Feb. 27, 1934. M. A. NELSON ET AL 1,948,534

FOOT MUSCLE EXERCISER

Filed July 25, 1932 2 Sheets-Sheet 1

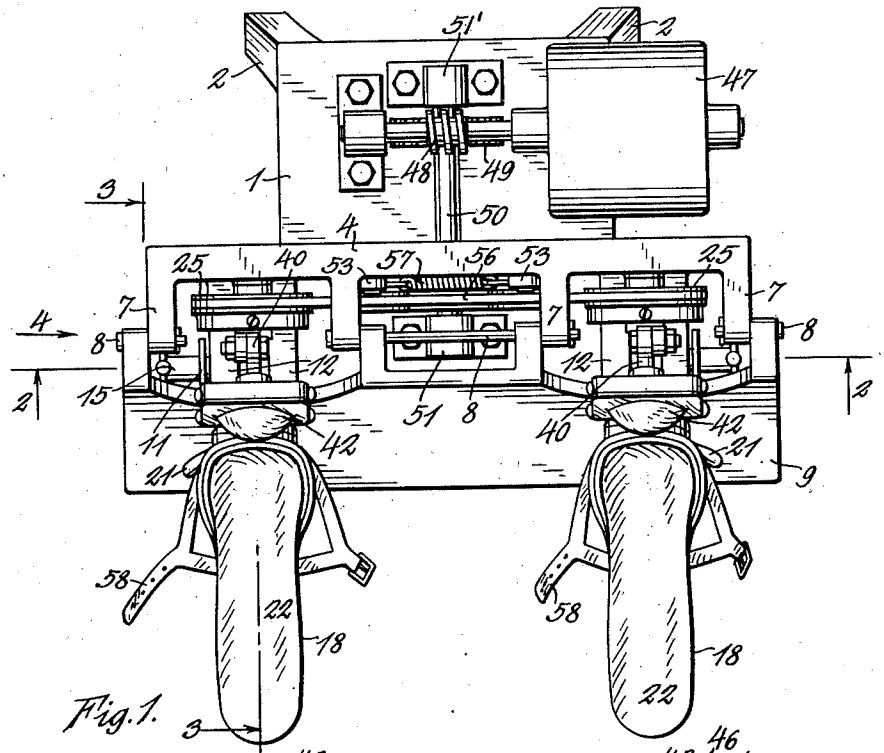

Fig. 1.

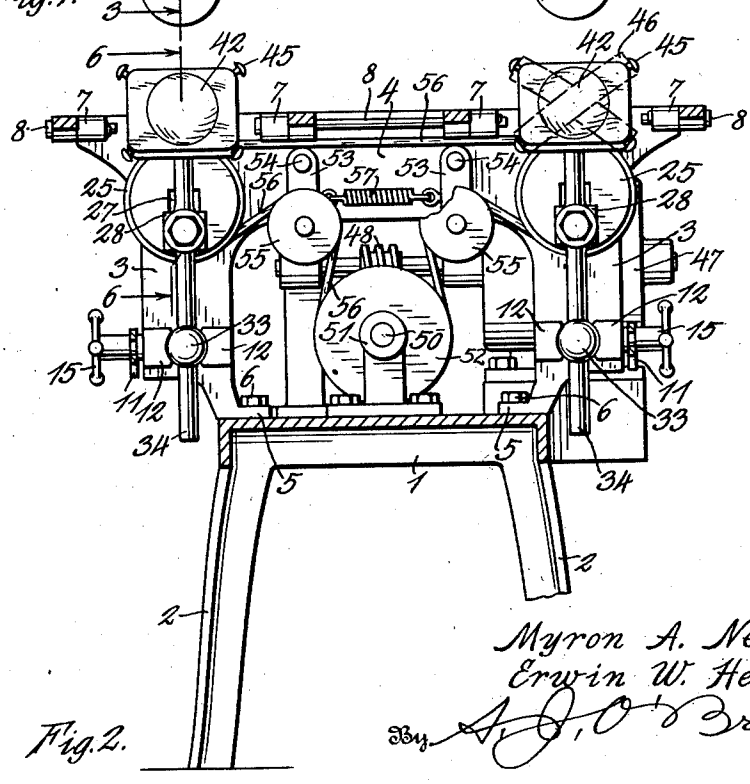

Fig. 2.

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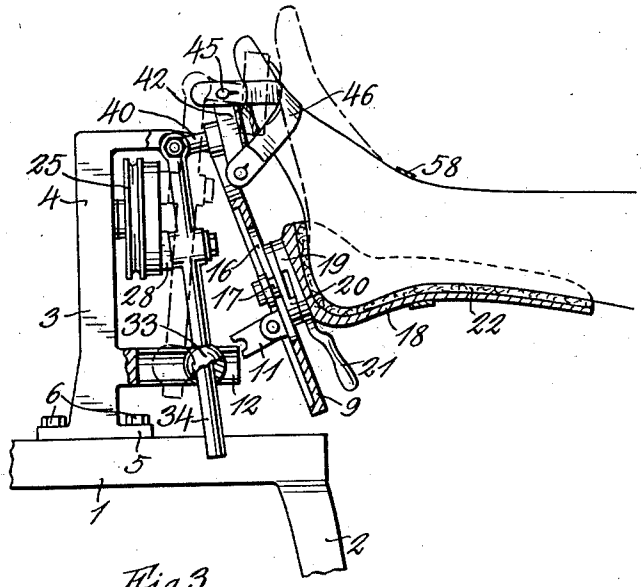

Fig.3.

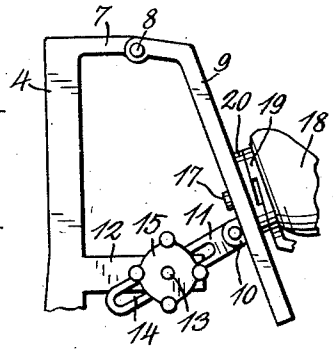

Fig.4.

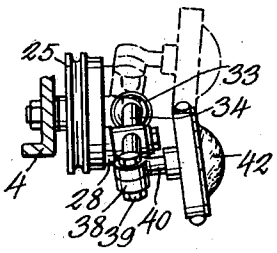

Fig.5.

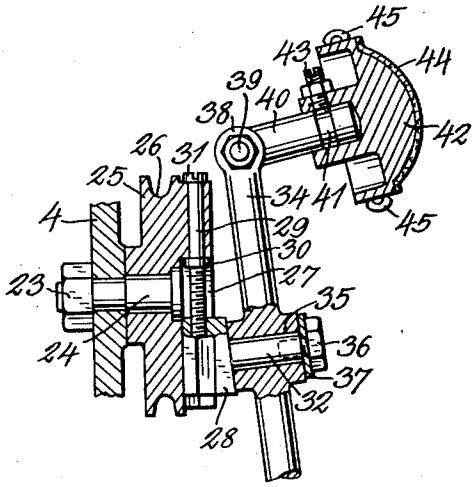

Fig.6.

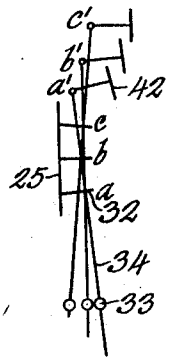

Fig.7.

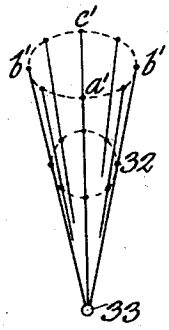

Fig.8.

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FOOT MUSCLE EXERCISER

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Application July 25, 1932. Serial No. 624,390

12 Claims. (Cl. 128—25)

This invention relates to improvements in apparatus for treating and exercising the feet and foot muscles with special reference to strengthening and correcting the arches.

Many people develop trouble with their feet due to the fact that the bones forming the arches become misplaced with the result that the arches fall and these abnormal arches produce great discomfort and unless corrected in time the condition grows steadily worse until it becomes necessary for the patient to resort to steel arch supports and other expedients which produce great discomfort and inconvenience.

It has been found that when defective feet of the type referred to are given a systematic exercise, especially in the early stages, that the bones resume their natural position and the muscles and tendons become strengthened so as to hold them in normal position, and it is customary for chiropodists and other professional people who give treatments for correction of such troubles to subject the feet to certain prescribed manipulations that if persisted in produce the results desired.

The exercise which has been found most useful for the correction of foot troubles is to bend the foot downwardly at the toes and at the same time move it sidewise so as to produce a compound movement that affects all the muscles and tendons whereby strengthening results are obtained.

It is the object of this invention to produce a mechanism by means of which the feet can be exercised in a manner to strengthen the muscles and tendons as to move the bones back into normal position.

Another object of this invention is to produce a machine that shall be automatic in its operation and by means of which either one or both feet can be exercised simultaneously and in such a way as to produce the corrective results aimed at.

A still further object of this invention is to produce a machine of a simple and substantial construction that can be readily operated and which will perform the desired operations without hurting or injuring the patient.

The above and other objects that will appear as this description proceeds are attained by means of a construction and an arrangement of parts that will now be described in detail and for this purpose reference will be had to the accompanying drawings in which the apparatus that forms the subject of this invention has been illustrated in its preferred form, and in which:

Fig. 1 is a top plan view of the machine embodying this invention;

Fig. 2 is a section taken on line 2—2, Fig. 1;

Fig. 3 is a section taken on line 3—3, Fig. 1, and shows a foot in place on the machine in the position it occupies during treatment;

Fig. 4 is a view looking in the direction of arrow 4, Fig. 1;

Fig. 5 is a top view looking onto the movable member to which the foot is attached;

Fig. 6 is a vertical section taken on line 6—6, Fig. 2;

Fig. 7 is a diagrammatic side elevation showing the manipulating element in three different positions; and

Fig. 8 is a diagrammatic view showing the path of the different points of the manipulating element or pedal.

In the drawings numeral 1 represents a base or support that is provided with four legs 2. The presence or the absence of the legs is immaterial, but in the preferred embodiment they have been provided so as to bring the mechanism to the proper height. Secured to the top of the base is a mechanism comprising a frame having two downwardly extending side portions 3 which are connected at their tops by means of a transverse portion 4. The lower ends of the sides 3 are provided with inwardly extending feet or lugs 5 that are fastened to the base by means of bolts 6. The upper edge of transverse member 4 is provided with forwardly extending projections 7 that are perforated for the reception of hinge pins 8, by means of which the movable plate 9 is secured in place. The relationship between parts 4, 7, 8 and 9 is shown most clearly in Fig. 4 from which it will be seen that the plate 9 has lugs 10 on its rear surface to which the slotted links 11 are pivotally connected. Extending forwardly from member 4 are two projecting brackets 12 that are perforated for the reception of a bolt 13 which passes through the slot 14 in the link 11. Bolts 13 are provided with clamping nuts 15 and by loosening these nuts the inclination of member 9 can be adjusted to suit different conditions and after it has been adjusted it is clamped in adjusted position by the nut 15. Plate 9 is provided with two vertical slots 16 spaced apart and extending through these slots are bolts 17 to the outer ends of which are secured supporting brackets 18. These brackets are separated from the plate by two cam members 19 and 20. Cam member 19 is provided with a handle 21 and by turning these plates relative to each other the bracket can be held in any adjusted

position. It will be seen from Figs. 3 and 4 that the cam members 19 and 20 have cam surfaces that spread the outer surfaces apart when rotated in one direction and allow them to move towards each other when rotated in the other direction. Brackets 18 are preferably provided with a lining 22 which may be made of felt or sponge rubber.

Secured to the transverse member 4 directly back of these slots 16 are bolts 23 that have each a cylindrical journal 24 on which is mounted for rotation a pulley 25. Bolts 23 are referred to in the claims as shafts. This pulley is provided with a groove 26 for the reception of a belt and the flat surface of the pulley is provided with a transverse recess 27 in which is slidably located a block 28. The sides of the recess 27 may be under cut in the manner common with what is known as T-slots and the block 28 may be provided with projecting ribs that engage in the slots so that the block will be held against transverse movement. In the embodiment shown a bolt or screw 29 has been mounted for rotation in a bearing formed in the solid portion of the pulley in such a way that it is in axial alignment with the slot 27. This bolt is provided with a collar 30 which prevents it from moving outwardly while the slotted head 31 prevents it from moving in the opposite direction. The blocks 28 have threaded openings with which the threads on the screws 29 cooperate and by rotating the screw the position of the block can be moved outwardly and inwardly with respect to the axis of rotation of the pulley. Other equivalent means for adjusting the position of the crank pin can, of course, be substituted for the one shown and described. The outer surface of each block 28 is inclined inwardly towards the center and has a crank pin 32 that is perpendicular to the inclined surface. It will be seen that when the pulley is turned about its axis of rotation the axis of the crank pin will move in such a way as to form the surface of a cone whose apex lies in the axis of pin 24 extended.

The projecting lugs 12 occur in pairs and preferably so located that a vertical line extending downwardly from the center of pin 24 will pass between the two lugs of each pair. The inner or adjacent surfaces of lugs 12 are concave as shown most clearly in Fig. 3 and are adapted to retain a ball 33. This ball has a diametrical opening for the reception of the lower end of the rod 34. Rods 34 are provided intermediate their ends with a transverse bearing 35 through which the crank pin 32 extends and are held in place on the crank pin by means of a nut 36 and a washer 37. Rods 34 extend above the bearing a distance substantially equal to the diameter of the pulley so that the upper ends of the rods will project a short distance above the upper edge of the pulleys, although this is not absolutely necessary, but is believed to be desirable. The upper ends of rods 34 are flattened as indicated by reference numeral 38 and are perforated for the reception of a clamping bolt 39. Secured to the upper end of each rod 34 is a cylindrical member 40 that is provided adjacent its outer end with an annular groove 41. Attached to the outer end of member 40 is a member that has been indicated by reference numeral 42, which is roughly speaking, semi-spherical, and is provided on its rear surface with a cylindrical opening into which the end of member 40 extends and is secured to this member by a set screw 43 whose inner end engages in the groove 41. A covering 44 is preferably applied to the convex surface. The periphery of member 42 is provided with headed pins 45 to which elastics 46 may be secured. The elastics serve to secure the upper end of the foot in place against member 42 in the manner shown most clearly in Fig. 3. Since rods 34 are connected with the crank pins 32 and since the latter are inclined with respect to the axis of rotation and since the lower ends of rods 34 are slidably connected with the balls 33 that in turn are guided in the grooves between lugs 12, the member 42 to which the foot is attached will be given a peculiar motion when the pulley to which it is secured is rotated.

In Figs. 7 and 8 the pulley 25 has been designated by a straight vertical line, while the crank pin 32 has also been designated by a straight line but in three different positions. Since the rods 34 are connected to the crank pins by elongated bearings as shown in Fig. 6, they will always extend perpendicularly to the axis of the crank pin, regardless of the position in which this is located during the revolution of the pulley. When the crank pin is at the bottom in the position designated by the letter *a* in Fig. 7 the upper end of the rod will occupy the position designated by the letter *a'* and when the disk is rotated ninety degrees, the crank pin is at the position indicated by the letter *b* and the upper end of the rod in the position indicated by *b'* while the crank pin is at the uppermost position as indicated by the letter *c*, the upper end of the rod occupies the position indicated by *c'*. It will be seen from Fig. 7 that the member 42 to which the foot is attached has a forward and backward, as well as an up and down motion and if we refer to Fig. 8, we will see that the upper end of rod 34 travels in a closed curve which resembles an ellipse. The several positions mentioned in connection with Fig. 7 have been indicated by corresponding numerals in Fig. 8. The position of the crank pin has been designated by means of a dotted circle, while the ball 33 that forms the pivot point for rod 34 has also been shown. There is also another motion which is not apparent from Figs. 7 and 8, but can be seen more clearly from Fig. 5 and this is a turning motion. It will be apparent that when the rod 34 is in the position designated by *b'* in Fig. 8, it will be turned inwardly in the manner shown in Fig. 5, so that the foot will be given a rocking motion, as well as an up and down and forward and backward motion.

Particular attention is called to the peculiar compound movement that the apparatus gives to member 42 and which this, in turn, imparts to the foot when it is under treatment. Although the crank pin 32 moves in a vertical circle, which in turn raises and lowers the upper end of rod 34, this does not necessarily lift the foot from the support because when the member 42 moves downwardly, it also moves away from the support so that the up and down movement is compensated for by the rocking or bending of the foot.

It will be apparent that when the foot is strapped to the member 42 and the pulley rotated, the foot will be bent about the instep and also twisted in both directions and simultaneously therewith rocked about the support and these three movements performed simultaneously will produce a strengthening action that will improve the tone of the muscles and tendons and will also bring the bones back into normal

position. The patient by resisting the action of the apparatus can subject the muscles and tendons to as severe strains as desired, because this strain depends on the voluntary resistance offered to the operation of the machine by the patient.

As far as the method and the results are concerned, a single pulley and crank disk constructed in the manner described and a single support is sufficient to carry out the method and obtain the results and it is also immaterial if considered broadly, how the pulley is rotated, and it may be rotated by a crank and thus operated by hand or it may be rotated by power in the manner to be presently described.

Since it is nearly always desirable to treat both feet of a patient, the machine has been constructed so that there are two duplicate parts, one for each foot. The two pulleys are driven simultaneously by power derived from an electric motor which has been designated by reference numeral 47. This motor is secured to the upper surface of base 1 and has its drive shaft provided with a worm 48, which cooperates with a worm gear 49 carried by shaft 50. Shaft 50 is journaled in a bearing 51 at the front of the machine and a bearing 51' at the rear. Secured to shaft 50 is a pulley 52 and secured to the lower ends of links 53 that are pivoted at their upper ends, as indicated by reference numeral 54, are idlers 55. These idlers are located in the plane of the grooves in pulleys 25 and 52 and the belt, which has been designated by reference numeral 56, extends around pulley 52 over pulleys 55 and thence around the pulleys 25. A spring 57 connects the two links 53 and produces sufficient tension to rotate the parts against normal resistance, but if for any reason the resistance should be excessive, then the belt will be permitted to slip due to the stretching of spring 57. This friction drive is believed to be of considerable importance in a machine of this type because if for any unforeseen reason the patient should exert too much resistance, or if some accident should take place, the belt would slip before any injury could result.

In the drawings straps 58 have been shown for securing the foot to the supports or bracket 18, but this is not necessary except occasionally and they can therefore be dispensed with, if desired.

It will be seen from the above description and from the drawings that the apparatus that forms the subject of this invention is specially well adapted for the purpose for which it is intended and that it is so constructed that when a patient's foot is applied to the same in the manner described and shown, it will subject the foot to a compound motion that has been found from experience to be very beneficial where weak or fallen arches are to be treated and which is also beneficial for people having normal feet, but which lack the necessary strength, as by the operation of this machine the required exercise is given to the muscles and tendons to impart to them the strength necessary to keep the parts in normal position and to prevent excessive tiring when walking.

Having described the invention what is claimed as new is:

1. A mechanism of the class described comprising, in combination, a support, a shaft carried by the support, a disk having a crank pin carried by the shaft and rotatable about the axis thereof, the axis of the crank pin being inclined with respect to the axis of the shaft, a rod pivotally connected with the crank pin, a guide for one end of the rod, means for turning the disk, and a foot clamping device secured to the other end of the rod.

2. A mechanism of the class described comprising, in combination, a support, a shaft mounted in the support, a crank disk carried by the shaft, a crank pin secured to the disk, the axis of the crank pin being inclined with respect to the axis of the shaft, a rod pivotally connected with the crank pin, a guide for one end of the rod, an attaching means carried by the free end of the rod, and means for turning the disk about the axis of the shaft.

3. A mechanism of the class described comprising, in combination, a support, a shaft mounted in the support, a crank disk carried by the shaft, a crank pin secured to the disk, the axis of the crank pin being inclined with respect to the axis of the shaft, a rod pivotally connected with the crank pin, a guide for one end of the rod, an attaching means carried by the free end of the rod, means for turning the disk about the axis of the shaft and a bracket carried by the support and projecting therefrom.

4. A mechanism of the class described comprising, in combination, a support, a shaft mounted in the support, a crank disk secured to the shaft, a crank pin carried by the disk, means for adjusting the position of the crank pin so as to vary its distance from the center of the shaft, the axis of the crank pin being inclined with respect to the axis of the shaft, a rod pivoted to the crank pin at a point intermediate its ends, and a guide for the lower end of the rod.

5. A mechanism of the class described comprising, in combination, a support, two parallel shafts mounted in the support, a crank disk carried by each shaft, a crank pin carried by each disk, means for adjusting the position of the crank pin so as to vary its distance from the center of the shaft, the axis of the crank pin being inclined with respect to the axis of the shaft, a rod pivoted to the crank pin at a point intermediate its ends, a guide for the lower end of the rod, means for turning both crank disks about the axis of their respective shafts, and an attachment means carried by the free end of the rod.

6. A mechanism of the class described comprising, in combination, a support, a shaft mounted in the support, a crank disk secured to one end of the shaft, a crank pin carried by the disk, means for adjusting the position of the crank pin so as to vary its distance from the center of the shaft, the axis of the crank being inclined with respect to the axis of the shaft, a rod pivoted to the crank pin at a point intermediate its ends, a guide for the lower end of the rod, an attaching means carried by the free end of the rod, and a bracket carried by the support and projecting therefrom.

7. A device of the class described comprising, in combination, a support, spaced shafts whose axes are substantially parallel mounted in each support, a crank disk carried by one end of each shaft, a crank pin secured to each disk, the axis of the crank pins being inclined with respect to the axes of the shafts, a rod pivotally connected to each pin, a guide means for the lower end of each rod, a drive shaft, and friction means for transmitting motion from the drive shaft to the other two shafts, the friction drive means being adjusted to slip when the resistance exceeds a predetermined value.

8. A device of the class described comprising,

in combination, a support provided with two spaced shafts whose axes are substantially parallel, a crank disk carried by one end of each shaft, a crank pin secured to each disk, the axes of the crank pins being inclined with respect to the axes of the shafts, a rod pivotally connected to each pin, a guide means for the lower end of each rod, a drive shaft having a pulley at one end, an idler pulley on each side thereof, a belt extending partly around the pulley on the drive shaft and over the idler pulleys, and a pulley secured to each of the other shafts in position to be engaged by the belt.

9. A machine for exercising the muscles of the feet comprising, a support, a shaft carried by the support, a crank disk secured to one end of the shaft, a crank pin attached to the disk, means for adjusting the position of the crank pin radially on the disk so as to change the throw, the axis of the crank pin being inclined with respect to the axis of the shaft so that it will generate the surface of a cone when the shaft rotates, a rod pivotally connected with the crank pin, the support having a projection provided with a slot that forms a guide for one end of the rod, means at the other end of the rod for attaching a foot thereto and a supporting bracket carried by the support in front of the crank disk.

10. A machine for exercising the muscles of the feet comprising a support, a shaft carried by the support, a crank disk secured to one end of the shaft, a crank pin attached to the disk, means adjusting the position of the crank pin radially on the disk so as to change the throw, the axis of the crank pin being inclined with respect to the axis of the shaft so that it will generate the surface of a cone when the shaft rotates, a rod pivotally connected with the crank pin, the support having a projection provided with a slot that forms a guide for one end of the rod, means at the other end of the rod for attaching a foot thereto, a supporting bracket carried by the support in front of the crank disk, and means for adjusting the position of the support.

11. A foot exercising machine comprising, in combination, a support, a shaft carried by the support, a crank disk carried by the shaft and rotatable about the axis of the shaft, a crank pin carried by the disk, the axis of the crank pin being inclined with respect to the axis of the shaft, a rod pivoted intermediate its ends to the crank pin, a guide for one end of the rod, means at the other end for attaching a foot to the rod, and means for turning the crank disk.

12. A device for exercising the foot muscles comprising, in combination, a stationary support, means carried by the support for receiving the heel of a foot to be treated, means for engaging the ball of a foot, means for securing the last mentioned means to the foot, and means for imparting to the ball engaging means a simultaneous motion comprising, a vertical component, a horizontal component in the plane of the vertical component, a horizontal component in a direction substantially perpendicular to the vertical and the first mentioned horizontal components, and a twisting force, the said ball engaging means traveling in a closed curve.

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