April 1, 1969 G. W. BALZ 3,435,564

VIBRATORY MOTOR ASSEMBLY FOR FINISHING MACHINE OR THE LIKE HAVING ADJUSTABLE ECCENTRIC WEIGHTS

Filed Oct. 22, 1965 Sheet 1 of 2

Fig. 1.

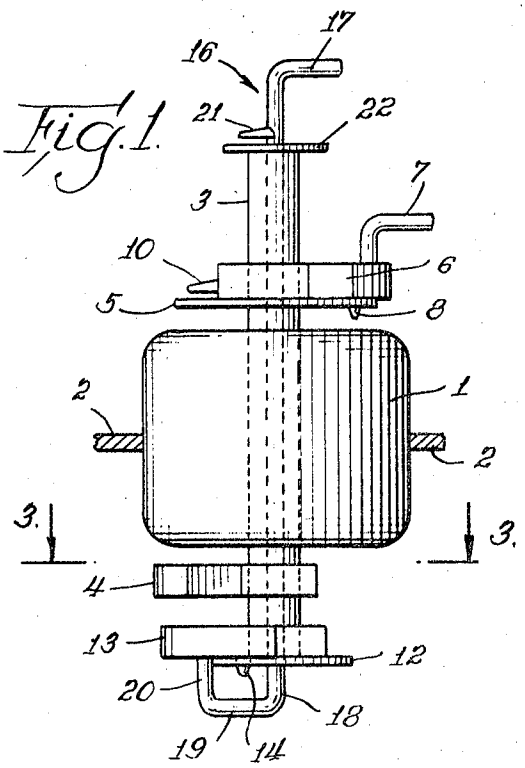


Fig. 2.

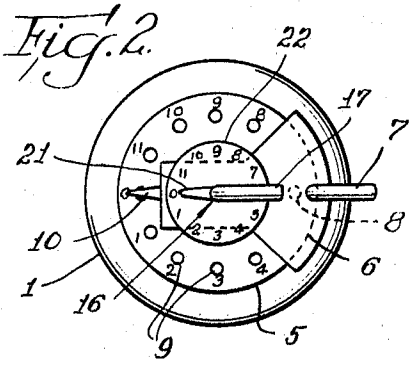


Fig. 3.

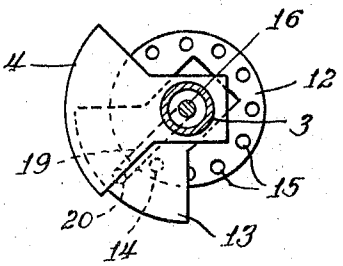
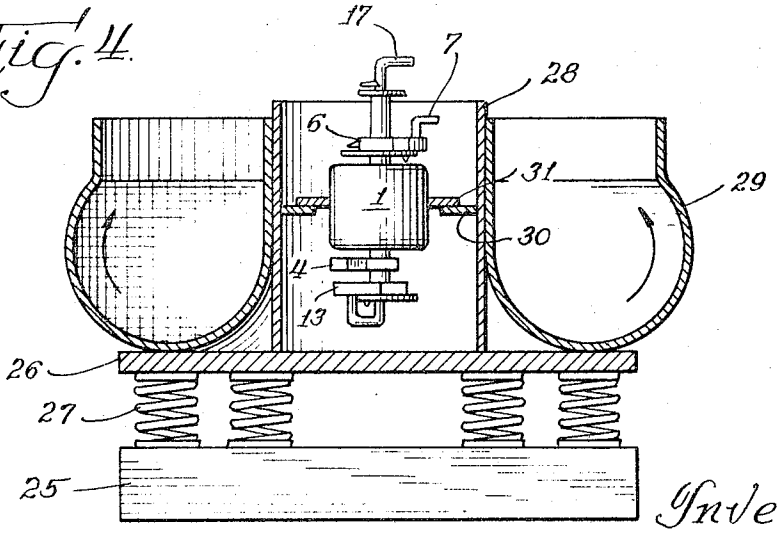


Fig. 4.



Inventor
Gunther W. Balz

By Gordon H. Arenchen
Atty.

April 1, 1969 G. W. BALZ 3,435,564

VIBRATORY MOTOR ASSEMBLY FOR FINISHING MACHINE OR THE LIKE HAVING ADJUSTABLE ECCENTRIC WEIGHTS

Filed Oct. 22, 1965 Sheet 2 of 2

Fig. 6

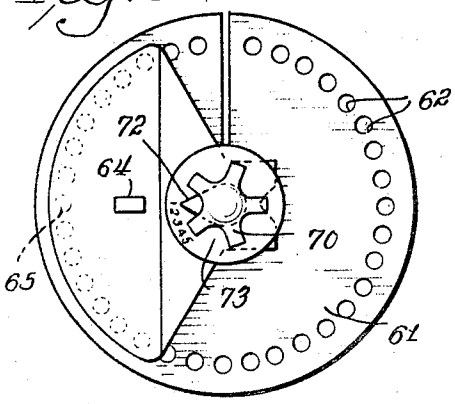


Fig. 7

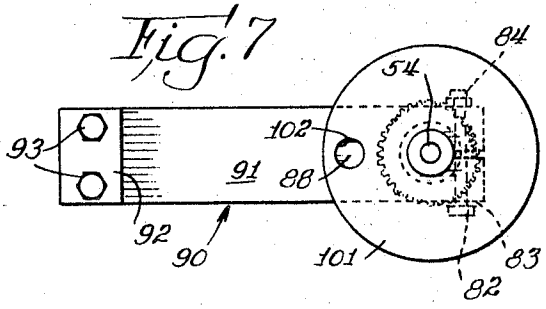
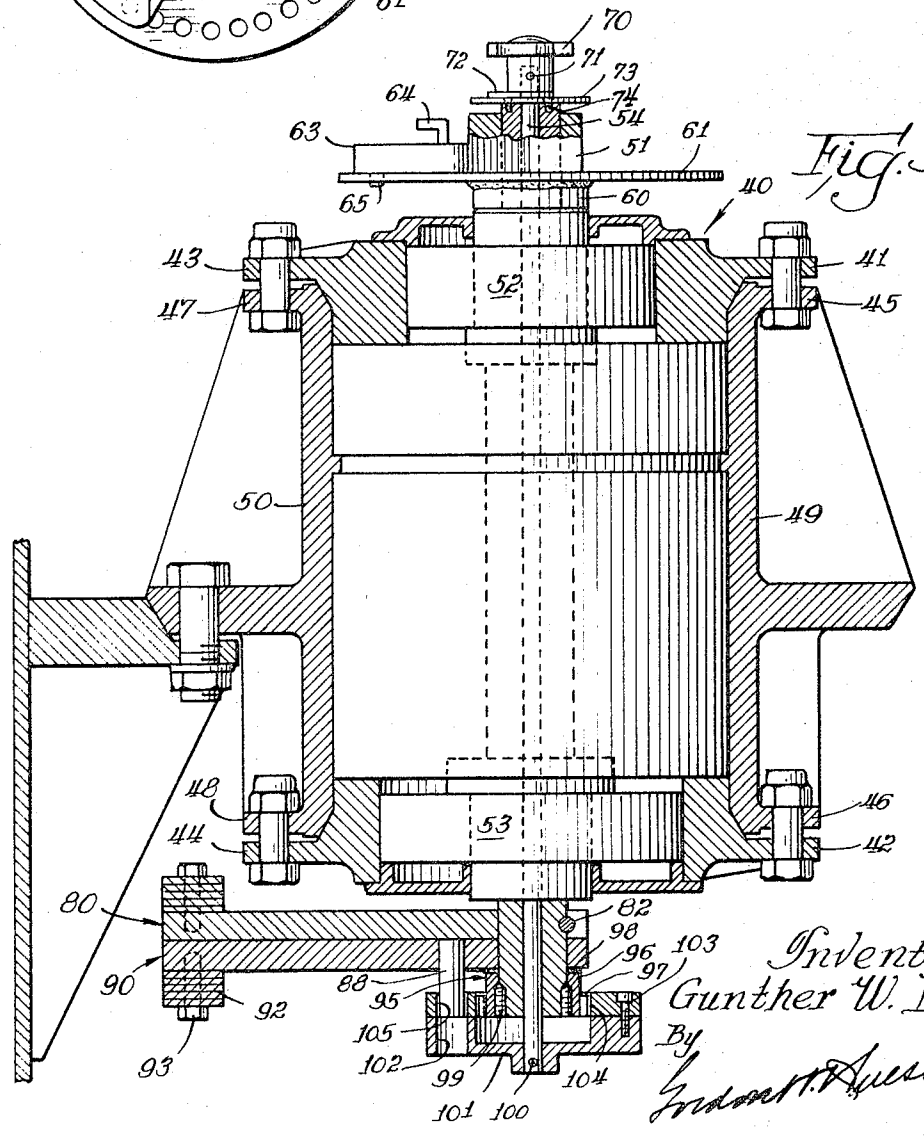


Fig. 5



Inventor
Gunther W. Balz
By
Edward F. Auescher
Atty.

United States Patent Office 3,435,564 Patented Apr. 1, 1969

3,435,564

VIBRATORY MOTOR ASSEMBLY FOR FINISHING MACHINE OR THE LIKE HAVING ADJUSTABLE ECCENTRIC WEIGHTS

Gunther W. Balz, Kalamazoo, Mich., assignor to Roto-Finish Company, Kalamazoo, Mich., a corporation of Michigan

Filed Oct. 22, 1965, Ser. No. 501,615
Int. Cl. B24b 31/06; F16h 33/10
U.S. Cl. 51—163 14 Claims

ABSTRACT OF THE DISCLOSURE

A vibratory motor assembly and finishing machine containing the same, having manually operable means, the manipulation of which both disengages an eccentric weight from a support mounted on the motor shaft and rotates the weight to a different rotative position, where the weight is operably reengaged with the shaft.

The present invention relates to vibratory machines, and is especially concerned with such machines having a vibratory motor with a shaft oriented in a substantially vertical position and having means for readily adjusting the positions of the eccentric weights thereof.

Vibratory machines of several different types having vertically oriented motors are known in the art. Such machines are used for various purposes including finishing, such as grinding and polishing, screening, and other similar processes requiring a vibratory or gyratory motion. Among the most important of such machines are finishing machines for parts such as metal parts, as representatively disclosed in U.S. Patent No. 3,161,993. Machines of the type described are vibrated in such a manner that a gyratory motion is produced, that is, a motion wherein the axis of the vibrating portion of the machine is incluined from the vertical and describes substantially a pair of conical surfaces as it gyrates. As a result of this type of gyratory motion, when material such as parts and/or refinishing material are placed in the vibrating chamber, orbital motion is imparted to the material so that it moves upwardly at the peripheral portion of the chamber and downwardly at the inner portion of the chamber. This results in relative movement between the finishing material and parts, causing the parts to be finished. Additionally, as for example in the apparatus described in the above-identified patent and application, it is desirable to cause procession or linear progression of the material in a circle around the chamber of the apparatus. This is desirable for example, where the parts are to be automatically discharged at a discharge station within the apparatus.

As is well known in the art, the production of linear motion and orbital motion in a mass confined in a chamber is dependent upon many factors, including the utilization of and the relative placement of eccentric weights, where such apparatus is employed. Moreover, the geometric relationship of the vibratory means including the motor and eccentric weights to the center of mass of the suspended apparatus is also a determining factor with regard to the nature of the motion imparted to the finishing mixture. Further important factors are the number of eccentric weights used, their relative positioning, their absolute mass, and their relative mass. Additionally, where two or more eccentric weights are utilized, their phase relationship is also a significant factor, particularly with regard to progression of the finishing mixture linearly along the finishing chamber, and to some degree with respect to the orbital motion of the mixture.

Normally little difficulty is experienced in obtaining

proper orbital motion of the finishing mixture. Even a single eccentric weight when properly displaced from the center of mass of the suspended system will provide suitable orbital motion. The direction of orbital motion is generally the same, regardless of the direction of linear motion, that is, in a direction such that the material rises in the outer or peripheral zone of the chamber or trough and descends at the inner or central zone thereof. However, in order to provide progression of the mixture in a linear direction, and in order to be able to determine and establish the direction of progression, it is desirable to utilize at least two separate eccentric weights, one affixed to each end of the motor shaft, and to establish the proper phase relationship between the eccentric weights. The direction of linear motion depends upon whether the upper eccentric weight is displaced clockwise or counter-clockwise with respect to the lower weight. If the upper weight is displaced clockwise through an angle less than 180 degrees, the direction of linear motion is counter-clockwise, regardless of the direction of rotation of the motor. When the upper weight is displaced counter-clockwise through an angle less than 180 degrees with respect to the lower weight, the direction of linear motion of the grinding mixture is clockwise, again regardless of the direction of motor rotation. The preferred positioning of the weights is usually about 45 degrees apart, either clockwise or counter-clockwise. Frequently, counter-clockwise rotation of the grinding mixture is desired, in which case the upper weight should be displaced about 45 degrees clockwise from the lower weight. Numerous other variations may be used to impart desirable linear and orbital motion to a finishing mixture and are well within the skill of the art.

In prior art finishing machines the eccentric weights are generally bolted or clamped to the motor shaft. Consequently, the adjustment of the eccentric weights to the proper relative positions is a difficult and time-consuming process. Moreover, after the position settings are changed from one position to another, in order to provide different finishing characteristics dependent upon the type of parts to be finished and the type of finishing material to be used, there is no provision for returning the settings to a previously determined position, and the operator must once again experiment with the settings in order to find the proper relative positions. This can be exceedingly time consuming.

It is accordingly an object of the present invention to provide an improved vibratory motor assembly adapted to be vertically mounted in a vibratory apparatus having a plurality of eccentric weights. It is a further object to provide a vibratory motor assembly wherein at least one of the eccentric weights is rotatively adjustable with respect to the other. It is a further object to provide a vibratory motor assembly of the type described having a fixed eccentric weight in addition to the two adjustable eccentric weights. It is a primary object to provide a vibratory motor assembly of the type described having means whereby the adjustable weights may be readily manually adjusted from the top of the apparatus, and whereby index means are provided to indicate to the operator in what position the adjustable weights are placed. It is further an object to provide such an apparatus wherein the adjustable eccentric weights hold their position even when subjected to the vibration of normal operations. It is an additional object to provide various forms of vibratory apparatus embodying the vibratory motor assemblies of the invention. Additional objects and advantages will be apparent to one skilled in the art and still other advantages will become apparent hereinafter.

The invention in its preferred embodiment is illustrated by the accompanying drawings in which:

FIG. 1 is a side elevation of a vibratory motor assembly according to the invention.

FIG. 2 is a top view of the apparatus.

FIG. 3 is a sectional view taken at the line 3—3 of FIG. 1.

FIG. 4 is a cross-sectional view of the vibratory motor assembly mounted in a finishing apparatus.

FIG. 5 is a cross-sectional view of the motor and weight indexing arrangement according to a somewhat modified embodiment of the invention.

FIG. 6 is a top view of a portion of the apparatus of FIG. 5; and

FIG. 7 is a bottom view of a portion of the apparatus of FIG. 6.

According to the invention, a vibratory motor assembly is provided having at least one and preferably two adjustable eccentric weights, preferably one mounted at each end of the motor shaft. Means are provided for rotating the eccentric weights to one of a number of positions, as well as means for retaining the weights in any selected position. Additionally, index means are provided for indicating to an operator in what position the eccentric weights are mounted and retained at any particular time.

Reference is now made to the accompanying drawings for a better understanding of the invention, wherein all of the parts are numbered and wherein the same numbers are used to refer to corresponding parts throughout.

Referring to FIGS. 1–3, the vibratory motor assembly is shown comprising a motor housing **1**, mounting brackets **2** attached thereto for mounting on vibratory apparatus, and a tubular shaft **3**. An eccentric weight **4** is fixedly mounted at the lower portion of the shaft. At the upper portion of the shaft an upper weight support or platform **5** is fixedly mounted supporting an upper adjustable eccentric weight **6** slideably mounted about the shaft. A handle **7** is affixed to the eccentric weight **6** for lifting and rotating. The eccentric weight **6** is maintained in place by means of a detent pin **8** adapted to be inserted in and engaged by a plurality of detent holes **9** arranged in the weight support **5** arranged in a circle concentric with the tubular shaft. An indicator **10** is mounted on the eccentric weight **6** for indicating the position of the weight in cooperation with index numerals **11** provided on the weight support or platform **5**.

A lower weight support or platform **12** is affixed to the motor shaft **3** at the lower end thereof and supports a lower adjustable eccentric weight **13** mounted thereon. The eccentric weight **13** is maintained in place with respect to the support **12** by means of a detent pin **14** affixed to the weight positioned in one of a series of detent holes **15** provided in the weight support **12** and arranged in a circle concentric with the shaft **3**. The lower eccentric weight **13** is lifted and rotated by means of a J-form lower weight control rod **16** comprising a handle **17** at one end, a major vertical portion **18** journalled in the axial channel of the tubular shaft **3**, a horizontal arm **19**, and a minor vertical rod **20** having its end affixed to the lower adjustable eccentric weight **13**. In order that the operator may determine the position of the lower weight from the operating position, an indicator **21** is affixed to the rod **18** and cooperates with an index scale **22**. Alternatively detent pin **14** may be placed in the weight supports and the holes **15** in the weights. Alternative means for accomplishing the releaseable engagement of the weight or weights with respect to said shaft, such as depressible spring bias or pressure between the weight and the support member, may also be used and will be apparent to one skilled in the art. For example, equivalent to lifting the eccentric weights to disengage same from their support members, the pins or other engaging means, wherever located, may be spring-biased and the weights released therefrom by depressing, twisting, turning, or the like.

The upper adjustable eccentric weight **6** is adjusted by grasping the handle **7** and raising the weight as it slides along the shaft **3** until the pin has become completely disengaged from the hole **9**. The weight may then be rotated until the indicator points to the proper numeral on the index disk. The weight is then lowered until the pin enters and is engaged by another detent hole **9**. The lower eccentric weight **13** may be adjusted by grasping the handle **17** and raising the weight until the pin **14** has become disengaged from the detent hole **15**. The weight may then be rotated by turning the handle **17** until the indicator **21** points to the proper position on the indexed disk **22**. The handle is then lowered until the pin **14** again engages the proper hole **15**. During operation of the vibratory motor the eccentric weights are maintained in position by means of the pins **8** and **14** and detent holes **9** and **15**. However, where the vibratory motion is unusually severe, the weights may be spring-loaded against the weight supports or platforms by means known in the art.

The positioning of the adjustable eccentric weights is significant in at least two respects. The relative position of the bottom adjustable weight with respect to the fixed bottom weight **4** is significant in controlling the impact and roll rate of the apparatus to which the motor assembly is affixed. The top weight is significant in determining and controlling the feed rate of material moving linearly in a circle within the chamber of the vibratory apparatus.

Referring to FIG. 4, a finishing apparatus is shown comprising a base **25**, a supporting plate **26** mounted on the base **25** by means of coil springs **27** and a tubular support **28** mounted on the plate **26**. Mounted on the plate **26** and surrounding the supporting member **28** is a finishing chamber **29** in the form of an annular trough. The trough may be disposed in a horizontal plane or it may equally well be inclined, spiralled, helixed, or the like. An annular flange **30** is mounted within the tubular support **28**, having affixed thereto a motor bracket **31**. The bracket supports an adjustable vibratory motor assembly similar to that shown in FIGS. 1–3 and having structure similarly numbered.

In operation, electric current is applied to the motor causing gyratory vibration of the apparatus, as described above. The mixture within the finishing chamber **29** comprising parts to be finished and a finishing material is moved in an orbital path in a direction shown by the arrows. Additionally, depending upon the adjustment of the relative positions of the various unbalance weight, the mixture is also caused to travel in a linear circular path along the trough, the direction depending upon the relative adjustment of the eccentric weights. The apparatus may be readily adjusted in the manner described above by manipulating the control handles **17** and **7** to obtain the proper type of vibration, depending upon the nature of the parts and finishing material. Moreover such adjustment of the eccentric weights may be readily accomplished by an operator from the top of the apparatus.

FIGS. 5–7 illustrate the motor and eccentric weight indexing arrangement in a somewhat modified embodiment of the invention. The apparatus shown comprises a motor housing **40** having mounting flanges **41**, **42**, **43**, and **44**, affixed to flanges **45**, **46**, **47** and **48** of brackets **49** and **50** affixing the motor and weight assembly to a vibratory apparatus such as a finishing machine (not shown).

Vertically mounted in the motor housing **40** is a tubular shaft **51** journaled in bearings **52** and **53**. Also contained within the motor housing **40** are a rotor, stator, and accessory structure (not shown, for convenience). Fixedly mounted on the tubular shaft **51** is a collar **60** having an indexing disc **61** affixed thereto. The disc **61** is provided with a plurality of circumferentially arranged indexing holes **62**. An eccentric weight **53** is slideably and rotatably journaled over the tubular shaft **51**, and is

provided with a handle **64** for lifting the weight. An indexing pin **65** is affixed to the bottom of the weight and positioned to be inserted into the holes **62** of the indexing disc **61**.

The assembly for providing adjustment and indexing of the lower adjustable weight assembly comprises a hand knob **70** affixed to the upper end of a lift rod **54** by means of a roll pin **71**. A pointer **72** is affixed to the hand knob **70** by suitable means such as screws or rivets. A setting or indexing disc **73** is affixed to the shaft **51** by suitable means such as screws **74**.

Affixed to the bottom of the shaft **51** is a non-adjustable eccentric weight assembly **80** comprising a weight arm **81** split at one end and clamped to the shaft by means of a cap screw **82**, a spring lock washer **83**, a nut **84**, and a locknut **85**. A plurality of weights **86** are affixed to the other end of the weight arm **81** by means of a bolt **87** threadingly engaged within a hole provided in the arm.

The adjustable eccentric weight assembly **90** comprises a weight arm **91** rotatably journaled by means of a hole provided therein about the shaft **51**. A plurality of weights **92** are mounted at the end of the weight arm **91** by means of cap screws **93**. A drive pin **88** is affixed to the weight arm **91** in a hole provided therein. A spur gear **95** is mounted over the shaft **51** and comprises a collar portion **96** and a toothed portion **97**. The spur gear **95** is separated from the weight arm **91** by means of a washer **98**. The spur gear **95** is affixed to the shaft **51** by means of set screws **99**.

Affixed to the lower end of the lift rod **54** by means of a roll pin **100** is an end cap having an opening **102** slideably receiving the drive pin **88**. Mounted on the end cap **101** by suitable means such as screws **103** is a sun gear or internal spur gear **104** having teeth in engagement with the teeth of the spur gear **95**. The sun gear **104** is also provided with an opening **105** in which the drive pin **88** is slideably positioned.

In operation, the position of the upper unbalance weight may be changed by grasping the handle **64** and lifting the weight until the indexing pin **65** is disengaged from the hole in which it was previously positioned. The weight may then be rotated about the shaft **51** until the desired position is reached. The weight is then lowered again, with the indexing pin being inserted into another one of the circumferential holes **62**. The relative position between the weight **63** and the shaft **51** is maintained during rotation of the weight during the operation of the apparatus.

The position of the lower adjustable unbalance weight may be changed by grasping the hand knob **70** and raising the lift rod **54**. As a result, the end cap **101** and sun gear **104** are raised, the drive pin **88** sliding through the openings **105** and **102** in the sun gear and end cap respectively. After the lift rod has been lifted a sufficient distance, the teeth of the sun gear **104** become disengaged from the teeth of the spur gear **95**. As as result, the hand knob may be rotated, causing rotation of the adjustable eccentric weight assembly **90**. When the desired position has been reached, as indicated by the pointer **72** and setting disc **73**, the hand knob is lowered, causing the end cap and sun gear to be lowered until the teeth of the sun gear once again engage the teeth of the spur gear at **95**, but now in a different rotative position, thus fixing the adjustable unbalance weight assembly **90** in rotative position with respect to the shaft **51** once more. This relative position remains unchanged during rotation of the shaft and operation of the apparatus used in conjunction with the vibratory motor.

Although the invention has been illustrated and described with respect to an apparatus in which the tubular shaft **51** is directly mounted on the motor, other arrangements may also be used. For example, a tubular shaft may be mounted in separate bearings for rotation about a vertical axis, the shaft having the upper adjustable weight assembly and lower fixed and adjustable weight assemblies mounted thereon in substantially the same manner as shown in the drawings. Power to rotate the shaft may be provided by a motor separately mounted at one side of the shaft and operatively connected thereto by means of pulleys and an endless belt. Although the invention has been particularly described and illustrated with respect to its application to the vibratory finishing art, numerous other applications in other fields and to other apparatus requiring a vertically oriented shaft and adjustable eccentric weights will be immediately apparent.

It is to be understood that the invention is not limited to the exact details of construction, operation, or exact materials or embodiments shown and described, as obvious modifications and equivalents will be apparent to one skilled in the art, and the invention is therefore to be limited only by the scope of the appended claims.

I claim:

1. A vibratory motor assembly adapted to be vertically mounted in a vibratory apparatus, said assembly comprising a motor, a shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted in axially spaced relationship on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, a plurality of detent means and a detent engaging means associated with each of said weights and supporting means for retaining said adjustable weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative positon.

2. A vbratory motor assembly adapted to be vertically mounted in a vibratory apparatus, said assembly comprising a motor, a shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, each of said supporting means being provided with a plurality of detent holes arranged in a circle concentric with said shaft and each of said weights being provided with a detent pin adapted to be inserted in said detent holes for retaining said weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position.

3. A vibratory motor assembly adapted to be vertically mounted in a vibratory apparatus, said assembly comprising a motor, a shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, each of said supporting means being provided with a plurality of detent holes arranged in a circle concentric with said shaft and each of said weights being provided with a detent pin adapted to be inserted in said detent holes for retaining said weights in any of a plurality of fixed rotative positions, manually operatable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position, and index means for indicating the rotative position of each of said adjustable weights.

4. A vibratory motor assembly adapted to be vertically mounted in a vibratory apparatus, said assembly comprising a motor, a shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, means biasing said adjustable weights against said weight supporting means, each of said supporting means being provided with a plurality of detent holes arranged in a circle concentric with said shaft and each of said weights being provided with a detent pin adapted to be inserted in said detent holes for retaining said weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position, and index means for indicating the rotative position of each of said adjustable weights.

5. A vibratory motor assembly adapted to be vertically mounted in a vibratory apparatus, said assembly comprising a motor, a shaft having an axial channel operatively connected to said motor, a fixed eccentric weight and a plurality of adjustable eccentric weights mounted on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, a plurality of detent means and a detent engaging means associated with each of said weights and supporting means for retaining said adjustable weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position.

6 A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated with said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a motor, a vertically oriented shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted in axially spaced relationship on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, a plurality of detent means and a detent engaging means associated with each of said weights and supporting means for retaining said adjustable weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position.

7. A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated with said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a motor, a vertically oriented shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted in axially spaced relationship on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, each of said supporting means being provided with a plurality of detent holes arranged in a circle concentric with said shaft

and each of said weights being provided with a detent pin adapted to be inserted in said detent holes for retaining said weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position.

8. A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated with said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a motor, a vertically oriented shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted in axially spaced relationship on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, each of said supporting means being provided with a plurality of detent holes arranged in a circle concentric with said shaft and each of said weights being provided with a detent pin adapted to be inserted in said detent holes for retaining said weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position, and index means for indicating the rotative position of each of said adjustable weights.

9. A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated wtih said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a motor, a vertically oriented shaft having an axial channel operatively connected to said motor, and a plurality of adjustable eccentric weights mounted in axially spaced relationship on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, means biasing said adjustable weights against said weight supporting means, each of said supporting means being provided with a plurality of detent holes arranged in a circle concentric with said shaft and each of said weights being provided with a detent pin adapted to be inserted in said detent holes for retaining said weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position, and index means for indicating the rotative position of each of said adjustable weights.

10. A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated with said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a motor, a vertically oriented shaft having an axial channel operatively connected to said motor, a fixed eccentric weight and a plurality of adjustable eccentric weights mounted in axially spaced relationship on said shaft, weight supporting means affixed to said shaft below each of said adjustable weights, a plurality of detent means and a

detent engaging means associated with each of said weights and supporting means for retaining said adjustable weights in any of a plurality of fixed rotative positions, manually operable means affixed to said upper adjustable weight, a rod journaled in the axial channel of said shaft having its lower end affixed to said lower adjustable weight and having manually operable means affixed to the upper end of said rod, whereby each of said adjustable weights may be independently disengaged from said weight supporting means and rotated and reengaged in a different rotative position.

11. A vibratory assembly adapted to be mounted in a vibratory apparatus comprising a tubular shaft having an axial channel adapted to be rotated while in vertical orientation, a rod slidably and rotatively mounted in the axial channel of said shaft having handle means affixed to the upper end thereof, an adjustable eccentric weight assembly comprising an arm rotatively journaled at one end about said shaft, a weight affixed to the other end of said arm, and a detent pin affixed to said arm at an intermediate position, a retaining member comprising a supporting plate affixed to the lower end of said rod having an internal cog gear fixedly mounted thereon, an external cog gear affixed to said tubular shaft coaxially aligned with and normally engaging said internal cog gear, said supporting member having a channel provided therein slideably engaging said detent pin and being adapted to be moved axially thereby disengaging said internal cog gear from said external cog gear, whereby said handle means may be raised to disengage said weight from said shaft, rotated to a new rotative position with respect to said shaft, and lowered to reengage said weight at said new rotative position.

12. A vibratory assembly adapted to be vertically mounted in a vibratory apparatus comprising a motor having a tubular shaft with an axial channel in vertical orientation, a rod slidably and rotatively mounted in the axial channel of said shaft having handle means affixed to the upper end thereof, an adjustable eccentric weight assembly comprising an arm rotatively journaled at one end about said shaft, a weight affixed to the other end of said arm, and a detent pin affixed to said arm at an intermediate position, a retaining member comprising a supporting plate affixed to the lower end of said rod having an internal cog gear fixedly mounted thereon, an external cog gear affixed to said tubular shaft coaxially aligned with and normally engaging said internal cog gear, said supporting member having a channel provided therein slideably engaging said detent pin and being adapted to be moved axially thereby disengaging said internal cog gear from said external cog gear, whereby said handle means may be raised to disengage said weight from said shaft, rotated to a new rotative position with respect to said shaft, and lowered to reengage said weight at said new rotative position.

13. A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated with said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a tubular shaft having an axial channel adapted to be rotated while in vertical orientation, a rod slideably and rotatively mounted in the axial channel of said shaft having handle means affixed to the upper end thereof, an adjustable eccentric weight assembly comprising an arm rotatively journaled at one end about said shaft, a weight affixed to the other end of said arm, and a detent pin affixed to said arm at an intermediate position, a retaining member comprising a supporting plate affixed to the lower end of said rod having an internal cog gear fixedly mounted thereon, an external cog gear affixed to said tubular shaft coaxially aligned with and normally engaging said internal cog gear, said supporting member having a channel provided therein slideably engaging said detent pin and being adapted to be moved axially thereby disengaging said internal cog gear from said external cog gear, whereby said handle means may be raised to disengage said weight from said shaft, rotated to a new rotative position with respect to said shaft, and lowered to reengage said weight at said new rotative position.

14. A finishing machine for finishing the surface of a part comprising a housing mounted for vibration defining a finishing chamber and having vibratory means operatively associated with said housing for subjecting a mixture comprising said part and a finishing material to vibration, said vibratory means comprising a motor having a tubular shaft with an axial channel in vertical orientation, a rod slideably and rotatively mounted in the axial channel of said shaft having handle means affixed to the upper end thereof, an adjustable eccentric weight assembly comprising an arm rotatively journaled at one end about said shaft, a weight affixed to the other end of said arm, and a detent pin affixed to said arm at an intermediate position, a retaining member comprising a supporting plate affixed to the lower end of said rod having an internal cog gear fixedly mounted thereon, an external cog gear affixed to said tubular shaft coaxially aligned with and normally engaging said internal cog gear, said supporting member having a channel provided therein slideably engaging said detent pin and being adapted to be moved axially thereby disengaging said internal cog gear from said external cog gear, whereby said handle means may be raised to disengage said weight from said shaft, rotated to a new rotative position with respect to said shaft, and lowered to reengage said weight at said new rotative position.

References Cited

UNITED STATES PATENTS

3,339,422	9/1967	Petrin	74—87
2,660,067	11/1953	Glover	74—87
2,677,967	5/1954	Galbraith	74—87
3,097,537	7/1963	Peterson	74—87 X
3,100,088	8/1963	Podmore	51—163 X
3,197,922	8/1965	Smith	51—163
3,266,739	8/1966	McKibben	51—163 X

HAROLD D. WHITEHEAD, *Primary Examiner.*

U.S. Cl. X.R.

74—87