Jan. 3, 1939. E. B. JORGENSEN 2,142,273

VIBRATING MACHINE

Filed March 9. 1936 4 Sheets-Sheet 1

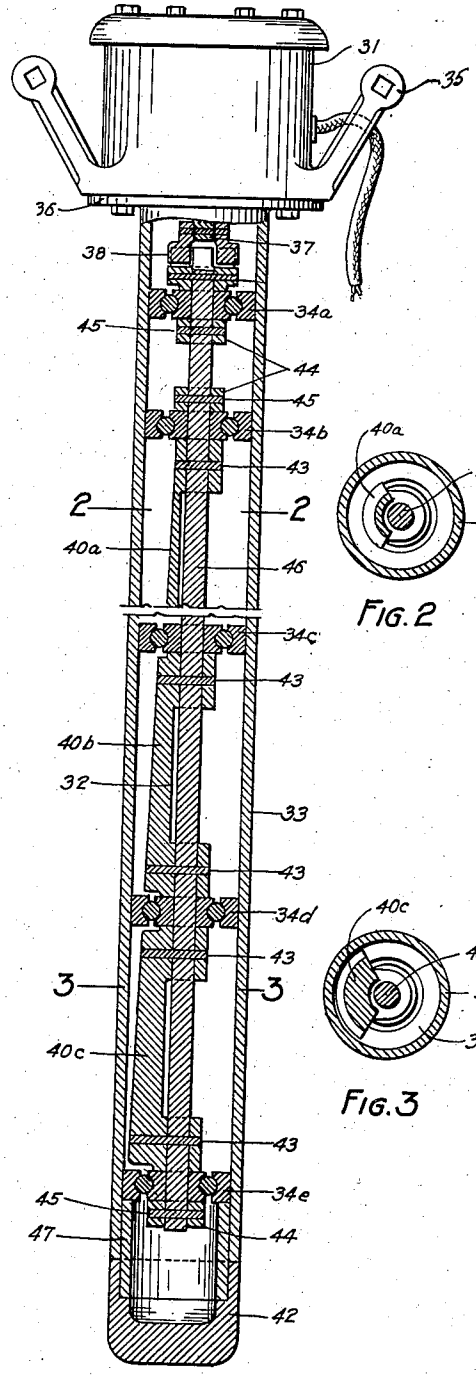


FIG. 1

FIG. 2

FIG. 3

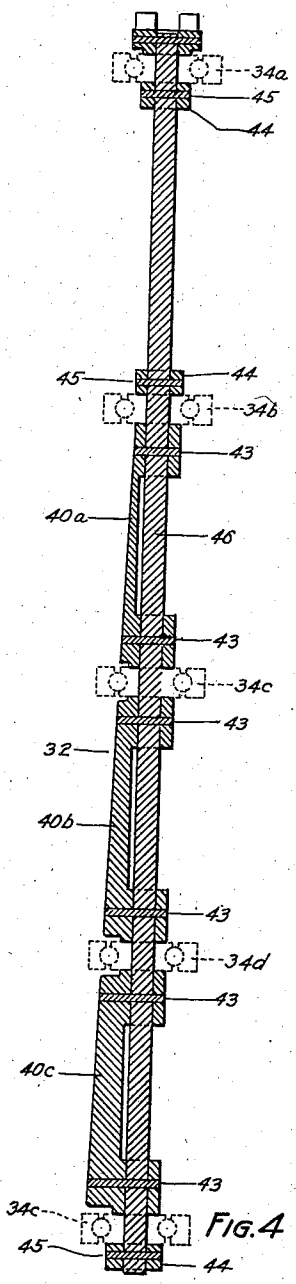


FIG. 4

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VIBRATING MACHINE

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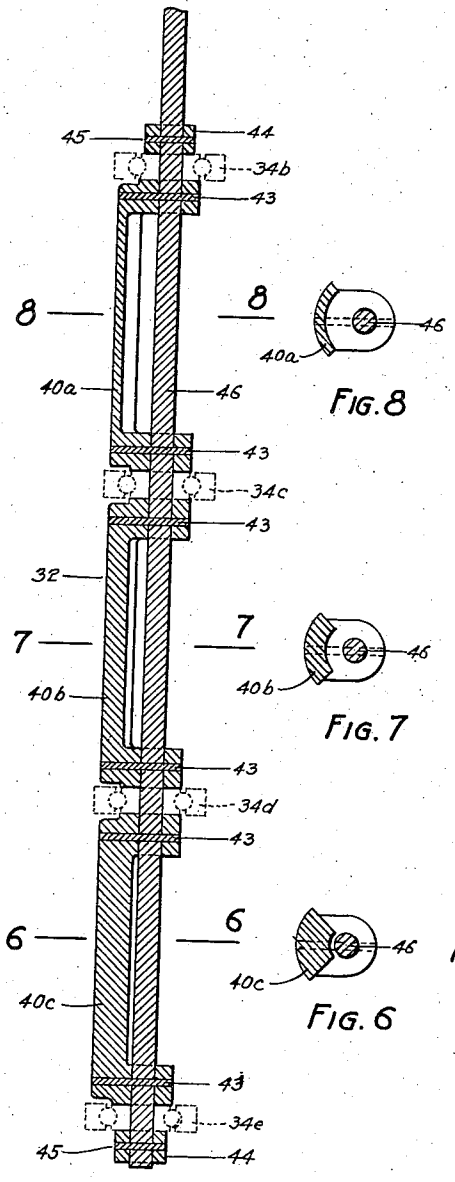


FIG. 8

FIG. 7

FIG. 6

FIG. 5

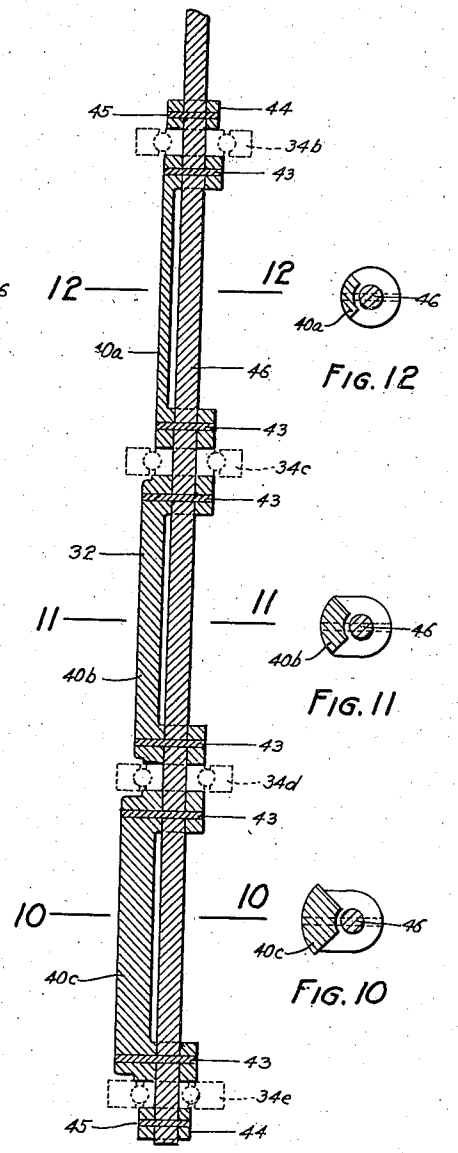


FIG. 12

FIG. 11

FIG. 10

FIG. 9

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Jan. 3, 1939. E. B. JORGENSEN 2,142,273

VIBRATING MACHINE

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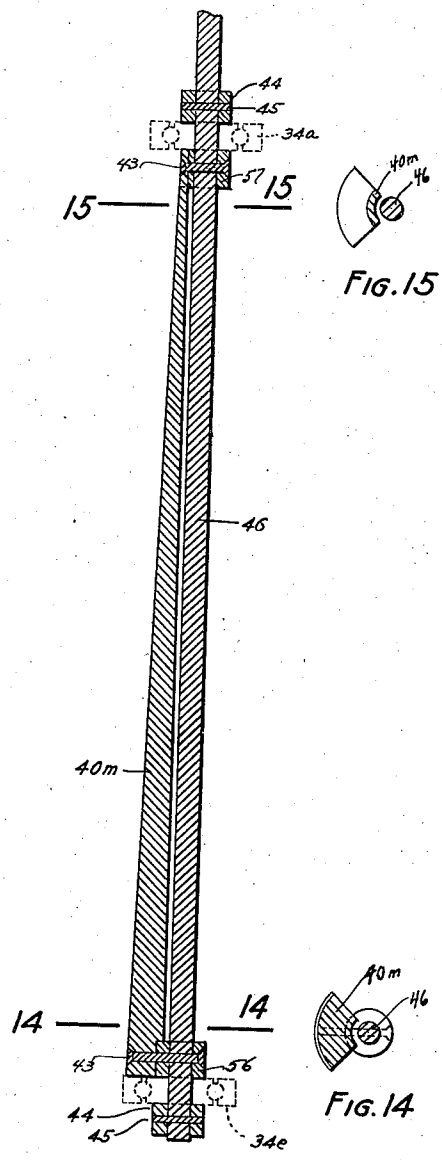


FIG. 13

FIG. 15

FIG. 14

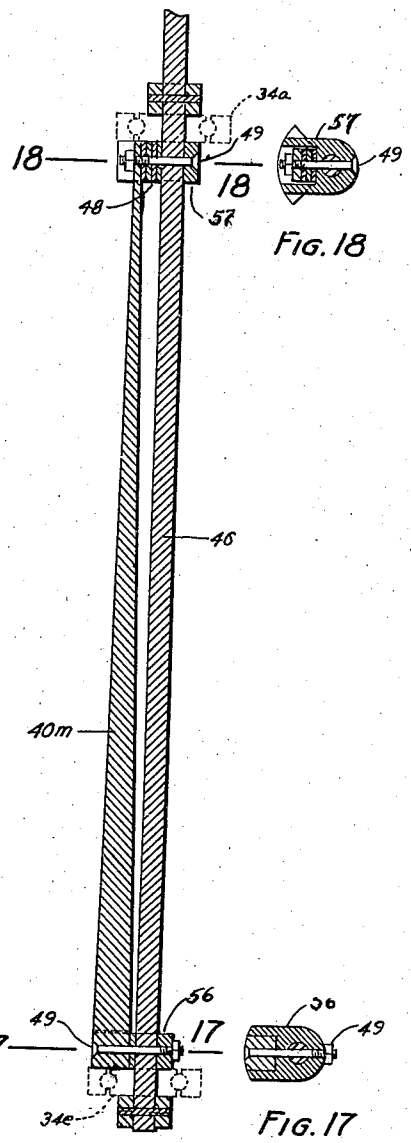


FIG. 16

FIG. 18

FIG. 17

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Jan. 3, 1939. E. B. JORGENSEN 2,142,273

VIBRATING MACHINE

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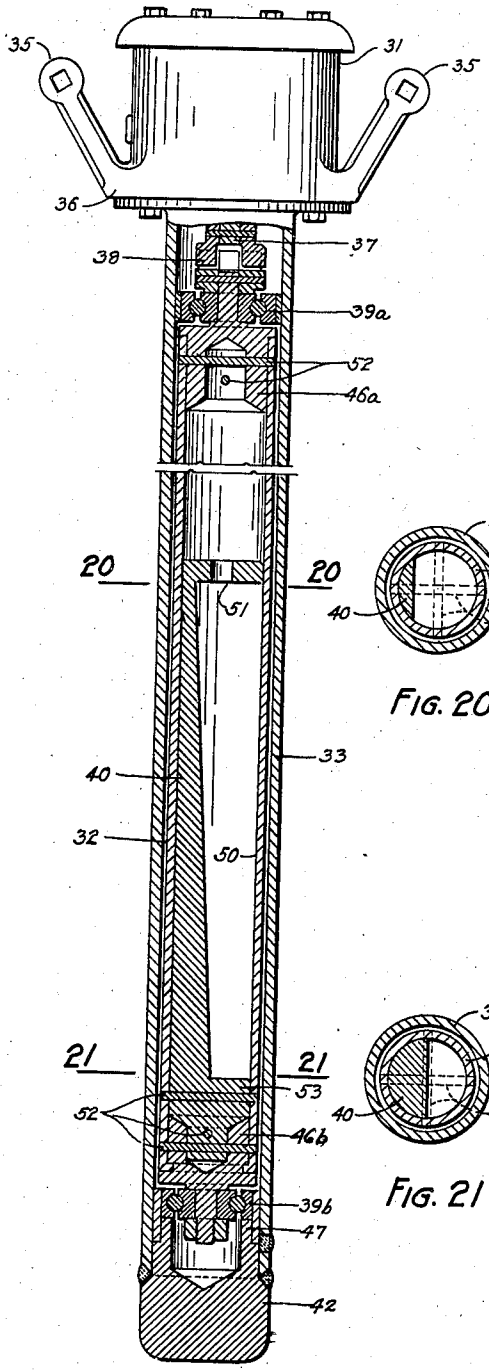


FIG. 19

FIG. 20

FIG. 21

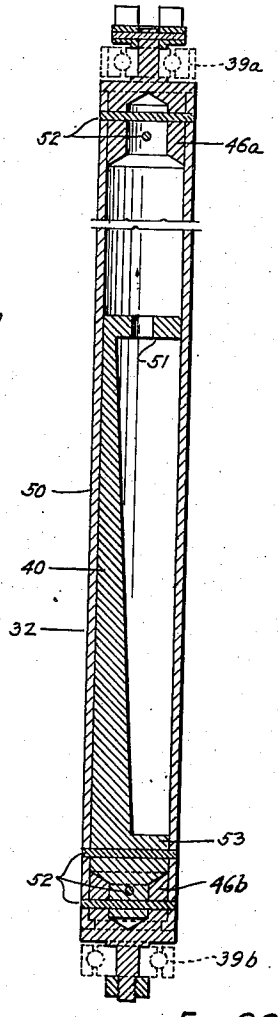


FIG. 22

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Patented Jan. 3, 1939 2,142,273

UNITED STATES PATENT OFFICE

2,142,273

VIBRATING MACHINE

Enoch Berg Jorgensen, Los Angeles, Calif., assignor, by mesne assignments, to Viber Company, Los Angeles, Calif., a corporation of California

Application March 9, 1936, Serial No. 67,928

10 Claims. (Cl. 259—1)

My invention relates to machines for vibrating cementitious mixtures such as concrete, and in particular to an elongated eccentric weight mechanism which may be inserted within the unset concrete and which produces high frequency vibration of low amplitude.

The object of my invention is to provide a vibrating machine which efficiently generates smooth, high-frequency, low amplitude vibrations in which the positions of maximum and minimum intensities of vibration are localized and controlled. Another object is to provide a vibrating machine in which the maximum intensity of vibration is developed in the portion of the machine insertible in the mixture to be vibrated, while the minimum intensity of vibration is developed near the motor or supporting means of the machine. Still another object of my invention is to provide means, in an eccentric weight vibrator, for controlling the positions of maximum and minimum vibrations. A further object of my invention is to provide eccentric weights for vibrator mechanisms of such relative dimensions and shapes that the position of minimum vibration and maximum vibration may be controlled. These and other objects will be apparent from the description and drawings, in which—

Fig. 1 is a side elevation, partly in section, showing one form of my improved vibrator having multiple eccentric tapered weights.

Fig. 2 is a cross section taken on the line 2—2 of Fig. 1.

Fig. 3 is a cross section taken on the line 3—3 of Fig. 1.

Fig. 4 is a section of a tapered three-weight assembly on a shaft, with phantom bearings shown.

Fig. 5 is a section of a graduated multiple weight assembly on a shaft the outer surfaces of the eccentric weights being the same distance from the shaft.

Fig. 6 is a cross section taken on the line 6—6 of Fig. 5.

Fig. 7 is a cross section taken on the line 7—7 of Fig. 5.

Fig. 8 is a cross section taken on the line 8—8 of Fig. 5.

Fig. 9 is a section of a graduated multiple eccentric weight assembly on a shaft, the outer surfaces of the weights being at decreasing distances from the shaft (starting from the lower weight).

Fig. 10 is a cross section taken on the line 10—10 of Fig. 9.

Fig. 11 is a cross section taken on the line 11—11 of Fig. 9.

Fig. 12 is a cross section taken on the line 12—12 of Fig. 9.

Fig. 13 is a section of a single tapered-weight rotor, the thickness and mass of the eccentric weight decreasing progressively from bottom to top.

Fig. 14 is a cross section taken on the line 14—14 of Fig. 13.

Fig. 15 is a cross section taken on the line 15—15 of Fig. 13.

Fig. 16 is a section of a single tapered-weight rotor, the eccentric weight having decreasing thickness and mass from bottom to top but having the eccentricity of the weight adjustable by means of adjustable mounting distances from the axis of rotation.

Fig. 17 is a cross section taken on the line 17—17 of Fig. 16.

Fig. 18 is a cross section taken on the line 18—18 of Fig. 16.

Fig. 19 is a side elevation, partly in section, showing another form of my improved vibrator having a tapered weight and having decreasing eccentricity from bottom to top of the rotor.

Fig. 20 is a cross section taken on the line 20—20 of Fig. 19.

Fig. 21 is a cross section taken on the line 21—21 of Fig. 19.

Fig. 22 is a section showing the eccentric rotor of Fig. 19.

In general, my vibrating machine comprises a high-speed rotary means 31, an elongated eccentrically weighted rotor 32, enclosed within a tubular vibratile casing 33, and suitable bearings 34 (*a*, *b*, *c*, *d* etc.) supported by the casing 33 for the high speed rotation of the rotor 32. Because the rotor 32 is eccentrically weighted relative to the axis of rotation, vibration is set up when it is rotated, the vibrations being transmitted through the bearings 34 to the casing 33, and from the casing to the concrete mixture or the like into which the vibrator tube may be inserted.

In my copending application for patent Serial No. 60,127, filed January 21, 1936, I have disclosed an improved rotor having a multiplicity of eccentric weights attached to a shaft, these weights being adjustable as to position along the shaft so as to produce zones of maximum and minimum intensities of vibration at desired locations within the machine. I have now discovered that the vibrator mechanism may be still further improved in efficiency, smoothness of operation, freedom from bearing troubles, and localizing of the ones

of maximum and minimum intensity of vibration by the use of multiple eccentric weights, or of single eccentric weight, so designed that, considering unit sections taken at right angles to the axis of rotation, the centrifugal force is greatest near the position desired for maximum intensity of vibration, and is least near the position desired for minimum intensity of vibration, and the centrifugal forces (for such unit sections) decrease more or less regularly from the position of maximum intensity to that of minimum intensity.

In a preferred form of my invention, referring specifically to Figs. 1, 2, 3 and 4, my vibrator consists of the rotary means **31**, which as illustrated is a high speed electric motor, having handles **35** attached to its housing **36**. The motor shaft **37** is connected in operative relation to the shaft **46** of the elongated eccentric rotor **32** through a flexible coupling **38**. Bearings **34** support this shaft **46** at the ends of the tapered eccentric weights **40** (*a*, *b*, *c*, *d*, etc.), the bearings fitting within and being supported by the elongated vibratile, tubular casing **33** attached at one end to the motor housing **36** and closed at the other by the nose piece **42**. The tapered eccentric weights **40** are so shaped that if the truncated cone of revolution which they would describe when rotated were projected to an apex, this apex will be located approximately at the center of the base of the motor, or near the supports or handles, where the minimum vibration is wanted. The weights **40** are attached to the shaft **46** by any suitable means, that shown being by means of pins **43** through the weights, weight supports and the shaft. Collars **44**, attached by pins **45** at the upper and lower ends respectively, of the weight assembly, and near the flexible coupling **38** serve to keep the parts assembled, and the thrust collar **47** near the bottom of the casing **33** holds the assembly in position in the tubular casing. The eccentric weighting of the shaft may be brought about by a multiplicity of weights, preferably with bearings between them as shown in Figs. 1, 2, 3 and 4, or a single weight member **40***m* attached by supports **56** and **57** may be used, as shown in Figs. 13, 14 and 15.

When rotated at high speed, the eccentrically weighted rotor **32** produces high frequency vibrations which are transmitted to the casing **33**, and by it to the concrete or other material into which the tubular casing **33** is inserted. With the tapered weights as described, the greatest intensity of vibration is near the end farthest from the motor, and the minimum vibration is at the motor and handles, which is desired for practical operation.

This improvement and these results may be accomplished by other equivalent forms of eccentric weights assembled as rotors, since it is believed that the peculiar focusing or localizing of the vibrational energy by the above described preferred embodiment of my invention is related to the decreasing centrifugal forces of the eccentric weights on the shaft, from the lower end (maximum intensity) to the upper end (minimum intensity). The centrifugal force, of any unit section, depends not only upon the mass which lies outside the center of rotation, but also upon the distance which the gravitational center of that mass lies from the axis of rotation.

Figs. 9, 10, 11 and 12 show another arrangement of multiple weights on a shaft, in which the "tapering" of the centrifugal force is by steps, the eccentric weights **40**, (*a*, *b*, *c*, *d*, etc.) being successively smaller (from bottom to top) but describing, on rotation, substantially cylindrical paths; and the distances from the axis of the several centers of mass also decrease successively in the same order.

Figs. 5, 6, 7 and 8 show still another arrangement of multiple weights on a shaft in which the outside paths of rotation are cylinders of substantially uniform diameter, but the weights **40** (*a*, *b*, *c*, *d*, etc.) are successively decreasing in effective eccentric mass (from bottom to top) while the distances from the axis of the centers of mass decrease only slightly successively in the same order.

Figs. 16, 17 and 18 show a single eccentric weight member **40***m* which upon revolving describes an outer truncated cone of revolution whose projected apex does not lie in or near the motor, and an inner inverted cone of revolution; the greatest eccentric mass with the shortest radius of rotation around the axis being near the bottom, and the least eccentric mass and longest radius of rotation being near the top, with graduations intermediate, so that the resultant effect gives maximum vibration intensity at the bottom, and minimum vibration intensity near the top. The distances from the axis of rotation of the ends of the weight member **40***m* are adjustable as indicated in Figs. 16, 17 and 18, in which the end supports **56** and **57** are recessed, and the positions of the ends of the weight relative to the axis of rotation are adjustable by means of varying thicknesses of shims **48** in the bottoms of the recesses or notches, the ends of the weights being secured to the end supports **56** and **57** and to the rotor shaft **46** by suitable means such as the screw bolts shown at **49**. This adjustability permits definite localizing of the positions of maximum and minimum intensities of vibration for each particular combination of parts in a particular vibration machine.

Figs. 19, 20, 21 and 22 show another vibrator in which the eccentric weight tapers from the lower end to the upper portion of the vibratile tube, but which describes an outer cylindrical figure of rotation. The rotary means **31** has a housing **36** with attached handles **35** and has attached to it a tubular vibratile casing **33** having a nose piece **42** closing the lower end of the casing, and providing a thrust collar **47** to support the lower bearing **39***b* for the stub rotor shaft **46***b*. The rotor **32** (Fig. 22) consists of a cylindrical tube **50**, an eccentric weight **40** attached to the inner surface of the tubular rotor, the thickness of the eccentric weight tapering from bottom to top, or having decreasing mass from top to bottom, and having a cylindrical supporting ring **51**, preferably made integral, at its upper end to reenforce and to hold the eccentric weight in position in the tube **50**; the lower end **53** of the eccentric weight being enlarged to fit inside of the tube **50** and adapted for attachment thereto and to the lower stub shaft **46***b* by the pins **52**. In the upper end of the tube **50** is attached a stub shaft **46***a*, which is enlarged to fit and to be attached to the upper end of the tube **50** by the pin **52**. This upper stub shaft **46***a* rotates in the bearing **39***a* and is operatively connected to the motor shaft **37** by the flexible coupling **38**.

By using elongated eccentric weights designed to give increasingly greater centrifugal forces from top to bottom, that is having greater "eccentricity", as described, I have found that vibrators for the internal vibration of such materials as unset concrete are greatly improved in efficiency. In one case I have been able to do the same amount of work in placement and consolidation

of material with a one and one-third horsepower motor driving a vibrator mechanism employing my improved type eccentric weights having graduated "eccentricity", as compared with three and one-half horse-power motor required to drive a similar machine but not having the tapered eccentric weights. I may therefore decrease the total weight of the machine and thereby improve manual handling and efficiency, or with the same power I may do additional work. In addition, the upkeep of bearings and other parts is greatly reduced because the vibration is localized where it is most useful, less useless vibration is generated and the vibration is smoother and of higher efficiency.

In this specification and claims the term "eccentricity" is used to designate the dynamic property of masses or portions of masses revolving "off-center" at high speed, and involves not only the weight or mass of material which is dynamically unbalanced in an eccentrically loaded rotor, but also the distance of the masses away from the axis of rotation.

While I have described and illustrated several modifications of my improved vibrators and vibrator rotors, I do not limit myself to these particular forms, but restrict my invention only in so far as is necessitated by the prior art and by the spirit of the appended claims.

I claim:

1. In a vibratory mechanism, an eccentrically weighted rotor consisting of a shaft, an unbalancing weight member whose mass per unit length between supporting means increases from end to end, and adjustable attaching means for supporting the ends of said weights at variable distances from the axis of rotation of said shaft.

2. A rotor for a vibrating machine consisting of a shaft and an eccentric weight of tapering mass attached to said shaft, and two or more axial supporting members disposed lengthwise on said shaft for holding said tapering weight to said shaft, said weight being proportioned so that when rotated the centrifugal force generated increases gradually from one weight end to the other.

3. A rotor for a vibrating machine consisting of a shaft, eccentric weights of tapering moments of inertia, and two or more axial supporting members disposed lengthwise on said shaft for holding each of said weights of tapering moments of inertia to said shaft, said weights being proportioned and placed along said shaft so that when rotated the centrifugal force generated increases uniformly from one end weight to the other.

4. A rotor for a vibrating machine consisting of an elongated shaft, a plurality of eccentric weights for attachment to said shaft, each of said weights having a tapered eccentricity from its one end to the other end, and two or more axial supporting members disposed lengthwise on said shaft for holding each of said eccentric weights to said shaft, the said weights being disposed and attached on said shaft so that the eccentricity of the whole assembly increases from one end weight to the other.

5. A vibrating mechanism consisting of high speed rotary means, a housing for said rotary means, a vibratile tubular casing attached at one end to said housing and adapted to transmit vibrational energy from its free end to the surrounding medium, an elongated shaft in said casing, bearings for said shaft supported by said casing, flexible coupling means for operatively connecting the shaft of the rotary means to the elongated shaft, and a tapered eccentric weight attached to said shaft, said weight being characterized by having greater eccentricity at the end away from the rotary means, and lesser eccentricity at the end adjacent the rotary means, whereby, by high speed rotation, maximum intensity of vibration is generated near the free end of the tubular casing, and minimum intensity of vibration is generated near the attached end.

6. A vibrating mechanism comprising high speed rotary means, a housing for said rotary means, a vibratile tubular casing attached at one end to said housing and adapted to transmit vibrational energy from its free end to the surrounding medium, an elongated shaft in said casing, bearings for said shaft supported by said casing, flexible coupling means for operatively connecting the shaft of the rotary means to the elongated shaft, and a series of weights of varying eccentricity attached to said shaft, the weight having the least eccentricity being positioned on the shaft nearest the flexible coupling means, and the weight having the greatest eccentricity being positioned nearest the free end of the shaft, with the intermediate tapered weights of graduated eccentricity positioned therebetween.

7. A vibrating mechanism comprising high speed rotary means, a housing for said rotary means, a vibratile tubular casing attached at one end to said housing and adapted to transmit vibrational energy from the free end to the surrounding medium, an elongated shaft in said casing, bearings for said shaft supported by said casing, flexible coupling means for operatively connecting the shaft of the rotary means to the elongated shaft, and a series of weights of tapering mass attachable to said shaft, two or more axial supporting members disposed lengthwise on said shaft for holding each of said weights of tapering mass to said shaft, each of said weights and attaching means being disposed lengthwise on the shaft so that the eccentricity of the series of weights increases from a position nearest the flexible coupling means to a position nearest the free end of the casing, whereby the maximum intensity of vibration is localized near the free insertible end of the tubular casing.

8. A vibrating mechanism comprising high speed rotary means, a housing for said rotary means, a vibratile tubular casing attached at one end to said housing and adapted to transmit vibrational energy from the free end to the surrounding medium, a tapered eccentric rotor having shaft means at each end for operation in said casing, bearings for said shaft means supported by said casing, and a flexible coupling means for operatively connecting the rotor shaft means to the rotary means, said eccentric rotor being characterized by having least eccentricity at the end nearest the flexible coupling means and greatest eccentricity near the free end of the casing.

9. A vibrating mechanism comprising high speed rotary means, a housing for said rotary means, a vibratile tubular casing attached to said housing and adapted to enclose the vibrating mechanism and to transmit vibrational energy to the surrounding medium, an eccentric rotor having shaft means at each end for operation in said casing, bearings for said shaft means supported by said casing, and a flexible coupling means for operatively connecting the

rotor shaft means to the rotary means, said eccentric rotor being in an elongated cylindrical form and having a tapering weighting member attached eccentrically and longitudinally to the inner surface of said elongated cylinder.

10. A rotor for a vibrating machine comprising an elongated cylinder, shaft means attached to the ends of said cylinder, and a tapering weighting member attached eccentrically and longitudinally to the inner surface of said elongated cylinder.

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