Jan. 7, 1936. S. J. FINN 2,026,620

LAST MANUFACTURE

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Fig. 1.

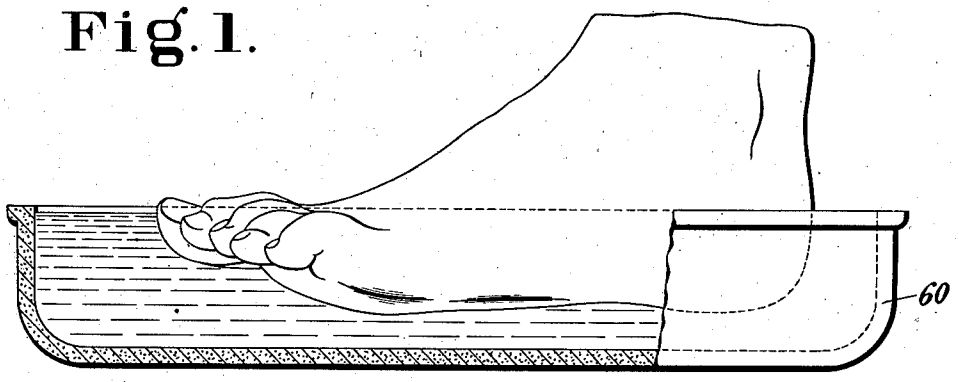


Fig. 2.

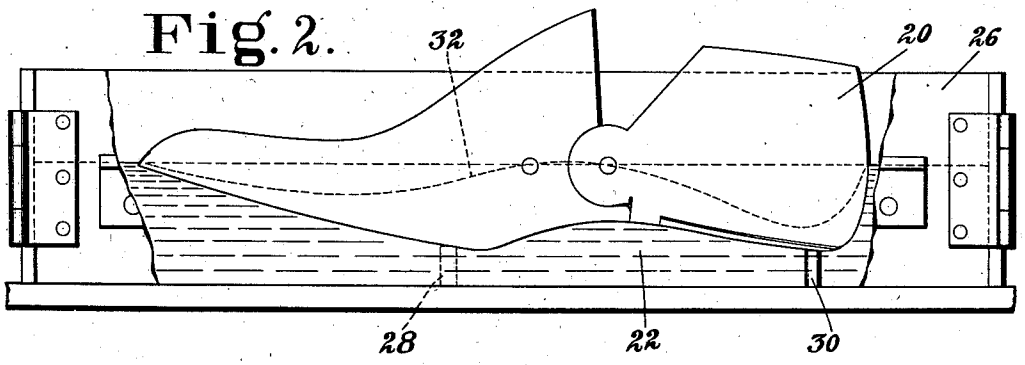
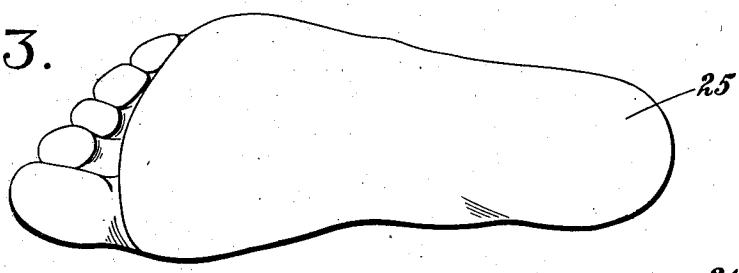


Fig. 3.



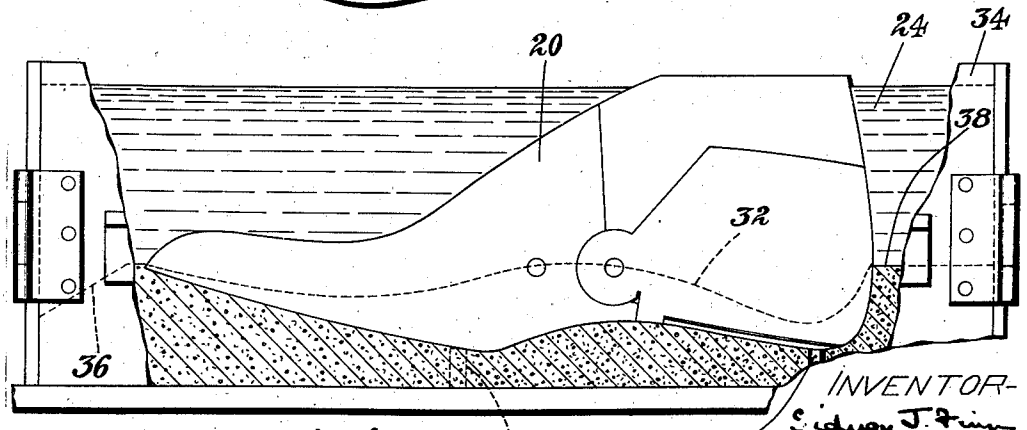


Fig. 4.

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Fig. 5.

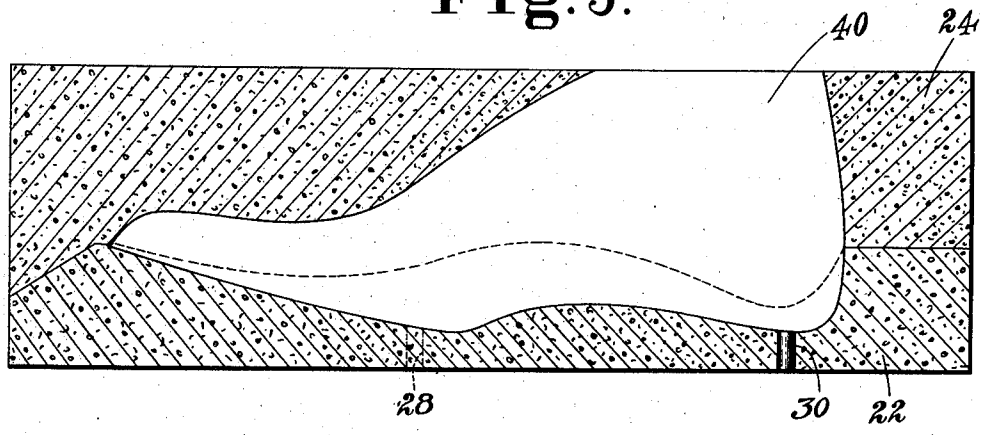
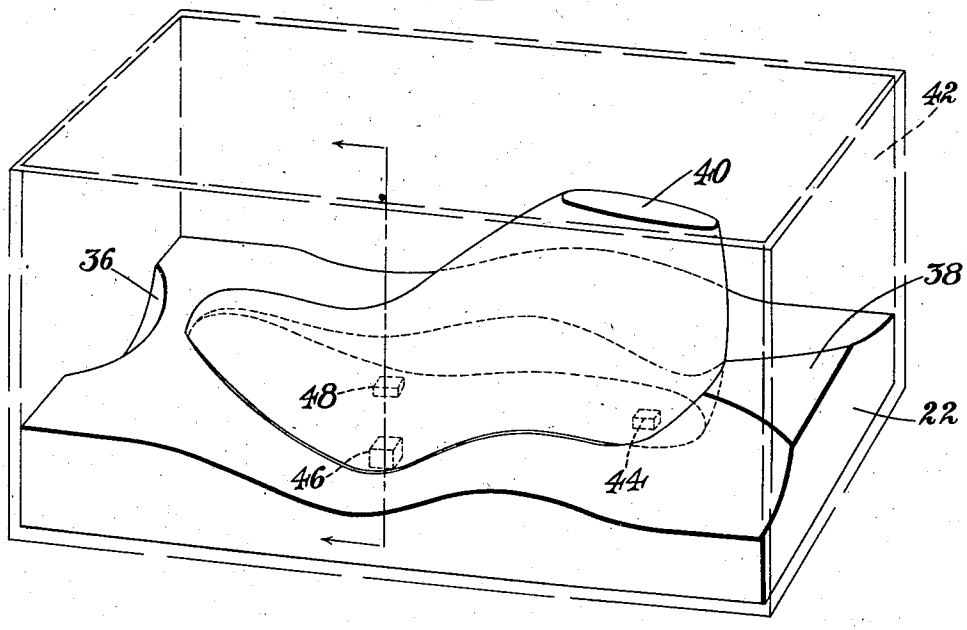


Fig. 6.



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Fig. 7.

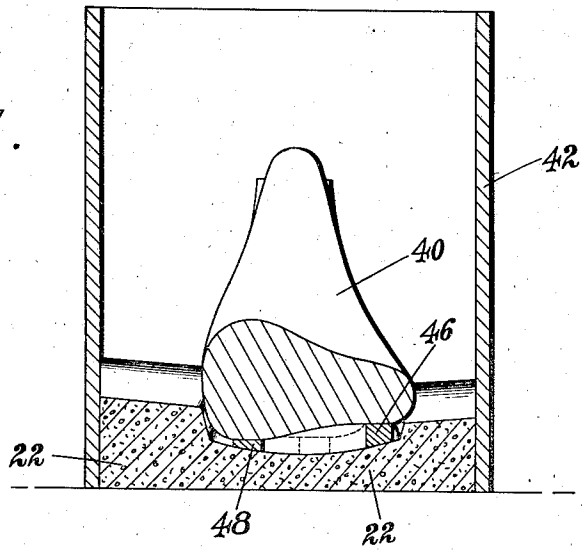


Fig. 8.

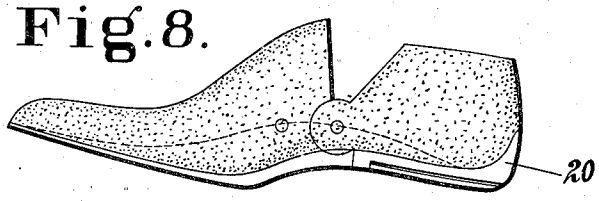
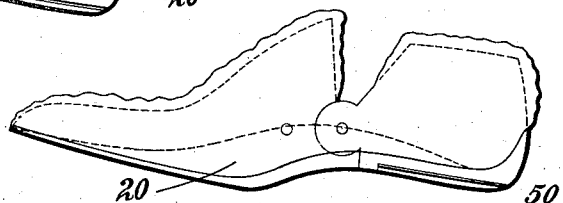


Fig. 9



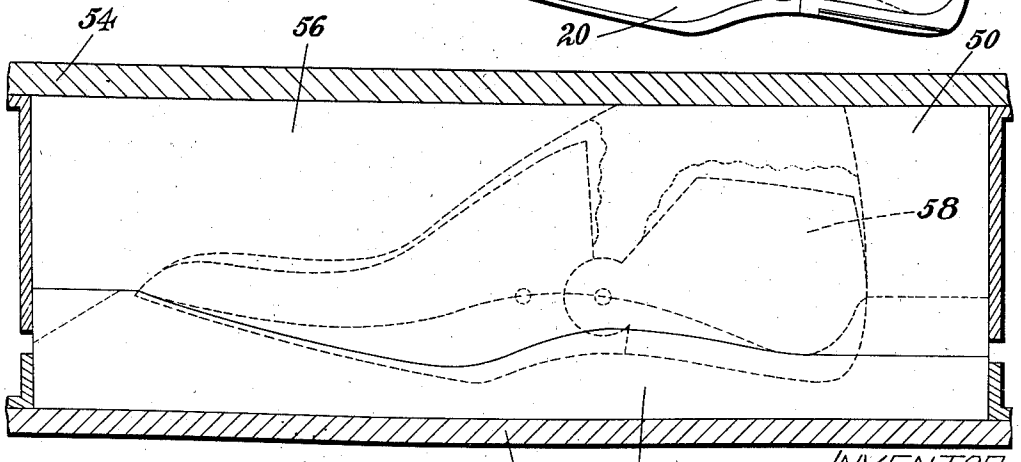


Fig. 10.

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Patented Jan. 7, 1936 2,026,620

UNITED STATES PATENT OFFICE

2,026,620

LAST MANUFACTURE

Sidney J. Finn, Beverly, Mass., assignor to United Shoe Machinery Corporation, Paterson, N. J., a corporation of New Jersey

Application December 13, 1930, Serial No. 502,165

23 Claims. (Cl. 12—142)

This invention relates to lasts and methods of making lasts and is illustrated herein with reference to the manufacture of lasts adapted for use in the manufacture of shoes of the character disclosed in United States Letters Patent No. 1,039,396 granted September 24, 1912 upon an application of Mathew Hilgert.

A shoe made in accordance with the disclosure of the above-identified patent is provided with space for the insertion of a filler-piece or inner sole between the foot of the wearer and the inside tread surface of the shoe. While the details of the form of the inserted filler-piece depend on the individual foot it may be constructed so as to control the posture of the foot by supporting the arches and muscles of the foot in such a way that the foot will be prevented from assuming an incorrect position during walking.

It is well-known that the bones of the foot are arranged substantially in the form of two distinct arches, the main or longitudinal arch extending from the os calcis to the heads of the first and fifth metatarsals and a secondary or transverse arch extending at the distall or front ends of the metatarsal bones transversely across the ball of the foot and forming a dome-like shape between the first and fifth metatarsals, this transverse arch forming a portion of and supporting the forward end of the longitudinal arch. The bones of these arches are not self-sustaining but are held in their respective arched formation by the fibrous inelastice ligaments which unite them at their points of articulation; a stratum of supporting muscles being arranged next to the bones which by their contraction and relaxation produce motion and locomotion and enable the foot to support and to balance the weight of the body. From an examination of the bony structure of the foot it will be readily seen that the weight bearing points of the human foot are at the heel or os calcis and at the heads of the first and fifth metatarsals. Normally these weight-bearing points are in the same horizontal plane. However, as soon as the foot is placed in the usual heeled shoe the heel of the foot is raised relatively to the forepart and consequently not only are the longitudinal and transverse arches of the foot displaced but the weight of the body is thrown more heavily on the forepart of the foot because of the elevation of the heel. This displacement of the arches of the foot frequently causes the ligaments attached to the bones of the arches to become strained and stretched to such an extent that there is a general subluxation of the various articulations which, if not corrected, will further result in a complete breaking down of the arches of the foot. Since the bones of the foot are given their principal support by the ligaments and are only controlled by the muscles and their attachments, it should be evident from the foregoing that if either the longitudinal arch or the transverse arch of the foot is insufficiently supported by the ligaments the muscular power of these arches will be insufficient properly to support and to balance its share of the weight of the body with the result that the weight-bearing points of the forepart of the foot may become displaced relatively to each other and to the heel end of the foot, thereby often imparting to the foot a tendency to roll toward one side or the other and eventually resulting in the muscles of the foot becoming completely unbalanced.

Accordingly, it is desirable that the upper surface of the inserted filler-piece which is to support the foot of the wearer be shaped to fit accurately the bottom of the foot in order that the weight of the wearer will be properly distributed over the bottom surface of the foot and freedom of movement allowed to the different bones and muscles of the foot while walking. The angular relation of the upper surface of this filler piece relatively to the inside surface of the sole of the shoe should be such that the weight-bearing points at the forepart of the foot will be supported in such a way that any malady of the foot due to an unbalanced muscular condition will be corrected and the foot thus restored to a properly balanced muscular condition.

In view of the foregoing, it is an object of the present invention to provide an improved process by which lasts may be made for use in the manufacture of orthopedic shoes which while they have the exterior appearance of regular or conventional shoes, are each provided with a definite amount of extra space for the insertion of a special filler-piece or innersole shaped to fit the individual foot and located between the foot of the wearer and the inside surface of the sole of the shoe.

A convenient way of carrying out this improved process will now be described, reference being made to the accompanying drawings, in which

Fig. 1 illustrates the taking of an impression in plastic material of the bottom portion of the foot of a person for whom shoes are to be made;

Fig. 2 is a side elevation of a molding box with a selected regular last in position in the box and the box partially filled with a molding medium to obtain a mold of the lower portion of the last;

Fig. 3 shows a bottom plan view of a male cast of the foot of Fig. 1;

Fig. 4 is a side elevation of the molding box with the lower mold and regular last shown in Fig. 2 in position in the box and the molding box filled with a molding medium to obtain a mold of the upper portion of the selected last;

Fig. 5 is a side elevation of the molds shown in Fig. 4, the molds being filled with jelly to form a jelly last;

Fig. 6 is a perspective view of a molding box containing the mold shown in Fig. 2 with the jelly last supported in predetermined relation thereto;

Fig. 7 is a vertical transverse section of the molding box and jelly last shown in Fig. 6 on a plane passing through the forepart of the jelly last;

Fig. 8 is a side elevation of the selected last (shown also in Fig. 2) with its upper portion roughened down to the parting line;

Fig. 9 is a side elevation of the last shown in Fig. 8 with its upper roughened portion covered or "plated" with freshly applied "Plastic Wood"; and

Fig. 10 illustrates means for shaping the upper portion of the plated last shown in Fig. 9.

In practicing the method of the present invention a pair of standard lasts 20 (Figure 2), illustrated herein as hinged or two-part lasts, are selected of a size and style appropriate for the feet of the individual for whom the shoes are to be made and a two-part mold is made from each selected last 20. Each two-part mold comprises a mold 22 (Fig. 2) of the lower portion of the selected last 20 and a mold 24 (Fig. 4) of the upper portion thereof. In making the lower mold 22 the last 20 is supported upon pins 28, 30 in a molding box 26. The pin 30 supports the heel end of the last 20 at the central portion thereof while the opposite sides of the forepart of the last are supported by the pins 28, 28, one of which is shown in Fig. 2. The pins 28, 30 are so arranged that the last 20 will be supported in the box 26 with its heel end in normal upright position, that is, with the vertical center line of the heel end of the last substantially at right angles to the base of the box 26. The parting line 32 (Figs. 2 and 4) of the two-part mold is determined by the widest part of the lower portion of the last 20 from toe to heel. Thus, an up-draw is provided in the lower mold 22 and a down-draw in the upper mold 24 so that the last 20 may be easily removed from the molds after the molding medium has set.

The two-part last 20 is shown in Fig. 4 in position upon the lower mold 22 while a molding box 34 is partially filled with a molding medium to form an upper mold 24 of the upper portion of the last. The space between the heel portion and the forward portion of the two-part last 20 is filled with modeling clay, for example "Plasticine," the "Plasticine" being continued above the cone of the last and being shaped to form continuations of the curved upper surfaces of the last and extending above the molding medium so that an opening will be provided in the upper mold 24, as clearly shown in Fig. 4. Locating surfaces 36, 38 (best shown in Fig. 6) of any desired shape may be formed on the upper surface of the lower mold 22 and on the lower surface of the upper mold 24, so that the molds may be readily assembled when removed from the box 34.

The next step of the method consists in obtaining accurate measurements of the bottom surface of each foot with the heel end of the foot located in a normal upright position in order to determine to what extent if any the longitudinal and transverse arches of the foot have been displaced by weakening of the ligaments and musicles of the foot. In order to obtain these measurements a vessel 60 (Fig. 1) is partially filled with a molding medium, such, for example, as plaster of Paris, and an impression is taken of the lower portion of each foot. In taking each impression the foot is held with the vertical center line of its heel portion located substantially at right angles to the horizontal and it is then immersed in the molding medium to its greatest width. After the molding medium has set the foot is removed, the surface of the impression is brushed with vaseline and the impression filled with plaster of Paris to obtain a male cast 25 of the bottom portion of the foot as shown in Fig. 3.

Since the bottom surface of each cast 25 is a detail duplication of the features of the bottom of each foot, it will be readily seen that accurate measurements may be obtained from each cast 25 to determine the position of the transverse arch relatively to the heel end of the foot.

While devices of various types may be used to perform this step of the method, a device which may be used advantageously for thus measuring the bottom surface of the cast 25 is disclosed and claimed in United States Letters Patent No. 1,997,721, granted April 16, 1935 on my application.

For the purposes of the present invention it will be sufficient to point out that by measuring across the forepart of the cast 25 with the vertical center line of the heel end thereof located at right angles to the horizontal, the positions of the arches of the foot relatively to each other and to the heel end thereof may be determined. If these measurements show a displacement of the transverse arch of the foot the inserted filler-piece may be constructed with a transverse wedge, that is, with one edge of greater average thickness than the other, so that the displaced arch will be lifted into a corrective position. This lifting of the displaced arch relieves any strain on the muscles and ligaments supporting that arch and tends to restore the entire muscular organization of the foot to a balanced condition.

Since the selected lasts 20 are of a size and style appropriate for the feet of the individual for whom shoes are to be made, it would be well to explain at this point that the next steps of the method herein illustrated consist in obtaining duplicates of the last 20 composed of a flexible yieldable material and in supporting these duplicates relatively to the surfaces of the impressions in the lower molds 22 in positions in which the feet of the individual are to be supported in the finished shoe by the inserted filler-pieces. Further, the method herein disclosed contemplates the forming of molds of the upper portions of said duplicates while they are supported in such positions so that the shapes of the upper portions of the required lasts may be correctly determined.

In order to obtain these duplicates the molds 22, 24 are assembled and filled with a jelly-like substance in liquid form, for example, refined gelatin or isinglass dissolved in hot water, which, after pouring, is allowed to cool and set thereby forming a jelly member or pattern 40 (Fig. 5) which is an exact copy of the selected last 20. The consistency of the jelly member 40 may be varied as desired by increasing or decreasing the amount

of gelatinous matter in solution but, in practice, it has been found that it should be stiff enough to retain its molded shape and yet be pliable enough to permit its being distorted or twisted at room temperature into any desired position or shape so that it may be supported above the surface of the impression in the lower mold 22 in accordance with the corrective position in which the foot of the individual is to be supported in a shoe by an inserted filler piece. After the gelatinous material has set the molds are separated, the jelly pattern is removed and the mold 22 is placed in a molding box 42 (Fig. 6). The jelly pattern 40 is supported relatively to the surface of the impression in the lower mold 22, by means now to be described. The heel end of the jelly pattern 40 is supported on the mold 22 by means of a block 44 and the opposite sides of the forepart of the jelly pattern are supported by means of blocks 46, 48. If the foot of the individual is in an unbalanced muscular condition, that is, if the arches of the foot are displaced as shown by the measurements taken from the cast 25, then the blocks 46, 48 will extend different distances above the surface of the impression in the mold 22 and, consequently, while the vertical center line of the heel end of the last will be located at right angles to the horizontal, the forepart of the jelly pattern will be distorted in accordance with the corrective position in which the foot of the individual is to be supported in the finished shoe by the inserted filler-piece. The space between the bottom of the jelly pattern 40 and the surface of the impression in the mold 22 corresponds in dimensions to the size of the filler-piece which is to be inserted between the foot of the wearer and the inside tread surface of the shoe.

With the jelly pattern 40 supported in accordance with the position in which the foot of the individual is to be supported in the finished shoe (Figs. 6 and 7), the molding box 42 is filled with plaster of Paris to obtain a mold 50 (Fig. 10) of the upper portion of the jelly pattern 40 which is complemental to the mold 22 of the lower portion of the selected last 20. As previously described, and as illustrated in Figs. 4 and 6, locating surfaces 36, 38 have been formed in the upper surface of the lower mold 22 and in forming the upper mold 50 it will be readily seen that complemental positioning or locating surfaces will be formed in the lower surface of the mold 50 thus allowing the molds 22, 50 to be reassembled properly when removed from the molding box 42. While the molds 22, 50 may be assembled and filled with a plastic material, such as plaster of Paris, to form a model from which a last may be obtained with the aid of the usual last-making machinery, the method herein illustrated contemplates the reshaping of the upper portions of the lasts 20 in accordance with the positions in which the feet of the individual are to be supported in the finished shoe. The next step, therefore, consists in roughening the upper portion of the last 20 down to the parting line, Fig. 8, and covering the roughened upper portion with "Plastic Wood" (Fig. 9) which consists of finely divided wood commonly called wood flour with a binder of pyroxylin dissolved in a volatile solvent such as acetone.

As previously described and as illustrated in Fig. 2, the impression in the lower mold 22 is taken from the lower portion of the last 20 while the matrix in the upper mold 50 is formed from the upper portion of the jelly pattern 40 while supported relatively to the impression in the lower mold 22 in accordance with the position in which the foot of the individual is to be supported in a finished shoe. The next step, therefore, consists in pressing the "Plastic Wood" which covers the upper portion of the selected last 20 into the shape of the matrix in the upper mold 50.

To assist in this pressing operation a pressing fixture 56 (Fig. 10) is provided having a lower member 52 for supporting the lower mold 22 and an upper member 54 for supporting the upper mold 50. The lower mold 22 is placed in the lower member 52 of the pressing fixture 56 and the last 20 with its roughened portion covered with "Plastic Wood" is placed in the impression in the mold 22. The upper mold 50 and upper member 54 of the pressing fixture 56 are placed over the upper portion of the last 20 and the pressing fixture 56 is placed on the table of a power press (not shown) of any usual or conventional type. The upper member 54 of the pressing fixture is then moved downwardly by means of a movable member of the power press until the bottom surface of the upper mold 50 contacts with the upper surface of the mold 22. The molds are held in this position under pressure until the "Plastic Wood" has set after which the pressing fixture and molds are taken apart and the reshaped or "plated" last is removed therefrom.

The last produced in the manner just described is indicated by the numeral 58 in Fig. 10. On this last an orthopedic shoe can be made in exactly the same way that a standard or ready-made shoe is constructed in a shoe factory, the completed shoe being provided at its lower portion with a definite amount of extra space for the insertion of a filler-piece of predetermined size and shape.

While the present method may be and, as illustrated, is practiced with the aid of a last pattern composed of gelatine, the term "jelly" is used herein in a comprehensive sense to include any material of that general nature which is capable of being readily flexed or distorted at room temperature.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. That improvement in methods of making lasts which consists in distorting a readily deformable pattern of a regular last, and reproducing a last having a portion corresponding in shape to the distorted pattern and another portion corresponding in shape to the regular last.

2. That improvement in methods of making lasts which consists in distorting the forepart of a jelly pattern of a selected last, and reproducing therefrom a last having its upper portion corresponding in shape to the distorted pattern and its lower portion corresponding in shape to the undistorted last.

3. That improvement in methods of making lasts which consists in producing a flexible model of a selected wood last, distorting said model by twisting its forepart about its longitudinal axis, and producing a last upon which to build a shoe by reshaping the upper portion of said selected last to the shape of the corresponding portion of the distorted model.

4. That improvement in methods of making lasts which consists in making a mold of the lower portion of a selected last, distorting a readily deformable reproduction of the selected last by twisting the forepart of said reproduction

about its longitudinal axis while maintaining its surface unbroken, making a mold of the upper portion of the distorted pattern, bringing said upper and lower molds together and thereby forming a complete mold from which to produce a last upon which to build a shoe.

5. That improvement in methods of making lasts which consists in making upper and lower molds of a selected wood last, making a jelly last pattern in said molds, distorting the jelly pattern by rotating its forepart about its longitudinal axis while maintaining its heel end in normal position, making a mold of the upper portion only of said distorted pattern, and reproducing a last from the lower mold of the selected last and the upper mold made from the distorted pattern.

6. That improvement in methods of making lasts for use in the manufacture of orthopedic shoes in which the feet are supported by filler-pieces, which consists in distorting the forepart of a flexible pattern of a selected last relatively to its heel portion, balancing said pattern above an impression in a mold of the lower portion of the selected last so that the bottom of the pattern is in the position in which the bottom of the foot is to be supported in the shoe by the inserted filler-piece, making a mold of the upper portion only of said distorted pattern, and using said mold and the mold of the lower portion of the selected last to reproduce a work last the upper portion of which is equivalent in size and shape to the distorted pattern and the lower portion equivalent to the filler-piece.

7. That improvement in methods of making lasts for use in the manufacture of orthopedic shoes in which the feet are to be supported by inserted filler-pieces, which consists in distorting the toe portion of a flexible pattern of a selected last relatively to the heel portion of the pattern an amount determined by measurements taken from a particular foot, supporting said distorted pattern above an impression in a mold of the lower portion of the selected last in the position which the foot is to assume in a finished shoe when supported by the filler-piece, making a mold of the portion of said pattern extending above the impression, and producing from said molds a last having an upper portion corresponding in shape to the upper portion of the distorted pattern and a lower portion corresponding in shape to the filler-piece which is to be used in the finished shoe.

8. That improvement in the art of making lasts which consists in selecting a regular last, making "a jelly" duplicate of said last, distorting the forepart of said jelly duplicate relatively to the heel end thereof to correct an unbalanced muscular condition of a foot, supporting said distorted jelly duplicate in predetermined relation to the surface of the impression in a mold of the lower portion of the selected last, and making a mold of the upper portion of said distorted jelly duplicate in said position to determine the shape of the upper portion of a last.

9. That improvement in the art of making lasts which consists in selecting a regular last, making a jelly duplicate of said last, distorting the forepart of said jelly duplicate relatively to the heel end thereof an amount sufficient to correct an "outside roll" or an "inside roll" in a particular foot, and supporting said jelly duplicate on a mold of the lower portion of said selected last in accordance with the corrective position in which the foot is to be supported in a finished shoe, and making a mold of the upper portion of said distorted jelly duplicate to determine the shape of the upper portion of a last appropriate for said foot.

10. That improvement in the art of making lasts which consists in making a flexible pattern of a selected last, said pattern being distortable at room temperature by pressure and retaining its distorted shape at such temperature, distorting said pattern and supporting it on blocks above an impression of the lower portion of the selected last so that the tread surface of the forepart of said pattern will be disposed at an angle relatively to the lower surface of the impression, and forming a mold from the upper portion of said pattern to determine the shape of the upper portion of an operative last.

11. That improvement in the art of making lasts which consists in making a mold of the lower portion and a mold of the upper portion of a last of predetermined size and style, casting a flexible form in said molds, twisting the forepart of said form relatively to the heel end thereof to correct an unbalanced muscular condition of a foot, supporting said twisted form in predetermined relation to said lower mold, making a mold of the upper portion of said twisted form, and making a last from the mold of the lower portion of the original last and the mold of the upper portion of the twisted form.

12. That improvement in the art of making lasts which consists in making a mold of the lower portion and a mold of the upper portion of a selected last, casting a jelly last form in said molds, positioning said jelly form with its upper portion distorted relatively to the surface of the impression in said lower mold and with its lower surface in a predetermined spaced relation from the surface of said impression in accordance with the position in which the foot of the wearer is to be supported in a shoe, and forming a mold of the upper portion of said jelly form complemental to the mold of the lower portion of the selected last to determine the shape of the upper portion of a last formed in said molds.

13. That improvement in the art of making lasts which consists in making a mold of the lower portion and a mold of the upper portion of a last of predetermined size and style, casting a flexible form in said molds, interposing a plurality of supports between the bottom surface of said flexible form and the surface of the impression in said lower mold, said supports being arranged to support the forepart of said flexible form in predetermined relation to the heel end thereof, and forming a mold of the upper portion of said flexible form complemental to the mold of the lower portion of the original last.

14. That method of making a last for use in the manufacture of an orthopedic shoe in which a foot is to be supported in corrective position by means of an inserted filler piece, which consists in making a mold of the lower portion and a mold of the upper portion of a last of predetermined size and style, casting a jelly last model in said molds, supporting said jelly model relatively to the surface of the impression in said lower mold in accordance with the position in which the foot is to be supported in the finished shoe, forming a mold of the upper portion of said jelly model in said position complemental to the mold of the lower portion of the original last, filling the two last-named molds with material to form a last, and reproducing a last from said molds by forcing them together under pressure.

15. That method of making lasts for use in the manufacture of orthopedic shoes in which the foot of the individual is supported in the finished shoe by means of an inserted filler piece which consists in making a mold of the lower portion and a mold of the upper portion of a last of predetermined size and style, casting a jelly last pattern in said molds, supporting said jelly pattern relatively to the surface of the impression in said lower mold with its heel end portion in normal upright position and with its forepart portion distorted in accordance with the position in which the foot is to be supported in the finished shoe, forming a mold of the upper portion of said distorted pattern in said position complemental to the mold of the lower portion of the original last, and reproducing a last by utilizing the original lower mold and the mold of the jelly pattern.

16. That method of making lasts for use in the manufacture of orthopedic shoes in which the foot is supported by means of an inserted foot mold which consists in making a mold of the lower portion and a mold of the upper portion of a selected last, casting a jelly model of a last in said molds, twisting the forepart of said jelly model relatively to the heel end thereof to correct a roll of the foot of the person for whom the last is being made, supporting said jelly model on said lower mold in accordance with the position in which the foot is to be supported in a finished shoe by means of a foot mold, making a mold of the upper portion of said twisted model in said position, roughening the upper portion of the selected last, covering said roughened upper portion with a plastic material and thereafter pressing the plastic material into the shape of the matrix in the mold of the upper portion of the twisted model while the selected last is supported in the mold of its lower portion thereby producing a last for use in the manufacture of orthopedic shoes.

17. That improvement in the art of making lasts which consists in selecting a regular last, making a duplicate of said last of a readily distortable material, supporting said duplicate in a distorted position in a mold of the lower portion of the selected last, making a mold of the upper portion of said distorted duplicate in said position, roughening the upper portion of the selected last, covering said roughened upper portion with a plastic material, and thereafter pressing the plastic material into the shape of the matrix in the mold of the upper portion of said distorted duplicate while the selected last is supported in the mold of its lower portion thereby to produce a last for use in the manufacture of orthopedic shoes.

18. That improvement in the art of making lasts which consists in selecting a regular last, obtaining a pattern of said last in a flexible material, distorting the forepart of said flexible pattern relatively to the heel end thereof to correct a roll of the foot of the person for whom the last is being made and supporting said distorted flexible pattern in predetermined relation to the surface of the impression in a mold of the lower portion of said selected last, making a mold of the upper portion of said distorted pattern in said position, roughening the upper portion of the selected last, covering said roughened upper portion with a plastic material, and thereafter pressing said plastic material into the shape of the matrix in the mold of the upper portion of said distorted flexible pattern while the selected last is supported in a mold of its lower portion thereby to produce a last for use in the making of orthopedic shoes.

19. That improvement in methods of making lasts which consists in covering the upper portion of a last with plastic material, said last being appropriate in size for a particular foot, and shaping the plastic material with molds to produce a last shaped to correct defects existing in said foot.

20. That improvement in methods of making lasts which consists in covering the upper portion of a selected last with plastic material, said last being appropriate to the foot of a particular individual, and shaping the plastic material to conform to the contour of a distorted pattern of the last by means of a mold made from said pattern.

21. That improvement in methods of making lasts which consists in applying to the upper portion of a conventional wood last a covering of finely ground wood mixed with dissolved pyroxylin to form a plastic mass, and shaping said mass under pressure by means of molds made from said last and a distorted pattern of said last, thereby producing a corrective last for use in the manufacture of orthopedic shoes.

22. That method of making lasts which consists in measuring the bottom surface of a foot, selecting a regular last appropriate in size and shape to said foot, covering the upper portion of said selected last with a plastic material, and shaping said plastic material by means of a pair of complemental upper and lower molds, the shaping surface of the upper mold being disposed in a predetermined relation to the lower mold so that the upper surfaces of the plated last will be distorted in a predetermined position relatively to the bottom surface of the body portion of the last, thereby producing a last for use in making an orthopedic shoe for said foot.

23. A pattern of a selected wood last made from material readily distortable at room temperature.

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