June 26, 1923.

1,459,841

B. A. MITCHELL

VIBRATOR FOR SCREENING MACHINES, ETC

Filed Feb. 6, 1919

2 Sheets-Sheet 1

Fig. 1

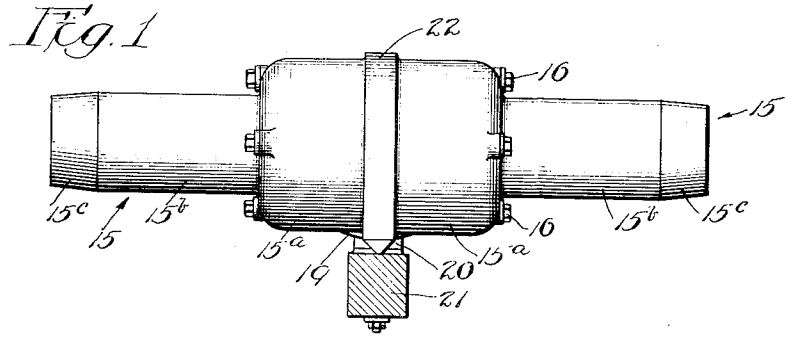


Fig. 2

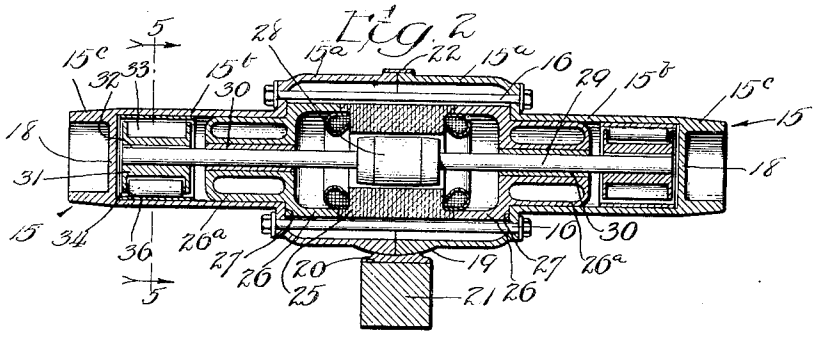


Fig. 3

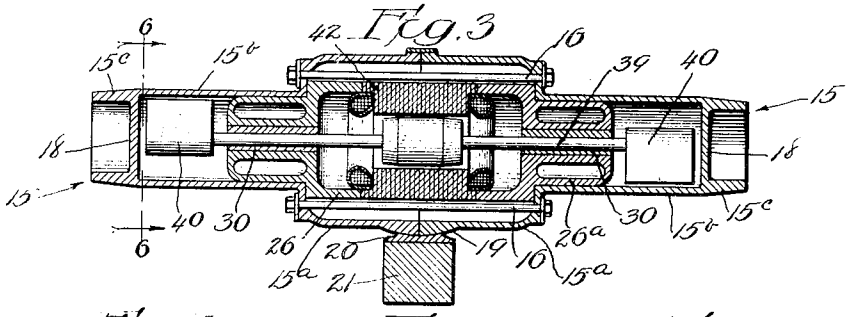


Fig. 4

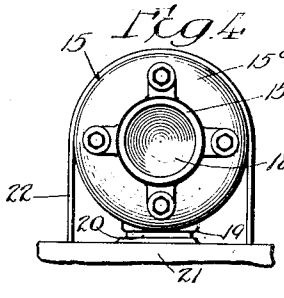


Fig. 5

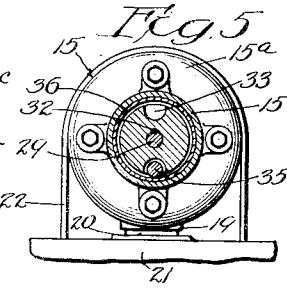
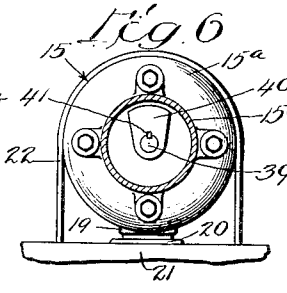


Fig. 6



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2 Sheets-Sheet 2

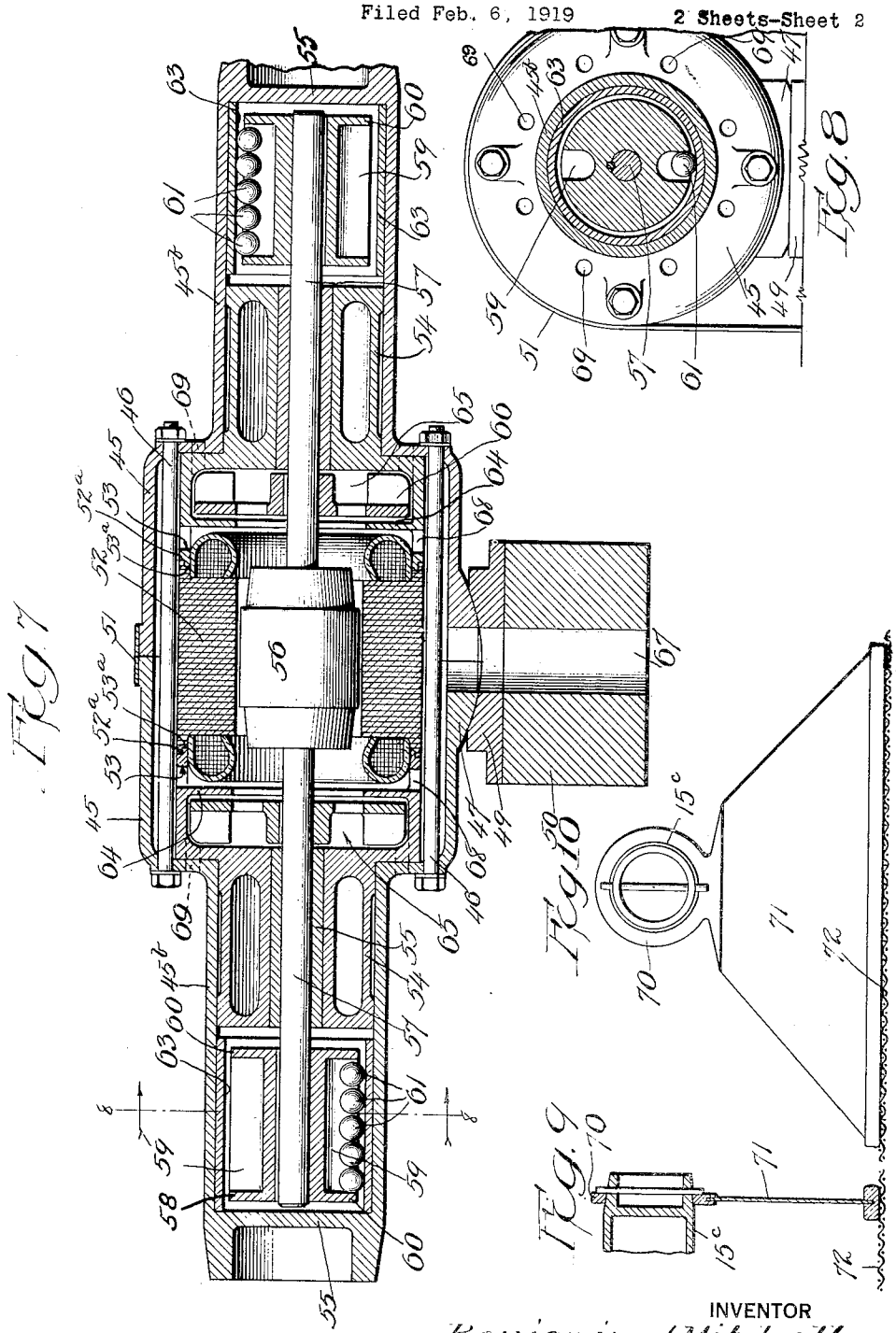


Fig. 7

Fig. 8

Fig. 10

Fig. 9

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UNITED STATES PATENT OFFICE.

BENJAMIN A. MITCHELL, OF GARFIELD, UTAH.

VIBRATOR FOR SCREENING MACHINES, ETC.

Application filed February 6, 1919. Serial No. 275,321.

To all whom it may concern:

Be it known that I, BENJAMIN A. MITCHELL, a citizen of the United States, residing at Garfield, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Vibrators for Screening Machines, Etc., of which the following is a specification.

This invention relates to vibrators, and more particularly to means for producing and applying vibratory and other harmonic motions in the industrial arts.

This invention has for its general object an improved construction and arrangement of parts adapted for producing vibratory and similar motions.

A more specific object is to provide a vibrator capable of producing vibrations varying in direction but executing closed orbits of constrained amplitude.

Another object is to provide a vibrator capable of producing high frequency harmonic motion with a minimum amount of wear on the parts.

Another object is to provide means capable of transforming motion of rotation at high speed into correspondingly rapid reciprocating motion, or one having a reciprocating component.

Another object is to provide an actuating mechanism capable of transmitting harmonic impulses to a restraining structure from a rotating system by means of an intermediate member.

Another object is to provide an arrangement utilizing the principle of rotating moments to produce vibration.

Still another object is to provide an improved device for actuating or oscillating screens, sieves, crushers, or other apparatus where agitation is desired.

Other objects and advantages will in part be specifically pointed out hereinafter and in part obvious from the arrangements and constructions here set forth.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of their application will appear in the appended claims.

For a more complete understanding of the nature and advantages of this invention reference should be had to the following detailed description, which described the best illustrative embodiments of this invention at present known to me, taken in connection with the accompanying drawing in which:

Fig. 1 shows a side elevation of my improved vibrators;

Fig. 2 shows a vertical longitudinal section through one form of my vibrator, the external appearance of which is illustrated in Fig. 1;

Fig. 3 is a longitudinal sectional view similar to Fig. 2, showing a modified form of the invention;

Fig. 4 shows an end view of the vibrator illustrated in Fig. 1;

Fig. 5 shows a transverse sectional view on the line 5—5 of Fig. 2;

Fig. 6 shows a transverse sectional view on the line 6—6 of Fig. 3;

Fig. 7 shows an enlarged longitudinal sectional view similar to Fig. 2, illustrating a third form of the invention;

Fig. 8 shows a transverse sectional view on the line 8—8 of Fig. 7;

Fig. 9 shows a side elevation of one end of the casing illustrating the method of connecting the same to a screen or other object to be vibrated;

Fig. 10 is an end view of the casing showing the apparatus illustrated in Fig. 9.

Referring now to the drawing and in particular to Figs. 1 and 2, 15 denotes the housing for the vibrator which is supported on a seat comprising the spherical protuberance at 19 for engaging with the plate 20 on the support 21, in order that the housing may be free to execute the harmonic motion set up from within by the vibrator mechanism. A strap is shown at 22 merely for the purpose of retaining the housing on its spherical seat.

The housing shown, for the convenience of assembly, is composed of two complementary central portions 15^a which are fitted together and are each provided with the tubular end portions 15^b terminating in tapered extremities 15^c. The two parts of the housing are held together by the bolts 16, the ends of the tubular portions each being closed by a wall 18.

Within the housing, the vibrating mechanism is shown as comprising a rotating element or shaft 29 which may be rotated by any suitable prime mover, as for instance

the electric motor whose stator is indicated at 25 and whose rotor 28 is secured on the shaft. To enable the rotating system within the housing to impart vibration or periodic motion of the desired constrained amplitude to the housing, the shaft 29 is arranged to impel, within the ends of the tubular end portions, means whose centers of mass are eccentric to the axis of rotation in paths which are substantially closed orbits. As indicated in Fig. 2 this means is composed of a pulley-like impeller 31 that is secured to the shaft 29 by keys at 32. The impellers 31 at the ends of shaft 29 are recessed on opposite sides as shown at 33 in order to be mechanically balanced when rotating. To secure the effect of eccentrically disposed mass centers, rollers 35 are shown as disposed in one recess of each impeller. The rollers 35 in the two tubular portions are disposed in diametrically opposite recesses, as shown, for reasons which will become apparent. The housing 15 thus constitutes a restraining structure to keep the rollers 35 in place against the centrifugal forces which tend to throw them out when the system is revolving. Raceways at 36 within the tubular portions are preferably provided for the rollers 35 in order to save their wear directly upon the interior of the housing.

Rigid support for the balanced rotating system within the housing is provided by means of the shells 26 which bear against and compress the stator 25 of the motor, and have shoulders 27 which abut against the interior walls of the housing. These shells terminate in extensions 26^a which protrude into the tubular portions 15^b of the housing 15 and provide journals at 30 for the shaft 29.

In operation the electric motor revolves the rotating system at a high rate of speed, for example, at 3600 revolutions per minute, carrying the rollers 35 around with it in closed orbits about the axis of rotation which may be nearly circular. These rollers are free to move in the recesses in the impellers 31, and in consequence bear outwardly under the influence of the centrifugal forces developed therein by the speed of rotation. The rollers 35 by reason of their diametrical disposition are at the extremities of a line passing through the center of the motor rotor and are hence in effect a pair of conical pendulums impelled with a canstant acceleration from the motor producing an unbalancing couple. The rotating system including the means impelled, the mass centers of which are eccentric to the axis of rotation, as a consequence seeks to revolve about a new axis of rotation. Thus the rotating system which has freedom of motion in a plane transverse to its axis of rotation is accordingly seen to be in a state of unstable equilibrium by reason of this unbalancing couple which is the product of the centrifugal forces acting on the lever arms obtaining along the axis of rotation from the center of the motor rotor to a point intersected by the plane in which the mass center rotates; that is this couple is composed of two rotating moments applied to the system in the same direction which tend to wabble the housing 15 on its spherical seat. These rotating moments, as will be perceived, each operates about an instantaneous axis which rotates with the centrifugal forces but is 90° out of phase therewith. As a consequence the ends of the housing execute harmonic motions of relatively small amplitude in a plane transverse to the axis of rotation with a frequency substantially the same as that at which the motor revolves the rollers 35. From this it will also be perceived that the location and character of the mass centers impelled eccentrically by the rotating system determine the character and amplitude of the harmonic motions executed by the housing.

Moreover it will be understood that in the arrangement here shown the rollers 35 or means whose mass centers are eccentric to the axis of rotation play the rôle of energy transmitters, receiving energy from the balanced part of the rotating system and imparting it to the restraining structure to produce harmonic motion. The rollers 35 thus impelled by the revolving element 29 serve as intermediated members which transmit kinetic energy from the rotating system to the housing 15 in substantially the same manner as that which takes place from bullets to ballistic pendulums.

In Figs. 3 and 6 there is illustrated a modified form of the invention which is similar to that above described, but differs mainly in the arrangement of the means employed to give the effect of eccentrically revolving mass centers. Instead of using rollers as at 35 driven by an element 29, a pair of unbalanced weights 40 are used which are located 180° apart on opposite ends of the shaft and are secured thereto by keys 41. As the shaft 39 rotates due to the operation of the motor here designated 42, the unbalanced weights 40 cause vibrations to be set up within the casing similar to those produced by the operation of the apparatus illustrated in Figs. 1, 2, 4, and 5, since the centrifugal forces acting on the mass centers result in the rotating moments which produce vibrations in accordance with the principle of this invention.

In Figs. 7 and 8 of the drawing there is illustrated still another embodiment of the invention which is the form at present preferred by me. In this construction the complementary parts form a housing 45 which parts are secured together by bolts 46 and have protuberances forming a spherical projection 47 seated in a recess formed in a

plate 49 mounted on the supporting member 50; the strap 51 being used to secure the housing to the support in the manner previously described. The stator frame 52 of an electric motor is mounted within the housing 45 of the vibrator and is clamped in position between the bearing shoulders 53 which are provided with annular flanges 53^a at their inner ends adapted to interfit with corresponding flanges 52^a formed on the motor frame. The bearing shoulders 53 abut against the shoulders at the ends of the central portions of the housing 45 and are provided with tubular projections forming bearings 54, which extend into and closely fit into the cylindrical portions 45^b of the housing. The ends of these cylindrical parts 45^b are closed by the end walls 55. The rotor 56 of the motor is mounted within the stator frame 52 and is keyed on a shaft 57, which is journaled in the bearings 54 and extends into the spaces between those bearings and the end walls 55, which spaces are occupied by the impellers 58. These impellers are provided on opposite sides with slots or grooves 59 which are closed at their ends by the flanges 60 and which are adapted to receive a plurality of balls 61 to supply the means whose mass centers are to be eccentric to the axis of rotation. These balls 61 are carried outwardly by centrifugal force when the shaft 57 is rotating and travel on the inner surface of the cylindrical raceways 63 which are mounted within the housing. As the shaft 57 rotates, these balls bear against the raceways 63 applying the centrifugal forces engendered therein which result in the rotating moments that produce high frequency harmonic motions in the housing which vibrates with increasing amplitude toward its outer ends so that the resulting motion generates two oppositely disposed cones having their apices substantially meeting at the middle point of the motor directly above the support 50. In this embodiment of the invention each bearing shoulder 52^a is provided with an inwardly extending flange 64 adjacent to the motor winding so that a chamber 65 is formed between each of these flanges and the adjacent bearing 53.

In this form of the invention it is also advantageous to employ means for ventilating the motor and vibrator housing. To this end fan wheels 66 are keyed on the shaft 57 within these chambers 65 and the rotation thereof produces a circulation of air which is adapted to cool the motor. This air is drawn in through a channel 67 which extends upwardly through the base 50. The air then flows through passages in the plate 49 and the spherical projection 47 which are in register. The air then flows into the space around the connecting bolts 46, from which it passes out through the port 68 into the spaces around the motor winding from whence the warm air is drawn out by the suction of the fan wheels and is carried off through the ports 69 which extend outwardly through the bearing shoulders and through radially extending walls of the castings 45 inwardly of the bolts 46.

In Figs. 9 and 10 there is shown the details of an arrangement adapted for applying the vibrations produced by these vibrators to a screening cloth or other medium which is to be vibrated. The arrangement shown comprises clamping rings 70 which are adapted to fit the tapered extremities of the vibrator housing which are secured thereto by transverse keys or other fastening means. These clamping rings are secured to plates 71 or other substantially rigid transmitting elements which bear upon the surface of the screen cloth 72 and transmit the high frequency vibrations thereto, the screen cloth being preferably held under tension such that the natural period of vibration resulting from such tension is resonant with the frequency of the vibrations applied by the vibrator, whereby the vibrations produced in the screen have substantially maximum amplitude and are transmitted to all parts of the screening surface substantially without nodes.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In combination, a rotating system mounted to have freedom of motion in a plane transverse to the axis of rotation, and means mechanically free of said system, and impelled thereby adapted to provide an eccentrically disposed mass center, whereby a moment having a rotating instantaneous axis is set up producing harmonic motion by said system in closed orbits transverse to said axis.

2. In combination, a rotating system mounted to have freedom of motion in a plane transverse to the axis of rotation, a balanced impeller adapted to rotate with said system, and means mechanically free

and driven by said impeller adapted to provide a center of mass disposed eccentrically to the axis of rotation, whereby a moment having a rotating instantaneous axis is set up.

3. In combination, a rotating system mounted to have freedom of motion in a plane transverse to the axis of rotation, a recessed impeller adapted to rotate with said system, and a freely movable means whose mass center is eccentric to said axis disposed in a recess of said impeller, whereby said means functions to transmit energy centrifugally for producing rotating moments that set up harmonic motion by said system in closed orbits transverse to said axis.

4. In combination, a rotating system mounted to have freedom of motion in a plane transverse to the axis of rotation, a recessed impeller adapted to rotate with said system, a ball disposed in a recess of said impeller with its mass center eccentric to said axis, and a restraining structure adapted to receive energy from the ball when rotating.

5. In combination, means for applying vibrations, a housing mounted to execute vibratory motions, a rotating element within said housing, an impeller having a recess secured on said element, and means having mass disposed in said recess arranged when rotated to emerge therefrom and apply a harmonic impulse of constrained amplitude to said housing.

6. In combination, means for applying vibrations, a housing having a universal support, a rotating element within, a prime mover for revolving said element, a recessed balanced impeller secured to said element, a member having mass disposed in said recess, and a raceway within said housing arranged to restrain said member to a predetermined course about the axis of rotation and arranged to apply the centrifugal thrust of said member when rotating to said housing whereby a rotating moment results producing a harmonic movement of said housing on its support.

7. A vibrator comprising a rotatable balanced impeller, and a freely movable member driven thereby and arranged to have its mass center eccentric to the axis of rotation and to develop centrifugal force for producing vibration without strain on the impeller parts.

8. A vibrator comprising a rotatable balanced impeller provided with a recess, and a ball disposed in said recess and arranged when driven to develop centrifugal force for producing vibration without strain on the impeller parts.

9. A vibrator comprising a rotatable impeller, and freely movable means having a mass center disposed eccentrically and arranged to be driven by said impeller whereby harmonic impulses are transmitted therefrom.

10. A vibrator comprising a restraining structure, a rotatable impeller within the structure, means for rotating said impeller, and a freely movable eccentric mass arranged to be urged by said impeller against said restraining structure.

11. A vibrator comprising a restraining structure, a balanced recessed impeller within the structure, means for revolving the impeller and a free eccentric mass disposed in a recess of said impeller and arranged to be urged by said impeller against said restraining structure.

12. A vibrator comprising a housing, a rotating element mounted within said housing, and members driven by said rotating element through small orbits within said housing for imparting a vibration to said housing without radial stress upon said rotating member.

13. A vibrator comprising a housing, a shaft mounted in said housing, means for driving said shaft, an impeller mounted on said shaft, and rolling members driven by said impeller and exerting radial forces on said housing for imparting thereto a vibration.

14. A vibrator comprising a housing, a shaft mounted in said housing, a balanced impeller mounted on said shaft and having recesses in opposite sides thereof, a rolling member mounted in one of said recesses, and a circular raceway adapted to coact with said rolling member and to transmit to said housing the vibrations produced by the rotation of said member.

15. A vibrator comprising a housing, a shaft mounted in said housing, driving means connected to the middle part of said shaft, and means connected to opposite ends of said shaft for imparting harmonic motion to said housing without producing radial strains upon said shaft.

16. A vibrator comprising a housing, a support to which the middle part of said housing is secured, a shaft mounted in said housing, revolving members connected to the opposite ends of said shaft for producing circular vibrations in said housing without producing radial strains upon said shaft, and means for connecting the free ends of said housing to the device to be vibrated.

17. Apparatus of the class described, comprising a vibrator housing, a shaft rotatably mounted in said housing, means for driving said shaft, a balanced impeller rigidly attached to each end of said shaft, members driven by said impellers to impart uniform circular vibration to said housing, and means for attaching said housing to the device to be vibrated.

18. Apparatus of the class described, com-

prising a vibrator housing, a rotating element mounted within said housing, a prime mover connected to said rotating element at its middle point, an impeller secured to each end of said rotating element, rolling members driven by said impellers but unconnected thereto, said rolling members being driven in an orbit by said impeller and thereby causing said vibrator housing to vibrate in a closed path, and means for connecting said vibrator casing to the device to be vibrated.

19. Apparatus of the class described, comprising a vibrator housing, a balanced rotating shaft mounted in said housing, a prime mover connected to said shaft, a balanced impeller secured to said shaft, rolling members within said impeller but having free radial movement with respect thereto, a cylindrical raceway secured to said vibrator housing and adapted to receive the radial thrust of said rolling members as said impeller rotates, and means for transmitting the vibrations set up by said housing to the device to be vibrated.

20. Apparatus of the class described, comprising a vibrator housing, a balanced rotating shaft mounted within said housing, a prime mover for driving said shaft, an impeller secured to each end of said shaft, rolling members mounted within said impeller with their centers of gravity lying outside of the axis of rotation of said impeller, the rolling members mounted in one impeller being disposed 180° from the rolling members mounted in the other impeller, a raceway secured to said housing to receive the radial thrust of said rolling members, and means to connect said vibrator housing to the device to be vibrated.

21. Apparatus of the class described, comprising a vibrator housing of tubular form, a shaft mounted in said housing coincident with the axis thereof, a prime mover connected to the middle point of said shaft within said housing, an impeller secured to each end of said shaft within said housing, raceways mounted in fixed position with respect to said housing around said impellers, spherical members mounted in said impellers with the center of gravity of the group of members in each impeller located exteriorly of the axis of rotation of said impeller, the center of gravity of one group of members being disposed 180° from the center of gravity of the members in the other impeller, and a fixed support connected to the central part of said housing whereby the free ends of said housing vibrate in circular paths having amplitudes increasing toward the ends of said housings.

22. Apparatus of the class described, comprising a housing comprising two complementary parts, removable bearing members mounted in said parts, a prime mover mounted between said bearing members and connected to said shaft, means for securing the complementary parts of said housing together and simultaneously securing said prime mover and said bearing members in position, and means connected to the ends of said shaft for producing vibrations.

23. Apparatus of the class described comprising a housing of tubular form comprising two complementary parts, each of said parts comprising a cylindrical portion and an enlarged portion, means for securing the enlarged portions of said complementary parts together, bearing shoulders mounted in the enlarged portion of said housing and having bearing members extending into said cylindrical portions, a shaft journaled in said bearing members, a prime mover mounted in the enlarged portion of said housing and connected to said shaft, and means connected to the ends of said shaft for producing vibrations by said housing.

24. Apparatus of the class described comprising a vibrator housing, bearing members mounted in said housing, a shaft journaled in said bearing members, a motor mounted in said housing with its rotor fixed on said shaft, means actuated by said shaft for ventilating said motor, and means having eccentric mass centers secured to said shaft for producing vibrations by said housing.

25. In a vibrator, including in combination, a frame, a rotor mounted to rotate with respect to said frame in running balance and an independent mass interposed between the rotor and the frame and revolved by the rotor to impart periodic vibration to said frame upon rotation of said rotor.

26. In a vibrator, including in combination, a frame, a rotor mounted to rotate with respect to said frame in running balance, an independent mass interposed between the rotor and the frame and revolved by the rotor to impart periodic vibration to said frame upon rotation of said rotor, and electromagnetic means for rotating said rotor.

In testimony whereof, I have subscribed my name.

BENJAMIN A. MITCHELL.