July 14, 1953 H. W. WEINERMAN 2,645,025

SUPRONIMETER AND FOOT BALANCING APPLIANCE

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Fig. 1.

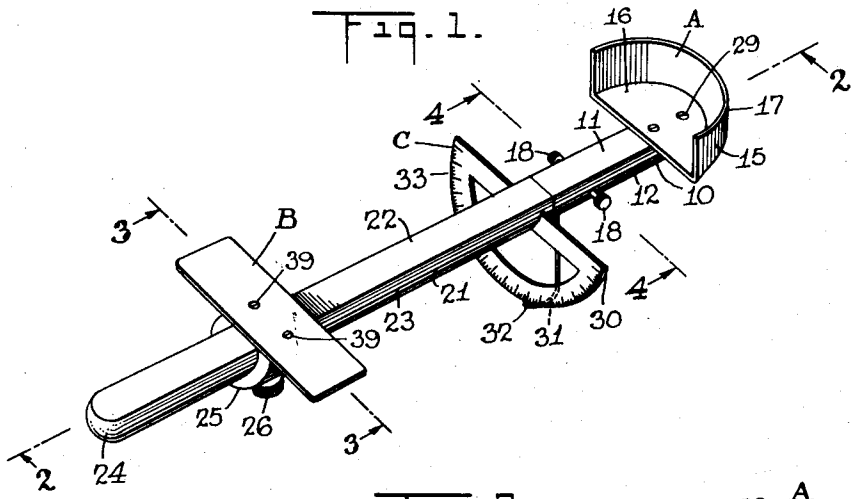


Fig. 2.

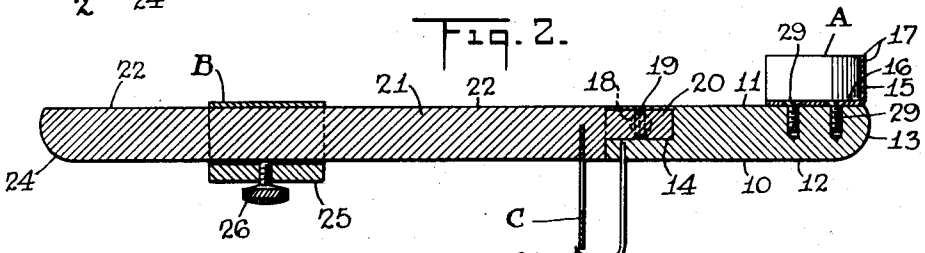


Fig. 3.

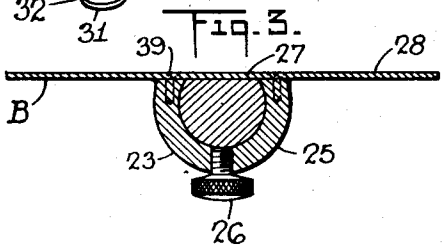


Fig. 5.

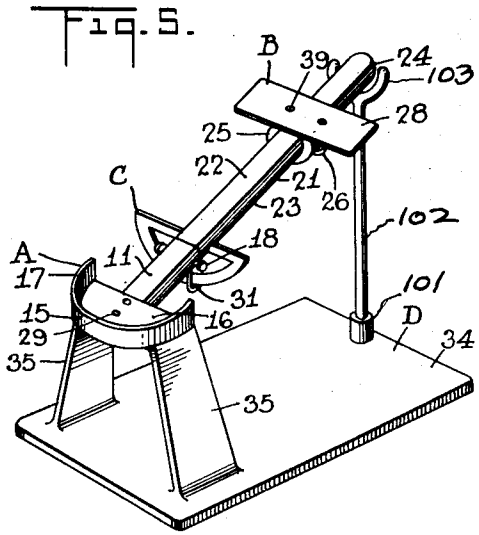
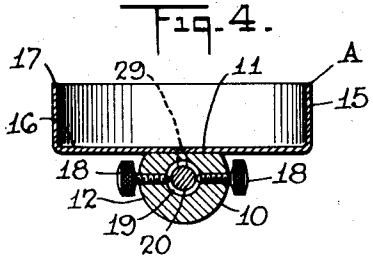


Fig. 4.



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Fig. 6.

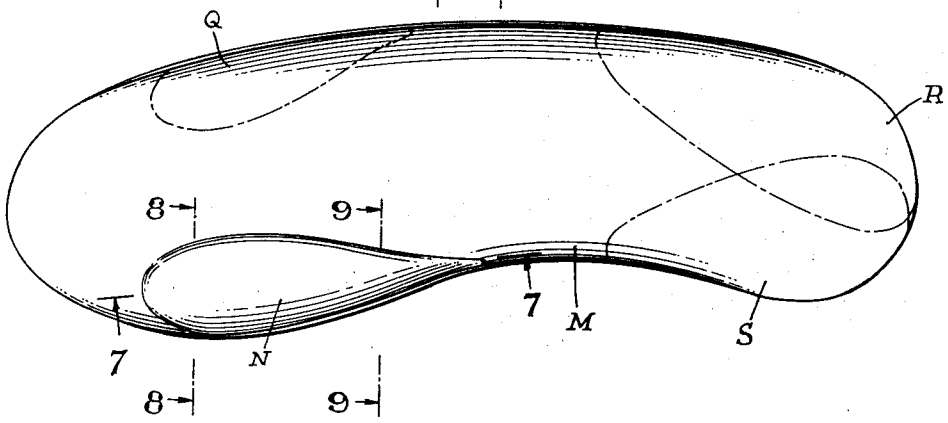


Fig. 7.



Fig. 8.

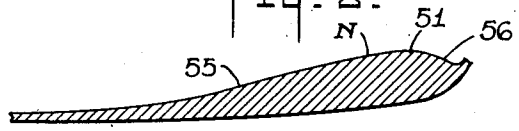


Fig. 9.

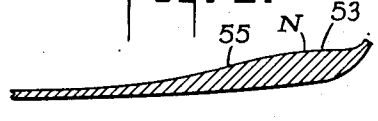
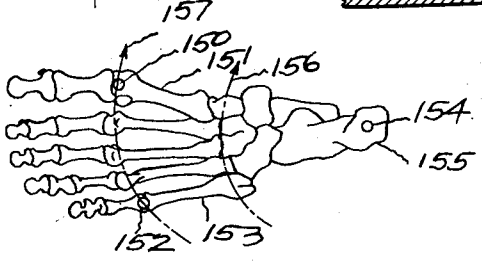


Fig. 10.



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SUPRONIMETER AND FOOT BALANCING APPLIANCE

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Application July 11, 1946, Serial No. 682,818

11 Claims. (Cl. 33—174)

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The present invention relates to a device to be known as a supronimeter for measuring the amount of pronation and supination and to a stabilizing or balancing appliance to accommodate said conditions.

The foot is not a rigid structure but has motion at the mid-tarsal joint. Considering the mid-tarsal joint as a dividing line that portion of the foot anterior or toward the toes is called the fore-foot; while the part of the foot posterior or toward the heel is called the rear-foot. Even when the rear-foot is held firmly, the fore-foot may rotate toward the inner border in pronation or to the outer border in supination. The inner border or edge of the foot is also known as the medial border while the outer border or edge is also known as the lateral border, so that pronation may be regarded as medial rotation while supination may be regarded as lateral rotation.

The foot has three points of weight bearing namely, the center of the heel, the head of the fifth metatarsal and the head of the first metatarsal. Normally on motion the rear-foot touches the ground first at the center of the heel and then the fore-foot touches the ground at the head of the fifth and first metatarsal almost simultaneously. Such a foot is said to be properly balanced or in proper function.

However, because of some disability in the foot, as the fore-foot approaches the ground the head of the fifth metatarsal will touch while the head of the first metatarsal will remain elevated.

In such a case in order for the head of the first metatarsal to touch the ground, the fore-foot will be compelled to rotate medially at the mid-tarsal joint and go into an attitude of pronation.

Conversely, if the head of the first metatarsal touches the ground first and the head of the fifth metatarsal remains elevated, the fore-foot will again rotate laterally at the mid-tarsal joint and assume an attitude of supination. In either case the foot is said to be in imbalance or dysfunction.

Because of such imbalance or dysfunction feet will either pronate or supinate and produce symptomatology. Only the restoration of proper balance or normal function will relieve these symptons.

The degree of pronation or supination will determine the amount of medial rotation or lateral rotation. Correction must be accurate and precise. If either condition is over-corrected we will then obtain an imbalance in the opposite direction and produce a dysfunctioning foot.

Comparison may be made to a three-legged table with one in the back and two in the front. If all three legs touch the supporting surface the

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table will be in perfect balance. If, however, either one of the two front legs is a fraction of an inch short the table will tilt in the direction of the short leg and may be considered in imbalance. To balance such a table it then becomes necessary to add to the short leg—no more and no less than the amount represented by the shortening.

It is among the objects of the present invention to provide an instrument or device to determine the degree of dysfunction or pronation and supination of the foot to enable provision of accurate corrective balancing or stabilizing appliances.

It is a further object to provide a corrective balancing or stabilizing appliance which may be inserted into a shoe or built unitarily with footwear and which will correct or balance the foot in case of pronation or supination.

Still further objects and advantages will appear in the more detailed description set forth below, it being understood, however, that this more detailed description is given by way of illustration and explanation only and not by way of limitation, since various changes may be made by those skilled in the art without departing from the scope and spirit of the present invention.

It is a particular feature of the present invention to provide an instrument to be carried and applied by the hand or to be positioned on a stand which will readily and accurately measure degree of pronation and supination.

It is a further feature to provide a corrective appliance having tear-shaped or streamlined wedges for balancing or stabilizing the foot by placing such wedges under the heads of the first or fifth metatarsal bones, and also if necessary the heel of the foot.

In the drawings which show several of the embodiments of the present invention by way of illustration and not by way of limitation,

Fig. 1 is a top perspective view of a supronimeter to be held in the hand during measurement according to the present invention,

Fig. 2 is a side sectional view taken upon the line 2—2 of Fig. 1 upon an enlarged scale as compared to Fig. 1,

Fig. 3 is a transverse sectional view upon the line 3—3 of Fig. 1 upon an enlarged scale as compared to Fig. 1,

Fig. 4 is a transverse sectional view upon the line 4—4 of Fig. 1 upon an enlarged scale as compared to Fig. 1,

Fig. 5 is a top perspective view of a supronimeter which is mounted upon a stand,

Fig. 6 is a top plan view of a balancing insert

which may be inserted or built into footwear pursuant to the measurements of the supronimeter of Figs. 1 to 5,

Fig. 7 is a longitudinal sectional view upon the line 7—7 of Fig. 6 of the typical wedge used to balance or stabilize the foot upon an enlarged scale as compared to Fig. 6,

Fig. 8 is a transverse sectional view upon the line 8—8 of Fig. 6 of the balancing wedge upon an enlarged scale as compared to Fig. 6,

Fig. 9 is a transverse sectional view upon the line 9—9 of Fig. 6 of the balancing wedge upon an enlarged scale as compared to Fig. 6, and

Fig. 10 is a bottom diagrammatic plan view of a skeleton of a right foot, illustrating the weight supporting structure.

Referring to Figs. 1 to 4, the supronimeter has a reel receiving member A, a forefoot receiving member B, and a pronation and supination measuring member C.

The bar portion 10 has a flat top face 11 and a cylindrical lower face 12, a rounded end portion 13 and a cylindrical recess 14. The heel contact member 15 has a semi-circular base 16 and a half cylindrical wall 17. The base 16 is held in position on the flat surface 11 by the screws 29. In its sides, the bar 10 carries one or two opposite stop screws 18, which might be replaced by a single screw at the bottom of the bar.

The screw or screws 18 engages the groove 19 in the cylindrical boss 20 of the bar 21. The bar 21 has a flat upper face 22, a cylindrical lower face 23, a round end 24 to match correspondingly shaped faces of the bar 10. Fitted upon and adjustable upon the bar 21 is the sleeve 25 carrying the stop screw 26, the sleeve 25 as shown in Fig. 3 having a flat upper face 27 and a transverse platform 28.

The measuring arrangement consists of a graduated arcuate member 30 fixed to the bar 21 and a swinging pointer member 31 fixed to the bar 10 which has forwardly and upwardly projecting portions 31 and 32. The portion 32 serves as a pointer to move over the arcuate graduated portion 33 of the member 30.

Considering the foot skeleton of Fig. 10, the three weight supporting portions or sections are indicated by the imaginary circles 150, 152 and 154. The circle 150 at the head of the first metatarsal bone 151, the circle 152 at the head of the fifth metatarsal bone 153 and the circle 154 on the heel bone 155 form the tripod supporting the weight applied to the foot. The mid-tarsal arch is indicated by the dot and dash line 156, while the metatarsal arch is indicated by the dot and dash line 157.

In operation, the hand of the measurer holds relaxed the supronimeter and applies it while the foot is in a relaxed position adjusting the platform or bridge 23 so it will extend transversely across the forefoot from the head of the first metatarsal bone to the head of the fifth metatarsal bone. The heel is positioned on the base plate 16 and against the semi-cylindrical backing member 17 and the set screws 18 are loosened permitting the natural pronation on the inside of the foot, or supination on the outside of the foot to take place. Then the screws 18 are tightened and the supronimeter removed. The reading of the position of the pointer 32 on the graduations 33 would then enable calculation of the amount of pronation or supination and proper design of a corrective balancing or stabilizing appliance as shown in Figs. 6 to 9.

In Fig. 5, the supronimeter is mounted upon a stand D having the base 34 and the legs 35 extending up to and supporting the base plate 16. The base plate 34 also carries the holder 101 receiving the upright rod 102.

The rod 102 carries at its upper end the yoke 103. The yoke 103 carries the end 24 of the bar 21. The measurement may then be made without placing the device on the foot by the hand of the person utilizing the device and to give the amount of pronation or supination on weight bearing.

Figs. 6 to 9 illustrate diagrammatically a corrective balancer or stabilizer appliance to be utilized. The insert M may be built into a shoe or inserted as a separate unit into the shoe. The unit M is provided with either a medial wedge N or a lateral wedge Q. Where necessary a heel wedge R or S may also be provided. The wedge N is designed to be positioned below the first metatarsal bone while the wedge Q is designed to be positioned below the fifth metatarsal bone to correct the amount of pronation or supination as determined by the instrument of Figs. 1 to 5.

The wedges N and Q are typically shown in Figs. 7 to 9 as provided with elongated ridge like elevations 50, raising to a crest 51 forwardly toward the toe or forepart of the foot and then sharply sloping downwardly as indicated at 52. Toward the heel the slope 53 is more gradual and it terminates in a decline at 54. As shown in Figs. 8 and 9, the ridge 50 is positioned close to the medial aspect or inner border of the foot and has a shallow slope 55 outwardly and a steep slope 56 toward the medial border of the foot. The wedge Q is of similar shape except that the slopes 55 and 56 are reversed.

The heel wedges R or S will also reach a highest point to the right or left and slope downwardly on all sides depending upon whether it is also necessary to correct for pronation or supination at the heel as well as at the medial or lateral border of the foot.

All of the wedges N, Q, R and S will have a tear drop or ovular appearance in top view as shown in Fig. 6.

The corrective appliance of Figs. 6 to 9 will balance or stabilize the foot, preventing supination or pronation and assuring proper function of the foot. The tendency of the foot in dysfunction to rotate will be overcome and proper balance assured.

The heights or thicknesses at the crest will vary from ⅛" to ⅜" corresponding to between about 2° to 15° swing of the pointer 32 on the same side of the forefoot as the reading on the scale C.

To determine the amount of correction necessary for the heel wedge R or S the supronimeter may be first used to measure disability in the forefoot and then reversed to determine the disability at the heel.

Ordinarily the wedges N, Q, R and S are cut from cork or resin impregnated plastic sheets having a thickness varying from 1/16 to ⅛" and a sufficient number are used after having been cut out in tear drop shape and glued together as by rubber cement, to give the proper thickness.

Then the surfaces of the wedge are shaped as shown in Figs. 7 to 9 by grinding on a sandwheel or other grinding means.

To fashion the insert M normally a cast is taken of the foot, which cast is used as a form for production of a thin foot contact shell of leather, stiff fabric or other suitable materials. To the bottom of the shell the wedges are adhered

in the proper positions and the bottom including the wedges is covered with leather, fabric or other protective materials. The wedges may also readily be positioned on top of the shell or next to the plantar surface of the foot. Instead of an insert to be inserted above the insole, the insole of the shoe may be so formed unitarily with the insert or be made unitarily with the shoe.

In providing a proper insert M after measurement by the device of Figs. 1 to 4, the insert may be provided with (1) a wedge Q alone; (2) a wedge N alone; (3) wedges Q and R together; (4) wedges N and S together; (5) wedges N and R together; (6) wedges Q and S together; (7) wedge R alone; or (8) wedge S alone. Normally a standard shape and size will be provided for the wedges N, Q, R and S, say for example of cork, resin impregnated fabrics and will be of a thickness determined by the reading of the supronimeter.

The supronimeter may read in degrees, which will require a trigonometric calculation to determine thickness of the wedge, or it may be calibrated in height of thickness of wedges required.

The heel section A may be provided with clip or strap means to hold it upon the heel of the foot and both hands of the operator to be free to manipulate the supronimeter.

As many changes could be made in the above supronimeter and foot balancing appliance and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A device for measuring pronation and supination comprising a heel receptor, a transverse contact bridge to extend between the heads of the first and fifth metatarsal bones, a rotary connection between said bridge and measuring means to record the amount of pronation and supination, said rotary connection including two flat top circular rods, one connected to the heel receptor and the other connected to the contact bridge, said rods being connected together to form a longitudinal extension of each other and said connection being formed by providing a projection on the end of one rod and a recess in the end of the other rod in which said projection turns and rotates.

2. A device for measuring pronation and supination comprising a heel receptor, a transverse contact bridge to extend between the heads of the first and fifth metatarsal bones, a rotary connection between said bridge and measuring means to record the amount of pronation and supination, said rotary connection being provided with lock means to enable or prevent relative rotary motion in said connection, said rotary connection including two flat top circular rods, one connected to the heel receptor and the other connected to the contact bridge, said rods being connected together to form a longitudinal extension of each other and said connection being formed by providing a projection on the end of one rod and a recess in the end of the other rod in which said projection turns and rotates.

3. A device for measuring pronation and supination comprising a heel receptor, a transverse contact bridge to extend between the heads of the first and fifth metatarsal bones, a rotary connection between said bridge and measuring means to record the amount of pronation and supination, said bridge being provided with adjustment to regulate the distance between the heel receptor and the bridge, said rotary connection including two flat top circular rods, one connected to the heel receptor and the other connected to the contact bridge, said rods being connected together to form a longitudinal extension of each other and said connection being formed by providing a projection on the end of one rod and a recess in the end of the other rod in which said projection turns and rotates.

4. A device for measuring pronation and supination comprising a heel receptor, a transverse contact bridge to extend between the heads of the first and fifth metatarsal bones, a rotary connection between said bridge and measuring means to record the amount of pronation and supination, said rotary connection including rods extending rearwardly from said bridge and forwardly from said heel, and also including a longitudinal socket at the adjacent end of one of said rods and a longitudinal cylindrical projection from the adjacent end of the other of said rods fitting thereinto, said rods being flat on their top faces and the adjacent interfitting ends of said rods receiving a recess and a projection fitting in said recess and rotating therein respectively.

5. A device for measuring pronation and supination comprising a heel receptor, a transverse contact bridge to extend between the heads of the first and fifth metatarsal bones, a rotary connection between said bridge and measuring means to record the amount of pronation and supination, said rotary connection including rods extending rearwardly from said bridge and forwardly from said heel, one of said rods carrying a graduated semicircular disk and the other of said rods carrying a pointer moving over said disk, said disk and pointer constituting said measuring means, said rods being flat on their top faces and the adjacent interfitting ends of said rods receiving a recess and a projection fitting in said recess and rotating therein respectively.

6. A supronimeter comprising a stand, a heel support on said stand, a rotary connection extending forwardly from said stand, a metatarsal supporting bridge on said connection and measuring means on said connection, said rotary connection consisting of two flat top rods, one permanently connected to the heel support and the other adjustably connected to the bridge and a connection between the adjacent ends of said rods consisting of a recess in one rod and a rotatable projection fitting into said recess from the end of the other rod.

7. A supronimeter comprising a stand, a heel support on said stand, a rotary connection extending forwardly from said stand, a metatarsal supporting bridge on said connection and measuring means on said connection, said metatarsal supporting bridge being adjustably supported on said connection, said rotary connection consisting of two flat top rods, one permanently connected to the heel support and the other adjustably connected to the bridge and a connection between the adjacent ends of said rods consisting of a recess in one rod and a rotatable projection fitting into said recess from the end of the other rod.

8. A device for measuring the amount of pronation and supination of the human foot comprising an elongated forward bar having a flat upper surface, and an elongated rear bar having

a flat upper surface, a pivotal connection between said bars consisting of a longitudinal recess in the adjacent end of one bar and a projection fitting thereinto on the adjacent end of the other bar, said pivotal connection enabling said bars to be connected together and aligned with each other, and means on each bar to support the front and rear of the foot, said means including a heel receptor permanently mounted on one bar and a transverse bridge adjustably mounted on the other bar, and an arcuate measuring disk on one bar at the end adjacent the other bar and a pointer on the other bar at the end adjacent the first bar to measure the relative rotation between the bars.

9. The device of claim 8 in which the heel receptor is permanently mounted upon a stand and said bars extend obliquely upwardly therefrom.

10. The device of claim 8 in which said transverse bridge and said pivotal connection are provided with set-screws to fix them in any desired position.

11. A supronimeter comprising a heel support cup, a rod mounted on the bottom of said cup extending forwardly therefrom to about the bottom arch of the foot, said rod having at its forward end a pivot recess and a downwardly extending pointer member, a rod extension having

a reduced diameter rear extension fitted into said recess and turning therein, a graduated angular measuring disk mounted adjacent said extension and cooperating with said pointer member and an adjustable cross plate mounted on said extension to support the fore part of the foot.

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