenable casting material may be machined and ground to serve in many applications of the device. For more severe services the raceways of a different hard material may be inserted such as disclosed in the above mentioned patents.

A hard ground ball **15** is adapted to roll upon the tracks **12** and **13**. Air may issue from a jet **16** supplied by a suitable source of fluid supply that is attached to a port **17**. A valve **18** may be provided in the fluid supply to turn the jet on and off. Although air is usually the medium used, it is within the spirit of this invention to operate on any suitable vapor or liquid, under pressure, and I wish not to be limited in the invention only to air which will be referred to frequently in the description.

The air enters through the jet **16** and sets up a high speed vortex of air in the cavity formed by the casting **10** and side walls **20** and **21**. The vortex carries with it the ball **15** upon the tracks **12** and **13**. It has been found that the speed of the ball is substantially the same as the speed of the air in the vortex. Although one wall could be a flat plate within the scope of the invention, for nicety of control of exhaust air and for best ball stopping functions the two walls are shown as identical and hence only one wall will be described in detail.

Wall **20** may be of suitably cast material having a face **23** machined to fit a machined shoulder in the casting **10**. The wall **20** has a boss **24** in which a cavity **25** may be cast or machined. The cavity **25** communicates by ports **26**, of which any suitable number may be provided, with the interior cavity of the vibrator. Fiber silencing pad **27**, which may be of any suitable material and which may vary in porosity to suit the application of the device, is inserted in the cavity **25** and is adapted to be pressed therein by a plate **30** which is spaced by a spacer **31** from the bottom of the cavity **25**. The plate **30** is held down by a bolt **32**, or the like. The spacer **31** is such as to present a suitable opening upon surface **33** of the silencing pad **27** to the atmosphere or can be connected to a suitable return pipe if desired.

The silencer pad **27** serves the dual function of silencing exhaust noises and providing variable amounts of restriction by reason of their controlled porosity in construction, for example, or by the compression of the same by the plate **30**. In different applications it is anticipated that different materials may be more desirable than felt

or fiber, for example. If the driving medium issuing from jet 16 is a liquid, or is hot or poisonous, or if the device is operated in a sterile area, it may be desirable to provide return pipes attached to the exterior of bosses 24 for example. In the event the driving medium is corrosive, all parts should preferably be of a corrosive resistance material, and accordingly it is to be understood that I am not to be limited to a particular material of a particular porosity.

It is necessary however, for proper operation of the ball stopping device when it is used and now to be described, that the restriction provided by pad 27 be such as to build up a predetermined positive pressure within the vibrator cavity when driving medium is admitted under pressure through the jet 16. It is also required that when the driving medium is turned off that the pressure within the body may be exhausted rather quickly within a predetermined time to cause automatic operation of the stopping device.

The operation and construction of the stopping device is best shown in Figs. 4 and 5. Fig. 4 shows the position of a stopping device 40 when the jet 16 is on; and Fig. 5 shows the position when the jet is off. It is to be noted in Fig. 4 that a diaphragm 41 under the influence of pressure within the vibrator is urged outwardly to clear the side of the ball 15 as it rotates on tracks 12 and 13. Referring to Fig. 5 it is seen that when pressure is off the diaphragm 41 will move to its normal position in which it is molded and bonded into a ferrule 42, in which position it will engage the side of the ball 15 in its path of rotation to thereby decelerate same.

The stopping device 40 may be made of any suitable material but is preferably of natural or synthetic rubber or a rubber like plastic material and is cast or bonded into a ferrule 42 in the position shown in Fig. 5. The resiliency of the material 41 and the thickness thereof is selected so as to provide a stopping force to a side, or opposite sides, of the ball 15 when in the position shown in Fig. 5 and of sufficient resiliency so that when the pressure under which it is to be operated is applied it will take substantially the position shown in Fig. 4. It is to be understood that the silencing pads 27 also provide escape of the spent air such that control of the internal operating pressure is obtained. Such resistance to escape of air is matched to the operating pressure of the stopping devices 40 so that the ball 15 can rotate at a proper speed to provide adequate vibration to the machine to which the vibrator is attached while still using a minimum of driving medium supplied to the vibrator.

By the construction of the stopping device 40 shown in Figs. 4 and 5, different ferrules 42 and different materials 41 may be supplied and the ferrule may be pushed out toward the interior of the vibrator and replaced. It is necessary that the walls 20 and 21 be removed to provide this function. However, it is within the spirit of this invention to provide means for mounting the stopping device 40 without disassembling the vibrator such as by screwing them into the side of the wall from the exterior. Any suitable number of stopping devices may be provided and it is found that one will stop a ball satisfactorily but that a pair will stop the same much more quickly. For very rapid stopping, as many stopping devices 40 as can be placed about the path of the ball may be provided.

The tracks 12 and 13 of this invention provide for increased life and improved operation. The ball 15 is of a suitable diameter to clear the walls 20 and 21, and the stopping devices 40 when pressure is supplied to the cavity of the vibrator. The tracks 12 and 13 have surfaces 50 and 51, that are, when finished, hardened and ground to a radius that is slightly less than the radius of the ball 15. Although not to be construed in a limiting sense, it has been found that a cross section radius for the tracks of substantially ninety percent of the radius of the ball works satisfactorily. It has also been found that the tracks 12 and 13 at their outer edges should contact the ball at points spaced approximately ninety degrees on the surface of the ball 15. Such structure eliminates the creation of serpentine corrugations. The concentration of centrifugal and lateral pressures upon the tracks 12 and 13 can be controlled by varying the points of contact above and below this ninety degree value as desired, and the device will operate successfully if there is a wide variation in the spacing of these points.

With the above described structure the ball 15 will work into the track surfaces 50 and 51. Working in of the ball causes the track surface to migrate and widens the contact area toward the center of the plane of the orbit containing the center of the ball 15 until ultimately one hundred percent of the track surface is contacted by the ball. It is to be noted that as the contacted surface widens the force concentration of contact diminishes to prolong the life of the device. It is further to be noted that the ball 15 spins faster with the tracks contacted closer to the center of rotation thereof. This action increases the gyroscopic inertia of the ball to further tend to reduce orbital abberations that contribute to the building up of corrugations.

The above described features can be used to advantage as improvements to many presently known and used vibrators. The features can be used separately or in combination as different applications of vibrators may require. For example, the improved housing is easily cast and machined and different cores can be provided to obtain different tracks, as desired, or to provide for insertion of replaceable tracks. The stopping device 40 can be used with any of many presently used vibrators as long as the outlet of the cavity is suitably restricted. The silencer can serve to advantage even though the restriction function thereof is not necessarily required. The improved tracks can increase the life of operation of substantially any vibrator of the type described. It is to be noted that the stopping devices 40 are arranged with respect to the tracks 12 and 13 so that the lateral force upon the ball applied by a stopping device 40 is absorbed at a favorable mechanical advantage by a track due to the substantially forty five degree angle of contact between the ball and the tracks. In other words, the action and reaction forces intersect at the center of the ball 15 at an obtuse angle. It would be obvious within the scope hereof to cause a stopping device to act upon the ball 15 directly opposite to the point of contact of the ball and track.

While I have shown and described in some detail one modification of my invention, obviously other modifications will occur to those skilled in the art. Accordingly I wish not to be limited in my invention only to the form shown and described but by the scope of the following claims. Material disclosed herein and not claimed appears in continuation in part application Serial Number 644,537, filed March 7, 1957, and entitled, "Machine Vibrator."

I claim:

1. In a fluid pressure operated vibrating device adapted for attachment to a member to be vibrated, in combination, a hollow body having sides and a smooth pair of raceways therein providing a substantially circular path; a ball within said body for rotation upon said path; an inlet including a port for admitting fluid under pressure into said body for creating a fluid vortex in a direction to drive said ball, means for controlling the supply of fluid to said port, fluid restricting outlet means upon at least one side of said body, and means for controlling the rotation of said ball comprising at least one resilient diaphragm member having a plurality of positions dependent upon fluid pressure in said body, one of said positions at a predetermined pressure causing a portion of said resilient member to contact said ball as it rotates upon said path to impede rotation thereof.

2. In a vibrator adapted for attachment to an object to be vibrated, in combination, a hollow metal body having a pair of raceways therein, said raceways being

ground to provide smooth substantially circular surfaces of substantially the same diameters, a spherical ball adapted to roll upon said surfaces in an orbital path, fluid inlet means providing a port for admitting fluid under pressure between said raceways for creating a vortex for driving said ball, means providing a restricted fluid outlet, and means for stopping said ball comprising, at least one resilient pressure responsive diaphragm device having a plurality of positions, one of said positions in the presence of fluid pressure being such that said ball will not engage said device when it moves along said path, and another of said positions in the absence of fluid pressure being such that said ball will engage said device when it moves along said path to decelerate said ball.

3. In a fluid pressure operated vibrating device adapted for attachment to a member to be vibrated, in combination, a hollow body having sides and a smooth raceway therein providing a substantially circular path; a ball within said body for rotation upon said path; an inlet including a port for admitting fluid under pressure into said body to create a fluid vortex in a direction to drive said ball, means for controlling the supply of fluid to said port; fluid outlet means upon at least one side of said body comprising, means forming a cavity in said one side, a fluid pervious sound silencing medium of predetermined fluid flow resistance compressed in said cavity, cover means for said cavity, said cover means having means forming a passageway for fluid out of said cavity, and means for securing said cover upon said cavity; and means for controlling the rotation of said ball comprising at least one resilient rubberlike member having a plurality of positions dependent upon fluid pressure in said body, one of said positions causing a portion of said resilient member to contact said ball as it rotates upon said path to impede rotation thereof, and another of said positions of said resilient member causing said portion not to contact said ball as it rotates.

4. In a vibrator adapted for attachment to an object to be vibrated, in combination; a hollow metal body having a pair of tracks therein, said tracks being ground to provide smooth substantially circular surfaces of substantially the same diameters, a spherical ball adapted to roll upon said surfaces in an orbital path, fluid inlet means providing a port for admitting a fluid under pressure between said tracks for creating a vortex for driving said ball, means providing a fluid outlet on a side of said body comprising, means forming a cavity, at least one port between the interior of said body and said cavity, fluid flow restricting means compressed in said cavity, cover means having means forming a passageway for the escape of fluid from said cavity, and means for securing said cover means upon said cavity; and means for stopping said ball comprising, at least one resilient pressure responsive rubberlike device having a plurality of positions, one of said positions in the presence of fluid pressure being such that said ball will not engage said device when it moves along said path, and another of said positions in the absence of fluid pressure being such that said ball will engage said device when it moves along said path to decelerate said ball.

5. In a vibrator including a perforated walled hollow housing having therein substantially circular tracks, a ball rotatable in an orbit defined by said tracks, a supply of fluid under pressure to the housing to create a vortex within the housing for rotating the ball, and means for restricting the exhaust of fluid from the housing, the combination of; means for impeding rotation of the ball when the pressure in the housing is below a predetermined value, comprising at least one member adapted to seal one of the perforations in a wall of the housing, and a rubberlike resilient diaphragm attached to said member, said diaphragm being mounted adjacent the orbit of the ball to contact the ball only when the pressure in the housing is below a predetermined minimum value.

6. In a vibrator including a hollow housing having therein substantially circular tracks, a ball rotatable in an orbit upon said tracks, and a supply of fluid under pressure to create a vortex within the housing for rotating the ball, the combination of; means for restricting the exhaust of fluid from the housing comprising a silencing medium of a predetermined resistance to fluid flow, means confining said medium to a predetermined geometrical shape; and diaphragm means movable into and out of the orbit of the ball in response to fluid pressure within the housing for impeding rotation of the ball when the pressure is below a predetermined value, said tracks being curved transversely of the orbit of rotation of the ball about a radius less than the radius of the ball and spaced so the ball contacts same at points spaced greater than the radius of the ball.

7. In a vibrator including a hollow housing having therein substantially circular tracks, a ball rotatable in an orbit upon said tracks, and a supply of fluid under pressure to create a vortex within the housing for rotating the ball, the combination of; means movable into and out of the orbit of the ball in response to fluid pressure within the housing for impeding rotation of the ball when the pressure is below a predetermined value, said tracks being curved transversely of the orbit of rotation of the ball about a radius less than the radius of the ball and spaced so the ball contacts same at points spaced greater than the radius of the ball, at least one of said tracks and said movable means being geometrically arranged with respect to each other and said ball so that the direction of force of the action of the movable means through the ball upon the track forms an obtuse angle.

8. In a fluid driven vibrator, in combination, a casing forming a cavity, a pair of spaced tracks defining a circular orbit within the cavity, a ball rotatable upon said tracks, a supply of fluid to the cavity for driving said ball, and an exhaust for venting the cavity; said tracks having surfaces curved transversely of the orbit, the transverse curvature of the surfaces being of a radius smaller than the radius of said ball so that as the tracks are worked in by use the surfaces contacted by the ball will widen toward the plane of the orbit that is traversed by the center of the ball until full track contact is obtained.

9. In a fluid driven vibrator, in combination, a casing forming a cavity, a pair of spaced tracks defining a circular orbit within the cavity, a ball rotatable upon said tracks, a supply of fluid to the cavity for driving said ball, and an exhaust for venting the cavity; said tracks having surfaces curved transversely of the orbit, the transverse curvature of the surfaces being of a radius smaller than the radius of said ball so that as the tracks are worked in by use the surfaces contacted by the ball will widen toward the plane of the orbit that is traversed by the center of the ball during rotation thereof, said ball being sized and said tracks being spaced so that before the tracks are worked in the ball will contact the tracks at points spaced more than half but less than the full diameter of the ball.

10. In a fluid driven vibrator, in combination, a casing forming a cavity, a pair of spaced tracks defining a circular orbit within the cavity, a ball rotatable upon said tracks, a supply of fluid to the cavity for driving said ball, and an exhaust for venting the cavity; said tracks having surfaces curved transversely of the orbit, the transverse curvature of the surfaces being of a radius smaller than the radius of said ball, and said tracks being spaced so that the ball will contact the tracks at points spaced more than half but less than the full diameter of the ball.

11. In a fluid driven vibrator, in combination, a casing forming a cavity, a pair of spaced tracks defining a circular orbit within the cavity, a ball rotatable upon said tracks, a supply of fluid to the cavity for driving said ball, and an exhaust for venting the cavity; said tracks having surfaces curved transversely of the orbit, the trans-

verse curvature of the surfaces being of a radius smaller than the radius of said ball.

12. In a vibrator including a hollow housing having therein substantially circular tracks, a ball rotatable in an orbit upon said tracks, and a supply of fluid under pressure to create a vortex within the housing for rotating the ball, the combination of; means for restricting the exhaust of fluid from the housing comprising a silencing medium of a predetermined resistance to fluid flow, means compressing said medium to a predetermined degree for controlling the resistance thereof, and means movable into and out of the orbit of the ball in response to fluid pressure within the housing for impeding rotation of the ball when the pressure is below a predetermined value, said tracks being curved transversely of the orbit of rotation of the ball about a radius less than the radius of the ball.

13. In a vibrator including a hollow housing having therein substantially circular transversely curved tracks, a ball having a radius greater than the radius of transverse curvature of said tracks and rotatable in an orbit upon said tracks, and a supply of fluid under pressure to create a vortex within the housing for rotating the ball, the combination of; means for restricting the exhaust of fluid from the housing comprising a silencing medium of a predetermined resistance to fluid flow, means confining said medium to a predetermined geometrical shape, and means movable into and out of the orbit of the ball in response to fluid pressure within the housing for impeding rotation of the ball when the pressure is below a predetermined value.

14. In a fluid driven vibrator, in combination, a casing forming a cavity, a pair of spaced tracks defining a circular orbit within the cavity, a ball rotatable upon said tracks, a supply of fluid to the cavity for driving said ball, and an exhaust for venting the cavity; said tracks having surfaces curved transversely of the orbit, the transverse curvature of the surfaces being of a radius smaller than the radius of said ball; said exhaust including a sound silencing member connected to said body.

15. In a fluid driven vibrator, in combination, a casing forming a cavity, a pair of spaced tracks defining a circular orbit within the cavity, a ball rotatable upon said tracks, a supply of fluid to the cavity for driving said ball, and a restricted exhaust port for venting the cavity; said tracks having surfaces curved transversely of the orbit, the transverse curvature of the surfaces being of a radius smaller than the radius of said ball; and fluid pressure operated means for controlling rotation of said ball.

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