

Oct. 24, 1939.

A. E. MURRAY

2,177,304

PROCESS OF OBTAINING EFFECTIVE FOOT IMPRESSIONS AND PRODUCTS THEREOF

Filed Oct. 30, 1936

2 Sheets-Sheet 1

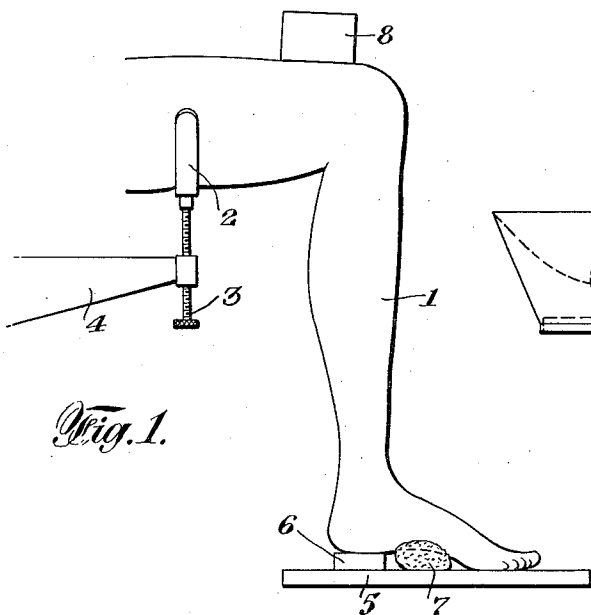


Fig. 1.

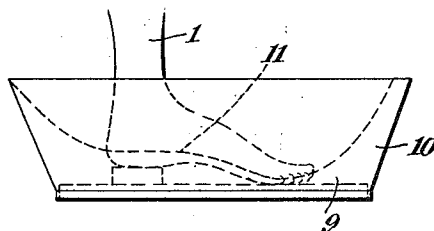


Fig. 2.

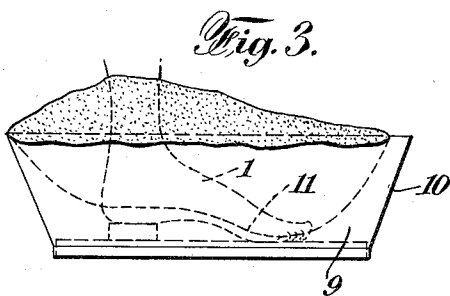


Fig. 3.

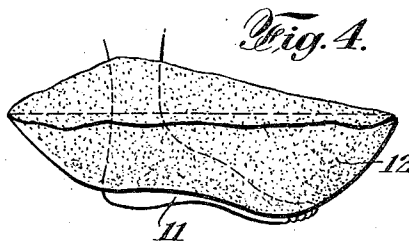


Fig. 4.

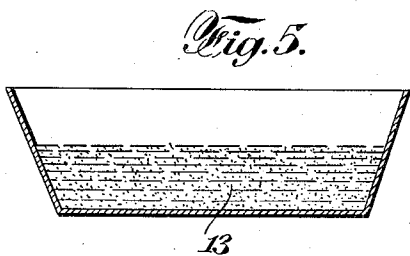


Fig. 5.

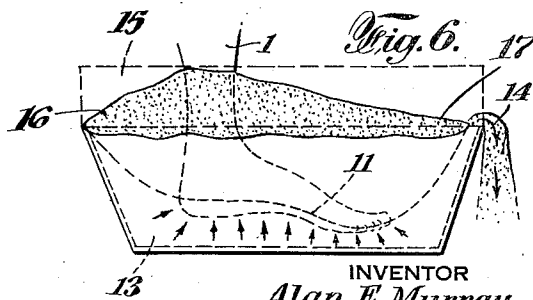


Fig. 6.

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2 Sheets-Sheet 2

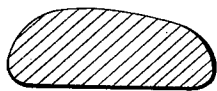


Fig. 7.

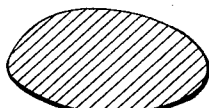


Fig. 8.

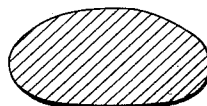


Fig. 9.

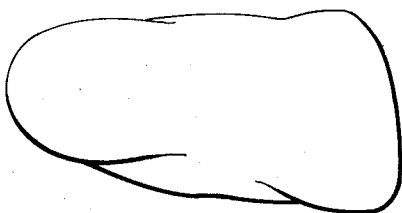


Fig. 10.



Fig. 11.

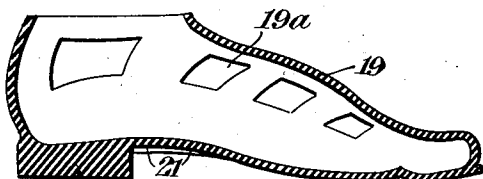


Fig. 12.

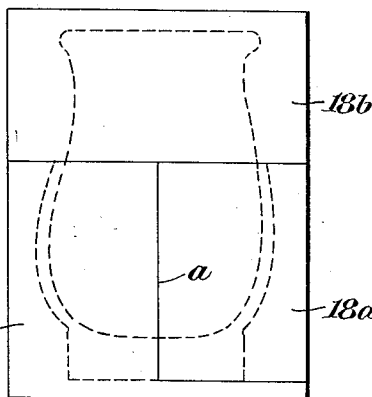


Fig. 14.

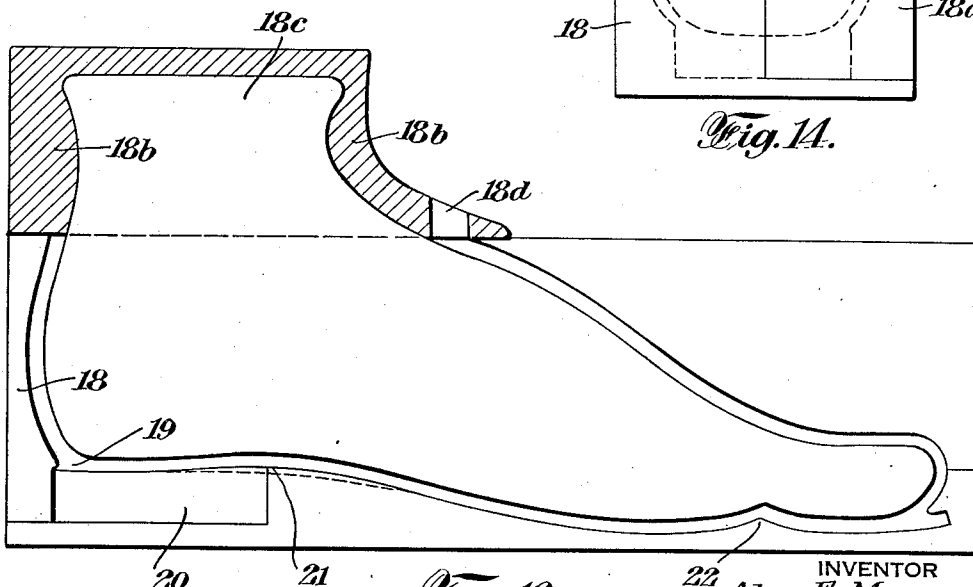


Fig. 13.

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UNITED STATES PATENT OFFICE

2,177,304

PROCESS OF OBTAINING EFFECTIVE FOOT
IMPRESSIONS AND PRODUCT THEREOF

Alan E. Murray, New York, N. Y.

Application October 30, 1936, Serial No. 108,405

3 Claims. (Cl. 18—55)

My invention relates particularly to a process and product thereof, for obtaining effective foot impressions or, in other words, effective molded contours of the foot.

5 The process herein is an improvement over the subject matter of my previous application upon appliance, Ser. No. 750,052, filed October 26, 1934.

Hitherto the greatest difficulty has been found in obtaining a duplication of the contours of the foot with sufficient accuracy to provide any foot correctives or supports or shoes that would be sufficiently correct to, in fact, by the use thereof, restore the foot to its normal condition of health. Previous methods have been found, in practice, to be not only uncomfortable because of such inadequacy but also not to serve the purpose of restoring the foot to its natural or normal condition. It is found that this could not be done by merely arbitrarily pressing the foot into an altered position approaching its normal shape because of the fact that such pressures were necessarily transmitted, not only through the soft tissues encasing the bones of the foot, but also because of lack of uniformity of proper distribution of forces applied in so altering the shape of the foot. I have discovered that an effective corrective for the foot could be obtained by applying pressure to the under part of the foot sufficient to alter the position of the bones, etc., of the foot to the intended and correct or natural position while providing a lock or hanger conforming to the opposite portion, as, for example, the upper portion of the foot conforming to the changed position on such opposite side and which naturally conforms itself not only to the readjusted position of the bones of the foot but also to the natural position of the soft tissues of that opposite or upper portion of the foot. I have, furthermore, discovered that when such lock or hanger has hardened or set to conform itself to such opposite or upper portion of the foot the other or under portion of the foot on which the pressure was initially exerted could then be accurately duplicated as to the contours thereof by applying a hydraulic material thereto which itself receives a uniform resistance or pressure from not only the bones of the foot in the readjusted position but also the soft tissues covering the bones of the under portion of the foot. This hydraulic material, furthermore, when hardened or set, provides an accurate duplication of the surfaces of the foot at the under portion thereof in the intended readjusted position of the foot. Furthermore, if desired, the original lock or hanger at the top of the foot may then be discarded and a new dupli-

cation of the contours of the upper portion of the foot can be taken while the foot is positioned in the accurate hardened hydraulic material on the under part of the foot above referred to, thus obtaining, instead of the original lock or hanger, a hardened contour containing a surface which conforms to the upper portion of the foot with the utmost accuracy. Positives or further negatives, separable in any convenient manner, may be made therefrom and it will be understood that any desired foot supports or enclosures or shoes can be made conforming to the contours of said positives or negatives, thus attaining, as above pointed out, foot supports or enclosures which are so completely exact in conforming to the readjusted position of the foot and taking into account the pressures unavoidably exerted by the soft tissues enclosing the bones of the foot, such that thereby not only comfortable but effective correctives are obtainable which can be used to restore the foot to its normal condition of health.

While my invention is capable of being carried out in many different ways, for the purpose of illustration I have described hereinafter only certain ways of carrying out the same, and which refer to the drawings herein, in which:

Fig. 1 is a side elevation illustrating the position and means for holding the leg and foot initially;

Fig. 2 is a similar view showing the foot, when so placed, within a tapered pan just before constructing the lock or hanger on the upper surface of the foot;

Fig. 3 is a similar view showing the lock or hanger produced therein;

Fig. 4 is a similar view showing the foot with the lock or hanger removed from the pan;

Fig. 5 shows the pan partially filled with the hydraulic material or plaster mass prior to the insertion of the foot and lock or hanger therein;

Fig. 6 is a similar view showing the formation of the body of material against the lower surface of the foot and hanger;

Fig. 7 is a cross-section of a foot that has been formed by the ordinary use of the foot against a flat surface support;

Fig. 8 is a cross-section of the foot shown as unsupported on any surface;

Fig. 9 is a cross-section of the foot in the position supported hydraulically in carrying out my method;

Fig. 10 is a view of a metallic arch support which may be made in accordance with my invention, as shown in Fig. 6 of my application upon Process of producing physiological shoes

and product thereof, Ser. No. 34,888, filed Aug. 6, 1935;

Fig. 11 is a similar view of an arch support with a soft front section therein, as shown in my application upon Foot support and construction involving the same, Ser. No. 43,658, filed October 5, 1935;

Fig. 12 is a view of a shoe made out of molded rubber, in carrying out my invention, and which may be latex, with or without fibres, such as wool, cotton, etc., therein, vulcanized in a colloidal state, known as Vultex;

Fig. 13 is a vertical section of a flask used in obtaining the shoe in Fig. 12;

Fig. 14 is a rear view of the 3-piece flask in Fig. 12.

In carrying out my method, for example, a leg 1 may be supported with the calf of the leg in a yoke or cradle 2 carried by the upper swiveled end of a thumbscrew 3 screw-threaded into a rigid bracket 4. The foot is then placed above a board 5 on which a heel block 6 rests which measures the height of the heel of the foot in the position of the ordinary shoe heel while the instep is made to rest against a support in the form of a lump of clay 7 made slightly plastic by wetting the same, while the ball and toes of the foot occupy the level of the front portion of the said board 5. It will be understood that in placing the foot in this manner the foot, by means of its underneath support, is given a placement which may be called arbitrary but which is, in fact, a readjustment upwardly of the relative positions of the bones of the foot in a normal foot or in an abnormal or deformed foot until, according to the medical skill of the operator, the foot bones will have attained the normal or correct position of the particular foot which it would have occupied before any deformation due to body weight supported by the foot or due to misuse of the foot, and into a position which the bones of the said foot would normally occupy if the normal foot were supported in a hydraulic support; in other words, an ideal position. This is intended, accordingly, to give to the surface of the tissues at the top of the foot its ideal contour of the normal foot when the foot is in body-supporting position. The board 5, heel block 6, lump of clay 7 and foot as located above, are positioned as described, with a weight 8 varying from nothing to the weight of the body, resting on the knee, within a pan 9 having outwardly flared sides 10 around all sides of the same. Dry sand is now introduced into the pan 9 until it reaches the position of the dotted line 11 in Fig. 2. That is to say the body of the sand is arranged so that all around the foot and in between the lower portions of the toes, and over the board 5, and around the block 6 and clay 7, the edge of the sand ends just slightly below the under-cut line running around the foot. By the term "under-cut line" I mean the line which divides the under-curvature of the foot from the rest of the foot. The outer portion of the body of the sand is flared upwardly and outwardly from the foot to the edge of the pan around three sides of the pan while at the front of the pan the sand is flared upwardly to form a thickened bank at the front of the pan as shown in Fig. 2. The inside surface of the pan, as well as the surface of the foot, will have been greased with any desired material, as, for example, vaseline, before introducing the sand, in order to prevent the contents from sticking to the pan, etc. A lock or hanger

12, in the form of a plaster mass, is now formed, filling the cavity in the pan above the sand and entirely around the foot up to a point just above the ankle, by pouring into the pan, in a semi-liquid state, a quantity of plaster of Paris mixed with water in the usual way, or any other similar way, and troweling the plaster up to the height referred to, as shown in Fig. 3, while the plaster is setting. The plaster, when set, forms a lock or hanger 12 covering the top surface of the foot slightly below the under-cut line and including and enveloping the ankle joint and overlapping slightly the edges of the pan to form a registry with the pan edge but not touching the front edge of the pan where a gap or space is left as shown in Figs. 3 and 6. While the plaster is semi-soft the lock or hanger is cut into with a knife or similar instrument, part of the way down along one or more vertical planes, as, for example, the plane constituting the longitudinal vertical median plane of the foot and another vertical plane at right angles to the same opposite the ankle. This is done to weaken the lock or hanger along these planes enabling it to be separated along said planes when hard. Any inadvertent excess plaster beyond what is desired above, may be now cut away and the foot elevated to withdraw it with the lock or hanger 12, the pan being slightly tapped to loosen it, by which means the lock or hanger will be readily removed, leaving the lock or hanger 12 on the foot, as shown in Fig. 4. This lock or hanger 12, which fits very accurately into the delicate contours of the upper portion of the foot tissues and maintains the relative position which has been given to the bones as well as the consequent contours of the upper tissues adjacent thereto, provides a baffle or positioning member. It is, however, true that this lock or hanger does contain, to a very slight extent, due to the soft tissues, a record of errors unavoidably introduced by pressing upwardly, as above, the bones through the agency of the intervening soft tissues, which errors may, however, be entirely removed, as later described herein. The formation of this lock or hanger, however, constitutes an important step in the procedure by which the ideal physiological contour is attained. Furthermore, in carrying out my process I may utilize materials in the succeeding steps which are progressively more fluent and hydraulic in their action, so that in the process herein, which may be designated as molding by tissue tension, there takes place a translation of contour as obtained by arbitrary force to obtain an ideal foot position, into contours which are ultimately formed by inner-tissue tension. In this way, any harsh angular elements of contour introduced by the initial arbitrary placement, as from the mode of supporting the foot, are eliminated. It will be seen that while the tissues of the foot approximate a liquid softness, at the same time the hard rigid elements of the foot, including the bones and ligaments, must be positioned in accordance with the requirements of walking and the ideal correction introduced by manipulative-medicine and yet so as to be able to obtain the contours of the soft tissues of the foot in their undistorted shape, as, for example, by obtaining an elevated arch of the foot, with slightly decreased foot length and coordinate slight changes in the toes, etc., in certain instances. With the lock or hanger 12 thus carried on the top of the foot, the former, which has a recess molded therein

fitting around the top of the pan, is now pressed down so as to fit over the upper edges of the pan containing a liquid or flowable plaster of Paris and water mixture 13, as shown in Figs. 5 and 6, the foot thus occupying a position spaced from the bottom of the pan the same as before but with the board 5, block 6 and lump of clay 7 removed. When the foot and lock or hanger 12 are thus inserted in the body of liquid plaster, the excess of the latter is forced out of the front of the pan at 14 as shown in Fig. 6 due to the hydraulic pressure developed in the pan by confining the plaster in the space between the foot, lock or hanger and walls of the pan. An equal pressure will thus be developed by the liquid 13 in all directions, enabling the contours of the adjacent surface of the foot to be duplicated with the greatest precision. This liquid 13 will not only thus exert an equal pressure upon the different parts of the foot surface but, due to its being confined in this way, will somewhat approximate the average pressure obtained by walking in soft mud, although the pressure in soft mud would not be uniform. This pressure will force the foot against the inside of the lock or hanger 12, bringing the foot intimately into contact with the contours which have been reproduced there, with resulting reflective action on the contours now obtained from the bottom of the foot. The hydraulic medium thus presses the foot upwardly and also reproduces in a negative form the contours of the lower portion of the foot while exerting the equal pressure at the different portions thereof. The hydraulic liquid will now fit the foot, the foot having been meantime in a state of suspension, but under pressure which has been equalized. A mean contour will thus have been attained, embodying the ideal of supporting the foot when in action in soft soil, sod or sand,—when the foot is in action,—as the pressure of the foot downward by the hand of the operator applying force to the lock or hanger thereon, coupled with the rush of the fluid plaster, contributes to the attainment of that ideal. In this connection it will also be noted that the forming of the lock or hanger around the ankle joint acts to locate the same definitely in all directions with regard to the foot. This will in fact, if desired, permit the use of a lock or hanger which has its lower margin slightly above the undercut line running around the margin of the foot, which may be of importance in forming metallic supporting members, such as arches, as, for example, of the general type set forth in my applications Ser. Nos. 34,888 and 43,658 above referred to (see Figs. 10 and 11 herein). Also, in this step of forming the body of liquid 13 or any moldable material, as, for example, any plaster of Paris, though the best results are obtained with a liquid, against the lower portion of the foot, the location of the lock or hanger 12 around the ankle of the foot will assist in locating the foot, and the operator can press his fingers and palm of the hand under the sole of the foot just previous to the introduction of the foot into the liquid 13, the hand being withdrawn as the liquid plaster is forced up to the front of the pan. This will assure the foot being accurately placed against the lock or hanger 12. Also, the amount of pressure exerted by the foot into the liquid 13 can be controlled by the operator according to the physical characteristics of the foot and the liquid, and the actual impression of the foot in the liquid can be arranged to take place at

the desired point in the setting of the liquid plaster, which may be chosen as a more or less quick setting plaster, as desired. Also, the size of the hole left at the front of the pan for the extrusion of the excess liquid can be changed to contribute to the control of said pressure. When the liquid 13 has set the lock or hanger 12 can be removed by cracking it along the planes where it has been cut, the same being readily removed because of the thin layer of sand adhering to the undersurface of the lock from the body of sand originally in the pan 9. There is thus obtained the impression of the lower part of the foot in the body of material 13 which can be used for producing body-weight bearing members or thin arch supports of swedged metal or any other material if this alone is desired to be made, and in connection with which, of course, a positive of plaster or metal may be formed from the said negative 13, from which positive the said members or supports may be produced in any known way. If, however, a product as, for example, a form-fitting shoe, is desired, a positive cast of the whole foot is needed. For this purpose, after the removal of the lock or hanger 12 the foot is placed in the previously mentioned negative 13 of the lower portion of the foot. This negative will now act as a baffle through the tissues of the foot in a way similar to that previously described. For this purpose a high enclosure 15, rectangular in shape and fitting on the upper edge of the pan 8, it utilized by flowing a liquid plaster of Paris thereon similar to the above after the sides of the extension 15 and the upper surface of the cast 13 have been suitably greased, or even by troweling on to the upper portion of the foot when so placed, a flowable plaster of Paris of mud-like consistency. The parting of the two halves 16 and 17 may be brought about, if they are to be divided along a vertical plane passing through the ankle, by dividing along a longitudinal plane of the foot, by a suitable partial previous incision therein before being set, and they may be removed after setting in the way as already described. If desired still greater accuracy may be attained by discarding the lower negative and using the upper negative as a baffle to cast a new lower negative in the same way, and again if desired the newest lower negative can be used as a baffle while casting against the foot another new upper negative and this process can be repeated until the desired complete elimination of errors is attained.

When, thereafter, the foot is removed from the sections, the impression pieces may be put together to form a resulting flask within which an ideal positive of plaster or metal of the foot may be produced by pouring in plaster of Paris or any other suitable material from which the same is desired to be made, and from this positive of the foot, forming a 3-piece external flask with two lateral surrounding shoe-shaped enclosures 18 and 18a form a shoe to conform to the external shape of the desired shoe shape having a parting line as shown in the heavy line *a* in Fig. 14 and an upper cover 18b, as well as a core 18c in the form of a positive cast of the foot flared at the top to hold the positive cast and the part 18b having a filling opening 18d as in Figs. 13 and 14. The form-fitting shoe as shown in Fig. 12 may be made from vulcanized rubber, vulcanized colloidal latex known as Vultex, or any other suitable material, liquid or comminuted solid from which cut-outs 19a may be removed thereafter

for ventilation, etc., the details of such a molded shoe 19 being set forth in my application aforesaid, Ser. No. 34,888. In forming said shoe, the latter will be given a heel 20, higher at 21 at the forward inside point next to the instep than at the rear of the heel and higher than at the front outside portion of the heel, and a recess 22 beneath the bending line of the toes to enable the sole of the completed shoe to grip the ground and cause the shoe to lengthen slightly in bending. This will make an ideal sport shoe also. A series of stock sizes and shapes may be produced in this way for types of feet, also, which would, of course, be much better form-fitting for the different feet of individuals than merely the changes in length and width with flat soles that have hitherto been available.

While I have described my invention above in detail I wish it to be understood that many changes may be made therein without departing from the spirit of the same.

I claim:

1. The process which comprises applying pressure to the under-surface of the foot to give the boney structure a desired position, applying to the opposite side of the foot a material adapted to set into a hard mass while conforming to the contour of said opposite portion of the foot, causing the material to harden, removing the pressure from the first mentioned portion of the foot and pressing said first mentioned portion of the foot in a soft viscous material adapted to set, while said hardened mass of material remains on said opposite side of the foot.

2. The process which comprises applying pressure to the under-surface of the foot, by supporting the foot on a heel piece, a plastic material opposite the arch and a supporter for the ball of the foot, to give the boney structure a desired position, applying to the opposite side of the foot a material adapted to set into a hard mass while conforming to the contour of said opposite portion of the foot, causing the material to harden, removing the pressure from the first mentioned portion of the foot and pressing said first mentioned portion of the foot in a soft viscous material adapted to set while said hardened mass of material remains on said opposite side of the foot.

3. The process which comprises applying pressure to the under-surface of the foot to give the boney structure a desired position, by supporting the foot on a heel piece, a plastic material opposite the arch and a supporter for the ball of the foot in a body of sand extending to a point just below the under-cut line of the foot, applying to the opposite side of the foot a material adapted to set into a hard mass while conforming to the contour of said opposite portion of the foot, causing the material to harden, removing the pressure from the first mentioned portion of the foot and pressing said first mentioned portion of the foot in a soft viscous material adapted to set while said hardened mass of material remains on said opposite side of the foot.

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