May 8, 1951 F. KRAUSE ET AL 2,552,188

SHAKER

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FIG. 1.

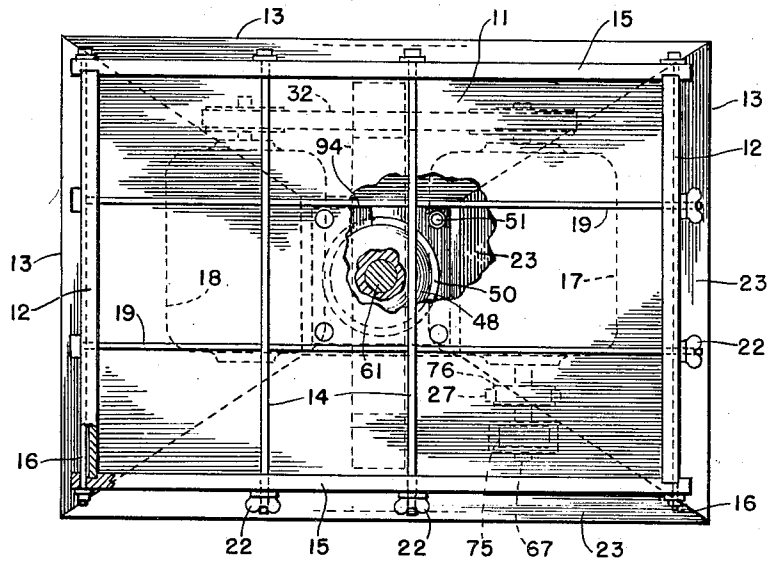
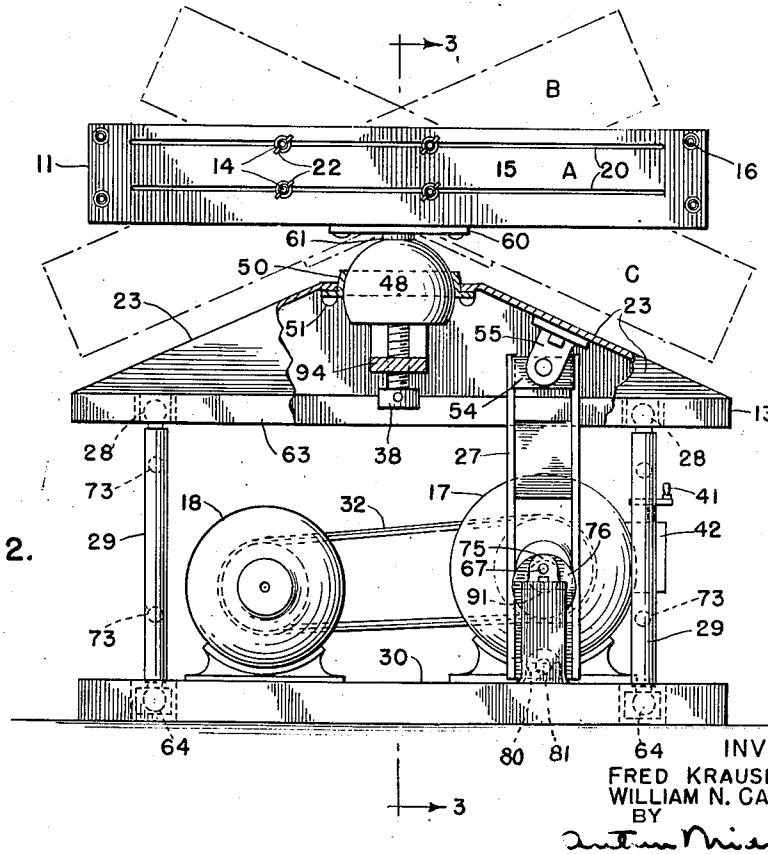


FIG. 2.



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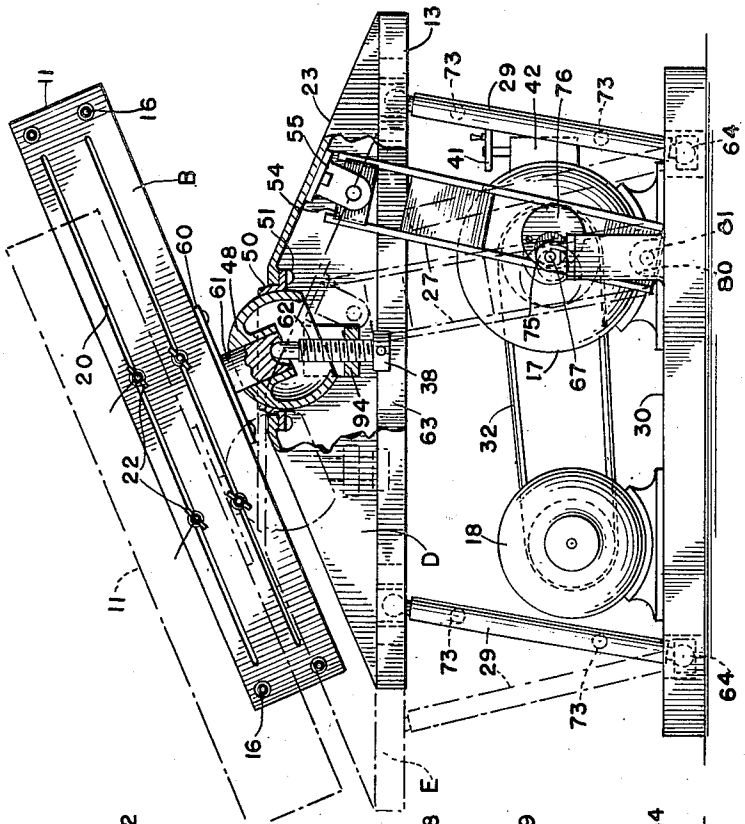


FIG. 4.

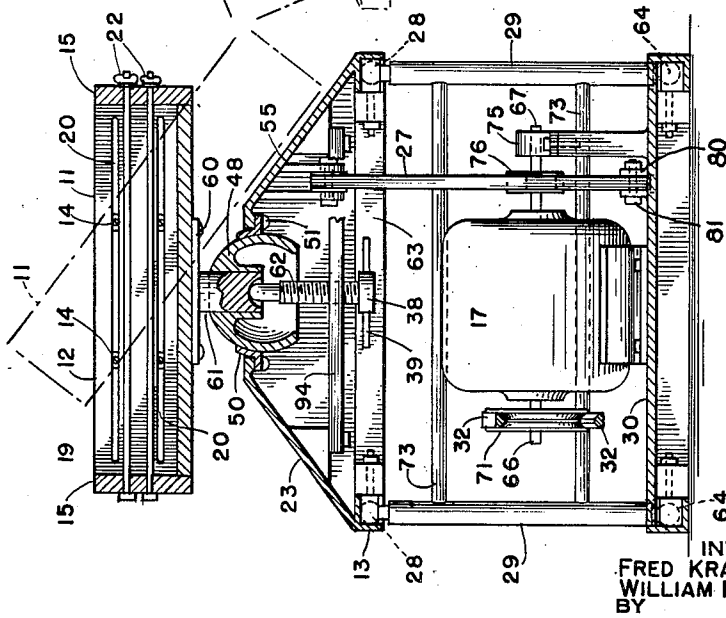


FIG. 3.

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FIG. 5.

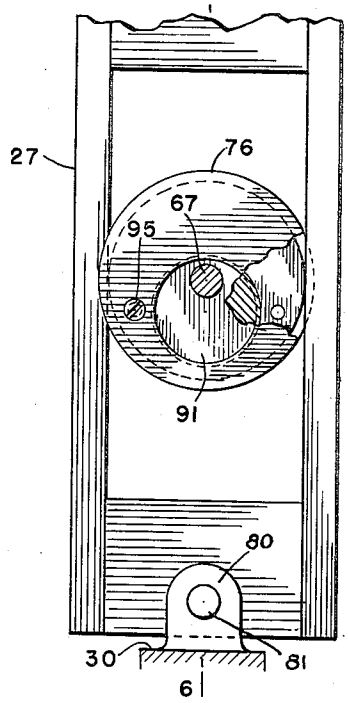


FIG. 6.

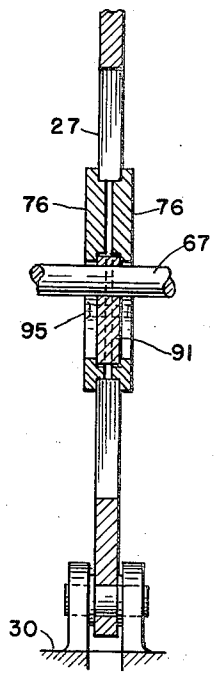
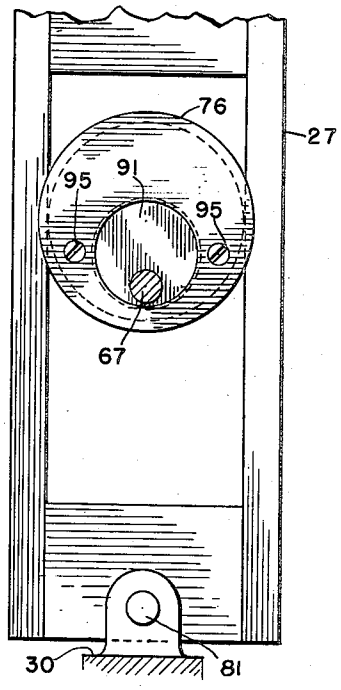


FIG. 7.



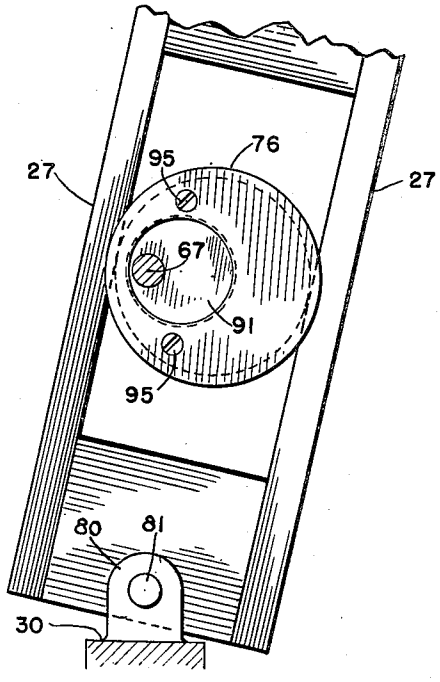


FIG. 8.

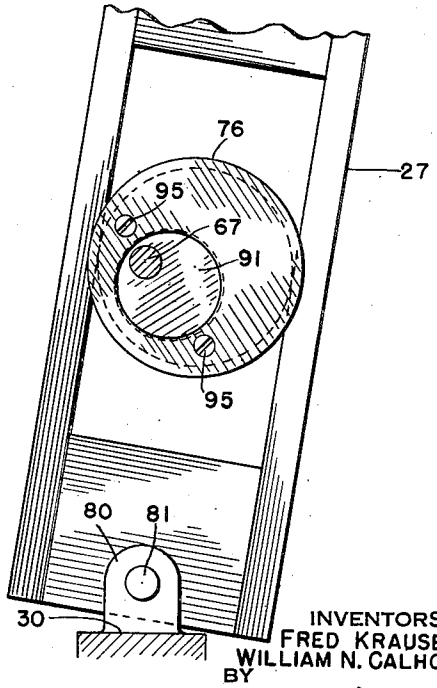


FIG. 9.

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Patented May 8, 1951

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UNITED STATES PATENT OFFICE

2,552,188

SHAKER

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Application April 27, 1949, Serial No. 89,846

2 Claims. (Cl. 259—75)

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This invention relates to oscillating type of machinery, commonly referred to as shakers or vibrators. It is particularly adapted for use as a laboratory shaker or mixer and is capable of performing a large variety of shaking motions, for example, on samples.

Many varieties of oscillatory shaking machines are known and several of these are adapted to accomplish rather specialized shaking, mixing and/or separation functions. However, so far as we are presently informed there exists no machine of simple, relatively inexpensive construction which is capable, with the aid of a few simple adjustments, of performing the wide variety of functions accomplished by practicing the invention hereinbelow described.

The limits of this invention are to be found in the appended claims and in the event of any immaterial or inadvertent conflict between the following specific descriptions and the claims, it is our intention that the claims are to govern.

In a simple embodiment, this invention comprises a motor driving a positive displacement variable speed but stepless hydraulic-type of power transmission unit. This in turn is connected to rotatable and steplessly adjustable eccentric or cam members which actuate a rigid throw or drive-arm. The motor power-transmission unit and eccentric members are mounted within a rigid, fixed, horizontal lower platform or frame. From the fixed platform there rise four rigid upright members which at their lower ends are rotatably connected to the fixed platform; at their upper ends these members are rotatably connected to a rigid, movable horizontal upper platform or frame. Motion is communicated to the movable platform by the action of the drive-arm. Centrally mounted on the movable platform is an adjustable ball-and-socket type joint; the ball member thereof fixedly supports a box-like carrier or trays. The latter, by virtue of the adjustable ball-and-socket joint is movable in a horizontal plane for a full 360°; motion in other planes is limited only by the construction of the socket but will ordinarily not exceed 180°. An important feature lies in the fact that the carrier or tray may be locked in the desired position by means of a single lock or set-screw causing pressure at the ball center.

When, for example, liquids in a container are placed firmly in the carrier and the shaker started it has been found possible to regulate the speed of excursions, throw and angle to cause: (*a*) a high splashing motion of the liquid against the opposite side of the container; (*b*) the liquids

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carrying over during the splash to result in a circular motion in a vertical plane; (*c*) a series of waves on the surface of the liquid with short heterogeneous motions within the liquid; (*d*) a series of waves which travel in the directions of the shaker motion while the whole mass of liquid rotates a number of times clockwise and then stops and reverses its direction, continuing to do this while the machine is running at a constant, pre-set speed. The first motions described are very useful in shaking and agitating chemical and bacterial solutions, especially when it is dangerous to overturn the flasks or containers as is done in rotating mixers. The last motion described has been found useful in the growth of bacterial serums which require a large surface area to be presented for the absorption of oxygen and the release of carbon dioxide gas. In this case, the shaker motion can be so regulated that foaming may be avoided and still the wave action allows a greater surface than normal to be presented.

Because of the great variety of speed, throw and angle adjustments over the full range of the machine, it can perform the functions of several specialized machines. These functions include Kahn test shaking, screening of solids, powder mixing, and vibration or shock testing of delicate equipment. Other simple or complex motions can also be attained.

The invention can perhaps be understood better by reference to the accompanying drawings wherein a preferred embodiment of the invention is depicted.

Fig. 1 is a top view of the shaker machine and shows particularly the arrangement of the container tray on the movable platform as well as the positioning of container clamp rods. Figs. 2 and 4 are vertical partial sectional views of the machine, illustrating in particular the arrangement of the drive-motor, power-transmission unit and the drive-arm. Fig. 3 is a sectional view of the machine shown in Figs. 2 and 4 (line 3—3 of Fig. 2). Figs 5 through 9 are views showing the details of the arrangement and operating positions of the drive-cams or eccentrics within the drive-arm.

More particularly in the drawings:

In Fig. 1 is shown a vertical view of tray or box carrier 11 which serves as an article carrier means located above movable upper platform 13; side-wall members 15 of tray 11 are clamped together at their ends by cross-members 12 (having bolted members 16). Side-wall members 15 have longitudinally-extending slots 20 through which

pass cross-rods 14 which may be held rigidly to side-wall members 15 by tightening wing-nuts 22. Similarly, rigid tie rods 19 pass through slots in cross-members 12 and are clamped thereto by wing-nuts 22. Mounted below upper platform 13 are motor 18 and power-transmission unit 17.

Figs. 2, 3 and 4 show vertical partial sectional views of the machine in various positions A, B and C of tray 11 and also in two operating positions D and E of upper platform 13. As indicated hereinbefore, the ball-and-socket joint mounting arrangement permits tray 11 to be tilted in any direction. Upper, movable platform 13 comprises horizontal, side-wall members 63 and upwardly and inwardly-extending rigid members 23 which support central plate 50; screws 51 attach central plate 50 (which is in the shape of a socket) to rigid members 23. Ball 48 is mounted rotatably within central plate 50 and may be fixedly positioned therein by tightening set-screw 38 within screw-plate 94. Rod 61 is centrally mounted on the upper portion of ball 48 as by welding and at its upper end supports tray-plate 60; the latter is firmly secured, as by screws, to tray 11. Upper platform 13 is movably mounted on four upright rigid rods or legs 29 having bearings 28 at their upper ends inserted in member 63 and bearings 64 at their bottom ends. Frame tie-rods 73 keep the rigid rods 29 aligned.

From the construction described it will be noted that the upper movable platform 13, which is sometimes referred to as an oscillatably mounted upper frame, is constructed so that from the horizontal sidewall members or lower frame portion thereof the upwardly and inwardly-extending rigid members 23 provide top plate members resulting in a structure resembling a truncated geometrical section which is topped by the support center plate 50 that provides a seat for a ball 48 that can be positionably locked in said seat by the screw 38. It will also be noted that the ball and socket construction just referred to extends above the uppermost surface of said truncated section or frame and whereby the tray 11, or box carrier as the same is sometimes referred to, is vertically spaced above the movable upper platform 13. The truncated formation of this platform is such that it provides a rigid construction and also such that the tray can be slanted in any direction with respect to a vertical line passing through the ball and socket connection as indicated by the dot-and-dash lines of Fig. 2, and that the tray or box carrier 11 can be positioned either horizontally or slantingly through 360 degrees about the vertical line as a center for such movement. A novel form of construction and a decidedly useful form thereof is realizable by and because of the features above referred to.

Both constant or variable speed motor 18 and stepless variable speed hydraulic power-transmission unit 17 are firmly secured to fixed lower platform 30; V-belt 32 delivers power from a drive or input shaft of motor 18 to a motor-driven power-transmission unit 17 embodying an output shaft 67. The unit 17 is of the variable speed type and preferably is rotatable both in a clockwise and in a counterclockwise direction; speed control may be made by adjustment of hand-wheel 41 which connects with selector 42. The rotation of shaft 67 is comunicated to upper platform 13 by means of eccentric members or cams (more fully described below) which are slidably mounted within rigid drive-arm 27; lower bearing 80 on lower platform 30 permits oscillation of drive-arm 27 about pivotal shaft 81, and slidable block 54 in drive-arm 27 transmits motion at the upper end thereof to movable platform 13 by means of bearing 55. Bearing 55 is fixedly positioned on one of the upwardly-extending members 23 of movable platform 13.

Fig. 3 is a sectional view of the machine and shows particularly the position of input shaft 66 and sheave 71 thereupon of power-transmission unit 17 as well as the driven or output shaft 67 which functions through cams 76 to effect a selected operative type of movement for the drive-arm 27. This figure also shows the support for one end of the output shaft 67, namely the supports provided by out-board bearing 75. The positioning of frame cross-rods 73 with respect to upright legs 28 is also shown.

Figs. 5, 7, 8 and 9 are views which show in detail the arrangement of the eccentric cam members and output shaft within drive-arm 27. Fig. 6 is an end sectional view of this arrangement as through dotted line 6—6 of Fig. 5. Thus, output shaft 67 extends through inner rotatable cam 91 and is rigidly fixed thereto, as by welding. Inner cam 91 is shown to be steplessly positionable within outer cam 76, which is formed of circular slotted discs held together with set screws 95.

This arrangement of a cam within a cam permits of a simple adjustment and variation in the extent of the oscillatory throw communicated to the movable upper platform.

Thus, when adjusting the throw it is only necessary to loosen two set-screws 95, whereupon inner cam 91 may be turned relative to its containing member (outer cam 76) and then clamped tightly to cam 76 by screws 95. The limits of throw are limited principally by the respective diameters of outer cam 76 and inner cam 91. Fig. 5 is illustrative of the point of practically no throw, that is, when the center of output shaft 67 coincides with the center of outer cam 76; Fig. 7 illustrates the adjustment for maximum throw (or amplitude of oscillation) when the center of shaft 67 is 180° away from the center of outer cam 76; i. e., when inner cam 91 has been rotated a full 180°. Figs. 8 and 9 show oscillatory positions of drive-arm 27 obtained by intermediate adjustments of the inner and outer cams.

An inspection of Figs. 1 to 4 inclusive indicates how the tray or box carrier 11 is located above the movable platform 13 and whereby said tray or box carrier can be turned to any position within and through a range of 360 degrees about upwardly-extending axial lines and whereby it can be tilted in any direction from the horizontal position shown in Fig. 2 to any one of innumerable tiltable positions, some of which are indicated by the dot and dash lines of Figs. 2, 3 and 4 and in this connection it will be noted that the only limit as to the degree of tiltability of the box carrier 11 is when by way of example a lower edge portion of the carrier contacts an underlying portion of the movable upper platform 13. Outside of this type of limitation the tray can be placed in limitless number of positions in any direction with respect to the center of the socket section 50, or as otherwise expressed, with respect to the center of the ball member 48 within the socket. Moreover, an operator of the shaker or vibrator can at will release the tightening set-screw 38 and thusly release the locking of the ball 48 in the socket section 50 for the purpose of changing the position of the tray to ascertain

a particular agitation or other technical effects which may be realized or may be realizable as the result of the changing of the position of the tray and subsequent locking of the ball and socket members with respect to each other.

The part of the construction described and which particularly includes (1) the ball socket member, or section provided as by the central plate member **50**, (2) the ball member **48** having an upwardly-extending rod **61** with connecting or tray-plate end **60**, and (3) means for fixedly holding the ball portion of the ball member **48** in the socket member **50**. This last-mentioned means is realized by the tightening set-screw **38** that extends through the screw plate **94**. The construction that includes 1, 2 and 3 may be referred to and is identifiable as a positionable and lockable ball and socket means. This ball and socket construction functions as an intermediate adjustable support for the tray or box carrier **11**. The ball and socket construction also serves as a spacing type of support by which the box or tray **11** may be supported, and which in fact is supported above and in vertically spaced relationship with the underlying oscillatable upper frame **13**. The member **11** which is specifically described as a box or tray may be viewed as indicative of that which may be broadly referred to as a carrier means for articles or materials to be treated. It derives support from the oscillatably mounted upper frame **13** through the medium of the positionable and lockable ball and socket construction just described.

A fundamentally important aspect of the invention hereof revolves about the introduction and embodiment of the positionable but lockable type of ball and socket construction disposed so that it functions at a location intermediate the oscillatable frame **13** and the carrier means or tray **11** which is preferably supported so as to be vertically spaced above the oscillatable frame **13**.

In operating the oscillatory shaker machine described in the foregoing statements, only a simple procedure is necessary. The material to be treated, say liquids in bottles, is firmly positioned in tray **11** by suitable adjustment of rods **14** and **19**; tray **11** is next tilted to the desired position while upper platform **13** is maintained at its maximum elevation from lower platform **30**. Then, set-screw **38** is tightened to clamp tray **11** at the required angle. Screws **95** on outer cam **76** are next adjusted and inner cam **91** rotated to obtain the desired throw; thereupon screws **95** are tightened and the machine is ready for starting.

The motor **18** is next started. This is preferably a constant speed electric motor, and may ordinarily be about one-half horsepower. Belt **32** moves, thereupon imparting rotating motion to output shaft **67** of power-transmission unit **17** and thus causing oscillation of upper platform **13** and tray **11**. The frequency of the oscillations may be varied by changing the speed of shaft **67** of the power-transmission unit; this variation is accomplished by turning hand-wheel **41** on selector **42**.

Having now particularly described our invention, what we claim is:

1. A self-contained oscillating machine comprising a motor, a rigid lower frame, at least three upright supporting members movably mounted on said frame, an upper frame oscillatably mounted to and supported by the supporting members, at least one upwardly-extending drive-arm oscillatingly attached both to the upper and lower frames and mounted whereby the upper end thereof has arcuate movement, a stepless variable speed power-transmission unit driven by the motor and embodying a rotatable output shaft member as well as means for steplessly adjustably and eccentrically connecting the output shaft member to said drive-arm, carrier-means, a ball and socket means for steplessly and adjustably mounting the carrier-means on the upper frame and clamping means for locking the ball in place whereby to hold the carrier means in selected position with respect to the upper frame which is oscillatably mounted as hereby defined.

2. An oscillating machine comprising a motor, a rigid lower frame which has at least three upright supporting members movably mounted on said frame, an upper frame oscillatably mounted to and supported by the supporting members, at least one rigid drive arm oscillatively attached both to the upper and lower frame, a stepless variable speed power transmission unit driven by the motor and having a rotatable output shaft member, means for steplessly adjustably and eccentrically connecting the output shaft member of said drive arm, carrier means, and intermediately disposed positionable and lockable means for steplessly and adjustably mounting the carrier means on the upper frame but in vertically spaced relation with respect to the latter, said positionable and lockable means being constructed so that it embodies a ball member, a socket member provided by a socket section that receives the ball portion of the ball member and means for locking the ball portion when positioned in the socket, whereby they will continue in rigid operative positioning relationship with respect to each other.

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