

Oct. 8, 1940.

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2,216,764

FOOT MUSCLE EXERCISING MACHINE  
Filed June 1, 1937

3 Sheets-Sheet 1

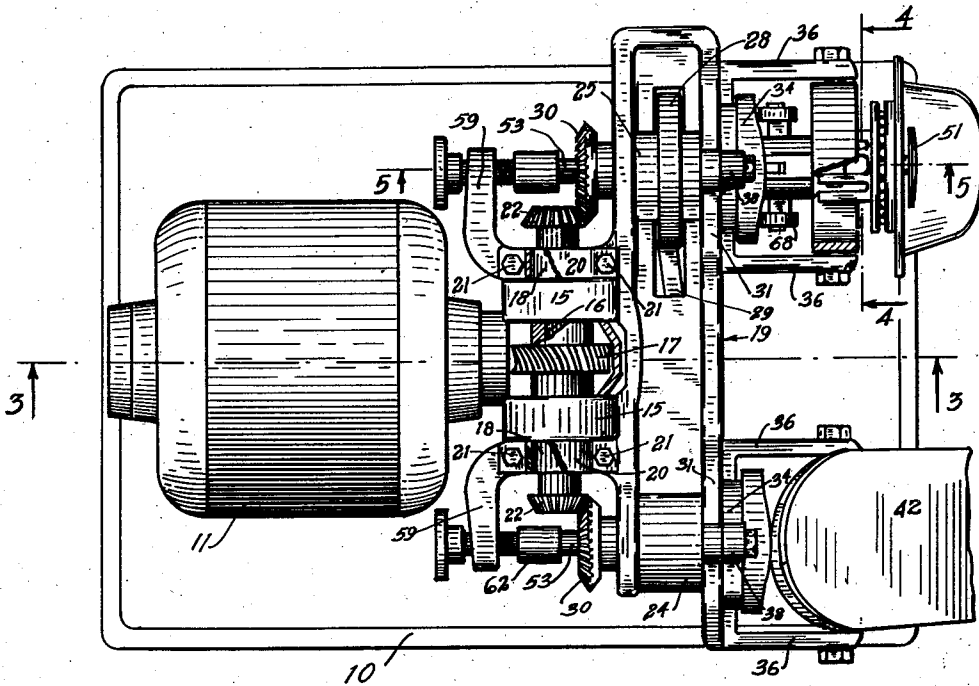


FIG. 1.

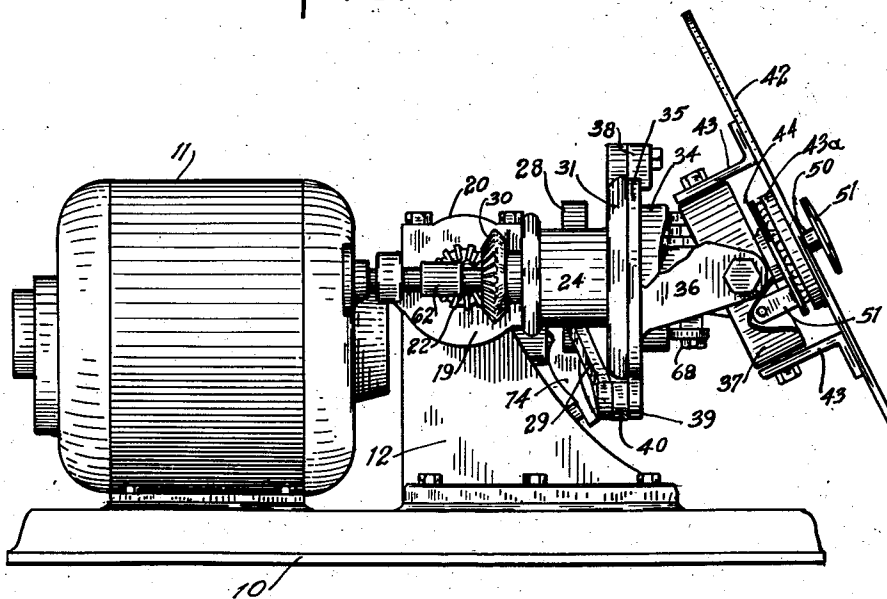


FIG. 2.

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3 Sheets-Sheet 2

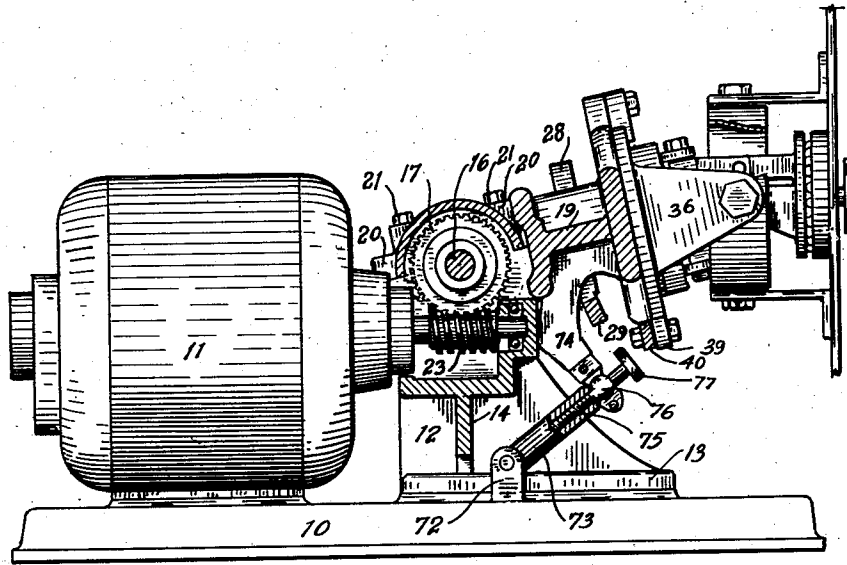


FIG. 3.

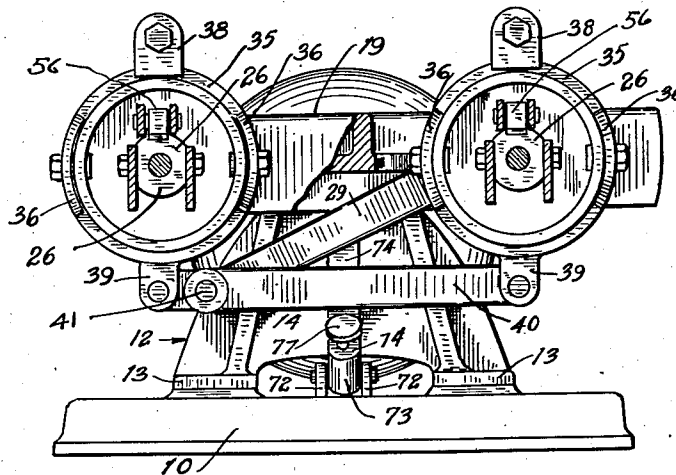


FIG. 4.

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3 Sheets-Sheet 3

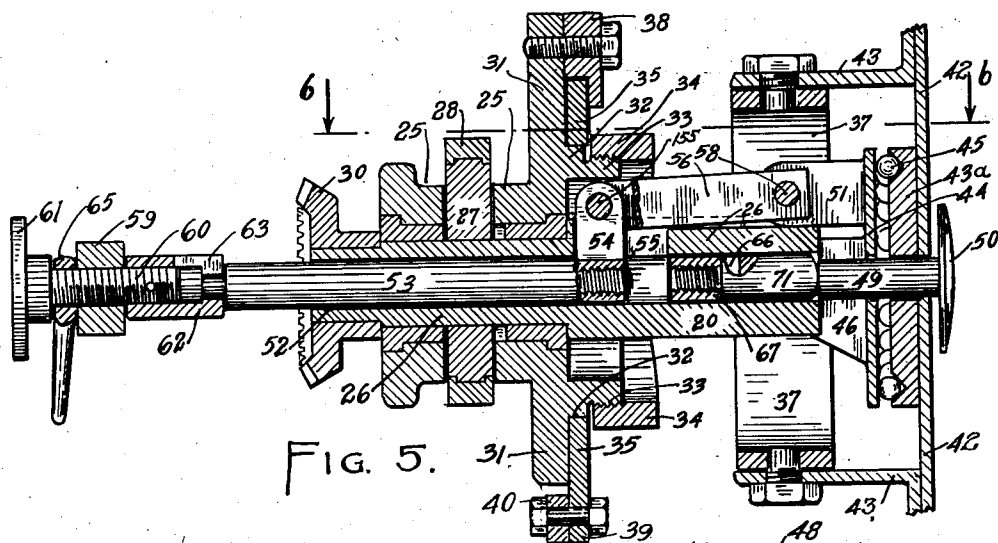


FIG. 5.

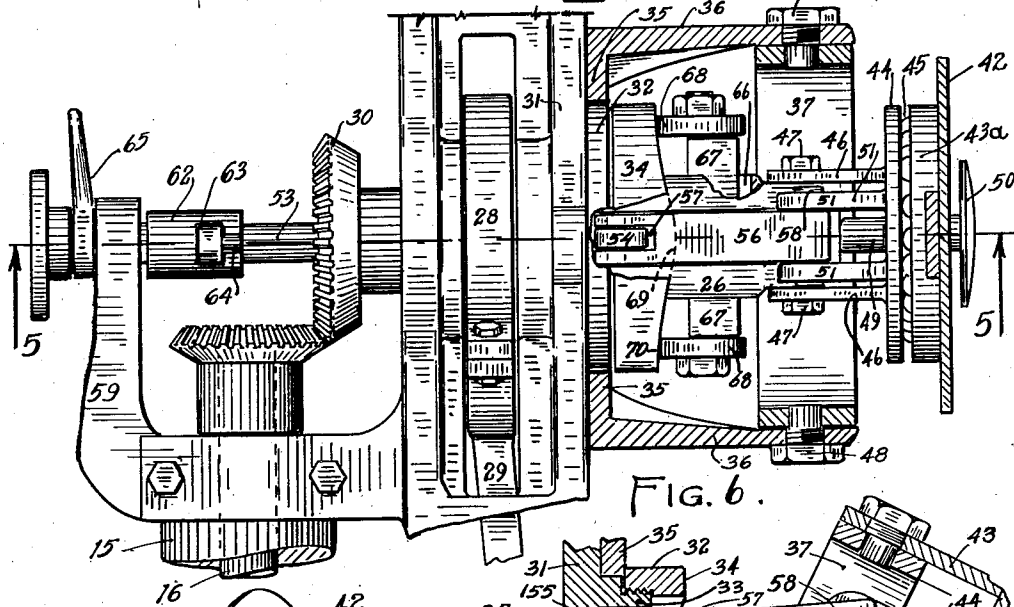


FIG. 6.

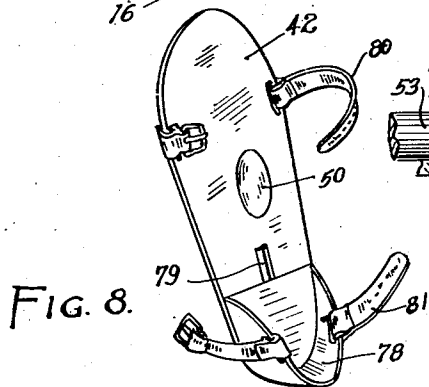


FIG. 8.

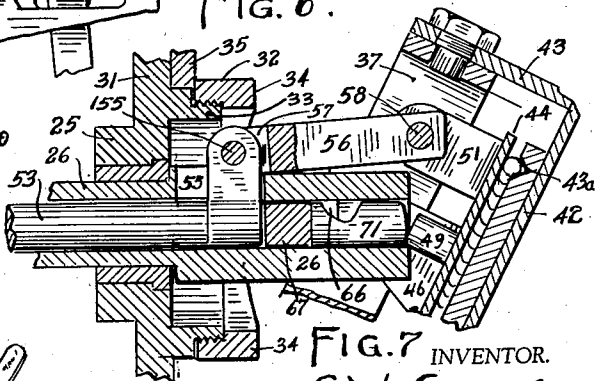


FIG. 7.

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## UNITED STATES PATENT OFFICE

2,216,764

## FOOT MUSCLE EXERCISING MACHINE

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Application June 1, 1937, Serial No. 145,807

21 Claims. (Cl. 128—25)

This invention relates to improvements in foot muscle exercising machines.

Many people have more or less difficulty with their feet due to fallen arches or misplaced metatarsal bones, and in many cases these are found to respond favorably to a treatment that consists primarily in exercising the foot by bending and twisting it in such a way as to loosen the joints and strengthen the ligaments between the bones as well as the muscles.

It is known that machines for this general purpose have been invented, but they are of a different construction and operate in a different way.

It is the object of this invention to produce a machine which will impart to the foot a wobble movement about a stationary pivot so as to simulate the treatments that are given manually by the most advanced chiropodists.

Another object is to produce a machine in which the amount of the wobble can be adjusted from a minimum to a maximum while the machine is running.

A further object is to produce a machine in which the wobble movement is combined with either one or two vibratory movements.

A still further object is to produce a machine in which the parts are of simple, rugged construction and suited for mass construction.

Another object is to produce a machine which will be of neat appearance and of moderate weight and which can be readily transported from place to place.

The above and other objects that may become apparent as the description proceeds are attained by a combination and arrangement of parts that will now be described in detail, and reference for this purpose will now be had to the accompanying drawings in which the machine has been illustrated in its present preferred form and in which:

Figure 1 is a top plan view of the machine;

Figure 2 is a side elevation thereof;

Figure 3 is a section taken on line 3—3 Fig. 1;

Figure 4 is a section taken on line 4—4 Fig. 1;

Figure 5 is a section taken on line 5—5 Figs. 1 and 6;

Figure 6 is a view partly in elevation and partly in section looking in the direction of arrows 6—6 Fig. 5;

Figure 7 is a fragmentary section, similar to that of Fig. 5, and shows the parts in a different position; and

Figure 8 is a perspective view of the foot plate. In the drawings, reference numeral 10 design-

ates the base of the machine and secured to the upper surface thereof is a motor 11 and a supporting bracket 12. The bracket has spaced feet 13 connected by a web 14, and its upper end is provided with spaced bearings 15 in which is journaled a shaft 16. Secured to this shaft, between the bearings 15, is a worm gear wheel 17. Each bearing 15 has a projecting hub 18, and these form trunnions on which the frame 19 is adjustably mounted and to which it is attached by means of the removable caps 20 that are held in place by bolts 21. Secured to the ends of shaft 16 are bevel gears 22. The motor shaft carries a worm 23 that engages and cooperates with the worm gear 17, in the manner shown in Fig. 3.

The frame 19 is provided with two bearings 24 and 25 in which are journaled identical shafts 26 constructed as shown in Fig. 5. Bearing 25 is interrupted in the manner shown in Figs. 1 and 5 and in the space between the two sections of this bearing, and non-rotatably attached to the shaft is an eccentric 27 carrying an eccentric strap 28 of the connecting rod 29. Bevel gears 30 are attached to the shafts 26 and mesh with bevel gears 22.

Surrounding the bearings 24 and 25 are circular flanges 31, each of which has a circular flange 32 whose outer end terminates in a threaded section 33 to which the cam ring 34 is attached. Flanges 32 serve as bearings for the annular bases 35 that carry diametrically positioned brackets 36 between the ends of which the gimbal rings or frames 37 are pivoted. The cams 34 serve to keep the annular bases 35 from moving outwardly away from the flanges 31 and the bases are furthermore guided by the lugs 38 in the manner clearly shown in Fig. 5. Each ring 35 is provided with a downwardly projecting lug 39 and these are joined by a connecting rod 40. The end of the connecting rod 29 is pivotally connected at 41 to the connecting rod 40 and therefore whenever the shaft 26, that carries the eccentric 27, is rotated, the annular bases, the brackets 36 and the gimbal rings 37 are oscillated about the centers of the shafts 26.

Foot plates 42, having spaced brackets 43, are pivoted to the gimbal rings or frames 37 so as to rock about axes perpendicular to the axes of the pivotal connections of the gimbal rings and the brackets 36, in a manner shown most clearly in Figs. 2 and 3. The foot plates or platforms 42 are larger than the rings or frames 37 and are positioned above and entirely outside of the latter as clearly shown in Fig. 2. Secured to

the under surface of each foot plate 42 is a ball race 43a and this cooperates with a similar ball race 44 to form a thrust bearing in which the races are spaced by balls 45. The ball race 44 is provided on its inner surface with spaced brackets 46 that are pivotally connected with the shafts 26, at 47; the axes of the pivots 47 lie in the same plane as the axes of the pivots 48, that connect the gimbal ring 37 with the brackets 36. The ball race plates 43a and 44 have central openings through which the shank 49 of the plunger 50 extends.

The ball race 44 is also provided with spaced, inwardly extending lugs 51.

Shaft 26 has an axial opening 52 in which is slidably mounted a rod 53 having a head 54 projecting from one side thereof. Head 54 is removable and threadedly connected to the end of the rod 53. Shaft 26 has a slot 55 in which the head 54 may slide. A connecting rod or link 56 has one end provided with a slot 57 for the reception of the head 54 and is connected to the latter by means of the pivot pin 155. The other end of link 56 is positioned between the brackets 51 and is connected to them by a pivot pin 58. It is now evident that by moving rod 53 longitudinally in the shaft, the assembly comprising the foot plate 42, ball races 43a, 44 and gimbal ring 37 will tilt about the axes of pivots 58 and in this way the plane of the thrust bearing can be adjusted to any desired angle with respect to the axis of rotation, thereby producing a wobble of the foot plate. It will be remembered that the gimbal ring 37 is pivoted to the brackets 36 and that the annular bases 35 are interconnected by means of a connecting rod 40 that in turn is attached to the eccentric by a connecting rod 29. If the eccentricity of the eccentric were zero, it is evident that the foot plates would remain in a fixed position as far as any rotary motion about the axis of the shaft is concerned.

The only motion of the plates 42 is a wobble motion, about the centers or rings 37 whose extent depends on the angular relation between the plane of the thrust bearing and the axis of the shaft.

Since foot plates 42 have their surfaces above the center of wobble, it is evident that whenever they are inclined to the axis of shaft 26, and the latter rotates, every point in the surface of the foot plates will travel in a circle.

Owing to the eccentricity of the eccentric, the annular bases 35, the gimbal ring and the foot plate attached thereto will oscillate about the axis of the shaft as the latter rotates, thereby giving to the foot plates an oscillating movement in addition to the wobble.

Means is provided for effecting an adjustment of the angular extent of the wobble and this will now be explained.

Referring now more particularly to Figs. 1 and 6, it will be noted that the frame 19 is provided with two parts 59 that project outwardly across the lines representing the axes of the shafts 26. The ends of the parts 59 have threaded openings in axial alignment with the shafts. A threaded rod 60 is operatively associated with the sides of each threaded opening and has a head 61 by means of which it can be turned. Secured to the end of member 60 is a sleeve 62 having an opening 63 extending inwardly through one side. The rod 53 has a neck 64 that is engaged by portions of the sleeve 62 and therefore whenever the threaded member 60 is rotated, it will move

longitudinally and impart a corresponding movement to the rod 53, thereby adjusting the angularity of the wobble. It will be observed that the connection between rod 53 and sleeve 62 is such as to permit relative rotation but to inhibit relative longitudinal movement. A lock nut 65 serves to clamp the screw 60 and hold it in adjusted position. By means of the adjusting mechanism just described, the angularity of the wobble can be adjusted from a minimum to a maximum while the machine is operating.

It is frequently desirable to apply a vibratory force to the sole of the foot and for this purpose plungers 50 have been provided, and these are given a reciprocating movement by the means which will now be described.

Shaft 26 has a transverse opening 66 that extends at right angles to the radial direction of the slot 55 and positioned in this opening is a bar 67 having its ends provided with trunnions on which the rollers 68 are journaled. Member 34 is provided with a cam surface having diametrically positioned high portions 69 and corresponding, diametrically positioned low points 70. A circular plunger 71 has a threaded connection with the bar 67 and extends outwardly in the opening 52 to a point near the end of the shaft where it contacts with the inner end of the part 49. When the shaft rotates, the bar 67 is also rotated and the rollers follow the cam surface of member 34, and when the latter has two high and two low surfaces, the plunger 50 will make two reciprocations for each revolution of the shaft.

The frame 19 and attached parts are also adjustable about the center of the hubs 18 of the bearings 15 and this adjustment is effected by a means that has been shown in Fig. 3 and which will now be described.

The base 10 is provided with two spaced lugs 72 between which and to which the lower end of the tubular nut 73 is pivoted. The frame 19 has a downwardly ranging integral arm 74 through which extends a bolt 75 having a spherical enlargement 76 that is positioned in a spherical opening in arm 74. When the bolt is turned by means of the head 77, it will move arm 74 towards or away from the end of the tubular nut.

The foot plates are provided with heel plates 78 that are adjustable along the slots 79 and with straps 80 and 81 for securing the feet to the plates.

The machine operates in the following manner:

The patient is seated on a chair with his feet against the foot plates 42 and his heels resting on the heel supports 78. The feet are now strapped in position by means of the straps 80 and 81. The wobble of the plates is usually adjusted to a minimum. The motor is now started 60 and the foot plates will begin to wobble to an extent dependent on the adjustment and the wobble can be increased during operation to the maximum for the particular patient.

The foot plates are also given an oscillatory motion by means of the eccentric and the connecting rods 29 and 40. The plunger 51 is selected of such length that it presses gently against the sole of the foot and is given a reciprocatory motion by the cooperation of the cam 34, rollers 68 and cooperating parts.

It will thus be seen that the feet are subjected simultaneously to three separate movements, (1) a wobble movement about a point, (2) an oscillatory movement about the axes of the shafts

26 and (3) a bending movement effected by the plungers 51.

By means of the screw 76 (Fig. 3) the frame 19 can be tilted about the axis of the shaft 18 and in this way an adjustment is effected that is highly useful in suiting the machine to individual feet.

The combination of means for simultaneously imparting wobble and oscillatory movement to the feet is highly important.

The points about which the plates wobble are positioned somewhere along the axes of the shafts 26 and below the center of the soles and therefore if the foot plates are oscillated simultaneously with the wobble, the toes and heels move in a closed path resembling the figure zero, providing the foot plates are oscillated once during each wobble. If the mechanism is changed so as to make two oscillations during each wobble cycle, the toes and heels will move in closed paths resembling the figure 8. It is, of course, a simple matter to alter the mechanism so that the foot plates will be oscillated either faster or slower than they are wobbled.

As pointed out above, whenever the foot plates are adjusted to wobble every point in their surfaces will travel in a circle due to the fact that the point of wobble is located below the surfaces of the plates.

By selecting plungers with shanks of the proper length, adjustments can be made to fit feet having different height arches and since the heel and the toe are anchored to the foot plate, the plungers will bend the foot when it is moved outwardly and permit it to straighten when it moves inwardly, thereby subjecting it to a flexing movement that serves to strengthen the ligaments of the metatarsal bones.

The movements produced by this machine may be duplicated by the hands of a skilled operator, but the manual manipulation will lack the uniformity of the machine treatment.

In the embodiment illustrated the parts are so arranged that the foot plates make one complete oscillation for each complete wobble and consequently the heel and toe of each foot travels in closed paths. The paths may be circular, elliptical or oblong, depending on the relative extent of the wobble. If the wobble is smaller in extent than the oscillation, the paths will be elongated ovals; if the up and down motion of the wobble is equal in extent to the oscillation the closed path will approach a circle and if the up and down motion, due to the wobble is greater than the transverse movement of oscillation, the paths will be ovals whose major axes extend up and down. If the relationship of the wobble and the oscillation devices were changed so that there were two oscillations for each complete wobble, the paths of the toe and heel would resemble the figure 8.

It is evident that the paths of the heel and the toe are the resultant of the two motions and that the shapes of the curves described by a point on the heel and/or the toe can be greatly varied by changing the relative speeds of the oscillations and the wobbles. In the device illustrated, the closed curve approaches in shape a circle.

Having described the invention what is claimed as new is:

1. A foot exercising machine, comprising in combination, a base, a foot plate supported thereby for universal movement about a pivot, a plunger element carried by the plate, means for reciprocating the plunger, and means for im-

parting to the plate a wobble motion about the pivot.

2. A foot exercising machine, comprising in combination, a base, a foot plate supported thereby for universal movement about a pivot, means for oscillating the plate about its pivot, a plunger element carried by the plate, means for reciprocating the plunger, and means for imparting to the plate a wobble motion about the pivot.

3. A foot exercising machine, comprising in combination, a base, a hollow shaft rotatably supported by the base, a foot plate supported by the hollow shaft for universal movement about a pivot, means for resisting the tendency of the plate to rotate about the pivot, means for imparting to the plate a wobble motion about the pivot, and means comprising a rod positioned in the shaft for adjusting the extent of the wobble while the foot plate is in motion.

4. A foot exercising machine, comprising, in combination, a base, a foot plate supported thereon for universal movement about a pivot, means for oscillating the plate about the pivot, means for imparting to the plate a wobble motion about the pivot, and means for adjusting the extent of the wobble while the foot plate is in motion.

5. A foot exercising machine, comprising in combination, a base, a foot plate supported thereon for universal movement about a pivot, means for oscillating the plate about the pivot, a plunger element carried by the plate for reciprocation, means for reciprocating the plunger, means for imparting to the plate a wobble motion about the pivot, and means for adjusting the extent of the wobble.

6. A foot exercising machine, comprising in combination, a base, two foot plates supported thereon for universal movement about spaced pivots, means for interconnecting the plates for simultaneous oscillation about their pivots, means for oscillating the plates, a plunger carried by each plate and mounted for reciprocation, means for reciprocating the plungers, and means for imparting to the two plates a simultaneous and equal wobble motion about their pivots.

7. A foot exercising machine, comprising in combination, a base, two foot plates supported thereon for universal movement about spaced pivots, means interconnecting the plates for simultaneous oscillation about their pivots, means for imparting to the plates a simultaneous wobble motion about their pivots and means for adjusting the extent of the wobble.

8. A foot exercising machine comprising in combination, a base, a bearing supported thereon, a hollow shaft mounted for rotation in the bearing, a wobble plate attached to the shaft and supported for rocking motion about an axis that intersects and is substantially perpendicular to the axis of the shaft, means comprising a bar positioned in the shaft for adjusting the angular relation between the plane of the plate and the axis of the shaft, a foot plate operatively associated with the wobble plate, means for holding the foot plate in parallel relation to the wobble plate while permitting relative rotary movement, whereby the foot plate will have a wobble movement corresponding to that of the wobble plate when the two plates rotate relative to each other, and means for holding the foot plate from rotating about the axis of the shaft when the latter turns.

9. A foot exercising machine comprising in combination, a base, a bearing supported thereon, 75

a hollow shaft mounted for rotation in the bearing, a wobble plate attached to the shaft and supported for rocking motion about an axis that intersects and is substantially perpendicular to the axis of the shaft, means passing through the shaft for adjusting the angular relation between the plane of the plate and the axis of the shaft, a foot plate operatively associated with the wobble plate, means for holding the foot plate in parallel relation to the wobble plate while permitting relative rotary movement, whereby the foot plate will have a wobble movement corresponding to that of the wobble plate when the two plates rotate relative to each other, means for holding the foot plate from rotating about the axis of the shaft when the latter turns, and means for oscillating the foot plate about the axis of the shaft while the latter turns.

10. A foot exercising machine comprising in combination, a base, a bearing supported thereon, a shaft mounted for rotation in the bearing, a wobble plate attached to the shaft and supported for rocking motion about an axis substantially perpendicular to the axis of the shaft, means for adjusting the angular relation between the plane of the plate and the axis of the shaft, a foot plate operatively associated with the wobble plate, means for holding the foot plate in parallel relation to the wobble plate while permitting relative rotary movement, whereby the foot plate will have a wobble movement corresponding to that of the wobble plate when the two plates rotate relative to each other, means for holding the foot plate from rotating about the axis of the shaft when the latter turns, a plunger extending through the foot plate, and means for reciprocating the plunger when the shaft rotates.

11. A foot exercising machine comprising in combination, a base, a bearing supported thereon, a shaft mounted for rotation in the bearing, a wobble plate attached to the shaft and supported for rocking motion about an axis substantially perpendicular to the axis of the shaft, means for adjusting the angular relation between the plane of the plate and the axis of the shaft, a foot plate operatively associated with the wobble plate, means for holding the foot plate in parallel relation to the wobble plate while permitting relative rotary movement, whereby the foot plate will have a wobble movement corresponding to that of the wobble plate when the two plates rotate relative to each other, means for holding the foot plate from rotating about the axis of the shaft when the latter turns, means for oscillating the foot plate about the axis of the shaft while the latter turns, a plunger extending through the foot plate, and means operated by the rotation of the shaft for reciprocating the plunger.

12. In a foot muscle exercising machine, a bearing, a shaft mounted for rotation in the bearing, two diametrically spaced brackets attached to the bearing, a gimbal ring encircling the shaft and pivoted to the brackets, a wobble plate attached to the shaft for rocking motion about an axis substantially perpendicular to the axis of the shaft, means for adjusting the angular relation between the plane of the plate and the axis of the shaft, a foot plate pivotally attached to the gimbal ring at points spaced 90 degrees from the pivots of the ring, the gimbal ring serving to hold the foot plate a predetermined position relative to the wobble plate whereby when the shaft rotates the foot plate

will move in unison with the movable plate, and means for adjusting the gimbal ring rotarily about the axis of the shaft.

13. In a foot muscle exercising machine, a bearing, a shaft mounted for rotation in the bearing, two diametrically spaced brackets attached to the bearing, a gimbal ring encircling the shaft and pivoted to the brackets, a wobble plate attached to the shaft for rocking motion about an axis substantially perpendicular to the axis of the shaft, means for adjusting the angular relation between the plane of the plate and the axis of the shaft, a foot plate pivotally attached to the gimbal ring at points spaced 90 degrees from the pivots of the ring, the gimbal ring serving to hold the foot plate a predetermined position relative to the wobble plate whereby when the shaft rotates the foot plate will move in unison with the wobble plate, and means for oscillating the gimbal ring about the axis of the shaft as the latter rotates.

14. A foot exercising machine comprising in combination, a base, a frame carried thereby, two spaced parallel bearings therein, a tubular shaft in each bearing, means for rotating the shafts in unison, a bracket ring mounted on the frame for oscillatory movement about the axis of the shaft, means interconnecting the bracket rings for synchronous oscillation, means responsive to the rotation of one shaft for oscillating the bracket rings, each ring having two opposite brackets, a gimbal ring pivoted on diametrically opposed points to the brackets and in concentric relation with the axis of the shaft, a wobble plate mounted on each axis for rocking movement about an axis perpendicular to the axis of the shaft, means comprising a rod slidable in each shaft for adjusting the angular relation between the plane of the wobble plate and the axis of the shaft to which it is attached, a foot plate associated with each wobble plate, the foot plate having each two brackets that are pivotally connected to the gimbal ring at points spaced 90 degrees from the pivots of the ring, the latter serving to hold the foot plate in a predetermined position relative to the wobble plate so that the foot plate may always remain parallel with the latter.

15. A foot muscle exercising machine comprising in combination, a base having an upwardly extending supporting bracket provided near its upper end with a horizontal bearing, a shaft rotatably mounted in the bearing, means for rotating the shaft, a main frame supported on the bracket for angular adjustment about the axis of the bearing, the main frame having a bearing near each end, a hollow shaft rotatably mounted in each of the last named bearings, the axes of the hollow shafts being substantially parallel and substantially perpendicular to the axis of the first mentioned shaft, means comprising bevel gears for transmitting movement from the first mentioned shaft to the hollow shafts, a thrust bearing member carried by the outer ends of the hollow shafts and attached to the latter for limited rocking movement about an axis perpendicular to the shaft, the bearing member having a bearing surface whose plane intersects the axis of the shaft, means comprising a rod slidable in the hollow shaft for tilting the bearing member about the pivotal connection whereby the bearing surface will wobble when the shaft is rotated, a foot plate having one side provided with a bearing surface that cooperates with the first mentioned bearing surface means for rockably sup-

porting the foot plate whereby it can wobble in unison with the first mentioned bearing surface, and means for holding the plate from rotating.

5 16. In a foot muscle exercising machine, a sub-combination comprising a tubular shaft, a foot plate carried by one end of the shaft and mounted for universal movement, and means for tilting the plate relative to the axis of the shaft, comprising a rod extending through the shaft, and 10 means for connecting the rod with the plate.

17. In a foot muscle exercising machine, a frame having a bearing, a tubular shaft journaled in the bearing, a ball race forming part of a thrust bearing connected with the shaft by 15 means permitting adjustment about a diametrical axis perpendicular to the axis of the shaft, the shaft having an opening communicating the axial opening, a rod slidable in the axial opening and provided with a head extending through the 20 opening in the wall of the shaft and means for effecting a connection between the head and the ball race whereby the latter will be angularly adjusted about its pivot when the rod is reciprocated in the shaft.

25 18. The device for exercising foot muscles which comprises means for subjecting the foot to a wobble movement about a pivot positioned below the sole of the foot and to a simultaneous oscillating movement about an axis substantially 30 perpendicular to the sole of the foot whereby the toes and the heel will travel in closed curves approximating in shape the letter O, and means

for simultaneously subjecting the sole of the foot to a vibratory force tending to bow the arch and to permit it to straighten.

19. In a foot corrective device, a hollow driven shaft; a swash plate rockably attached to an 5 end of said shaft and rotatably with said shaft; means comprising a member positioned in the opening in the shaft for adjusting the angle of the swash plate means, a foot plate member parallel with said surface of the swash plate; means 10 preventing rotation of said foot plate member; and ball bearing means interposed between said foot plate member and said swash plate.

20. A machine of the character specified, including a base, a frame supported on said base 15 for tilting in a vertical plane, a platform positioned above said frame supported for tilting in a vertical plane at right angles to said first mentioned plane, means comprising a tiltable swash plate for actuating said frame and said platform 20 to impart to the latter a wobble motion, and means for tilting the swash plate to vary the extent of wobble.

21. In combination with a support, a frame pivotally secured thereto about a horizontal axis, 25 a plate pivotally secured to said frame upon an axis lying below the top surface thereof to provide a gimbal joint, means for maintaining said plate in sloping position and imparting thereto a universal tilting motion, and means for adjusting the slope of the plate while it is tilting. 30

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