April 30, 1940. J. P. FREDERICKSEN 2,198,699

METHOD OF AND MEANS FOR FLEXING SOLES

Filed May 26, 1938 2 Sheets-Sheet 1

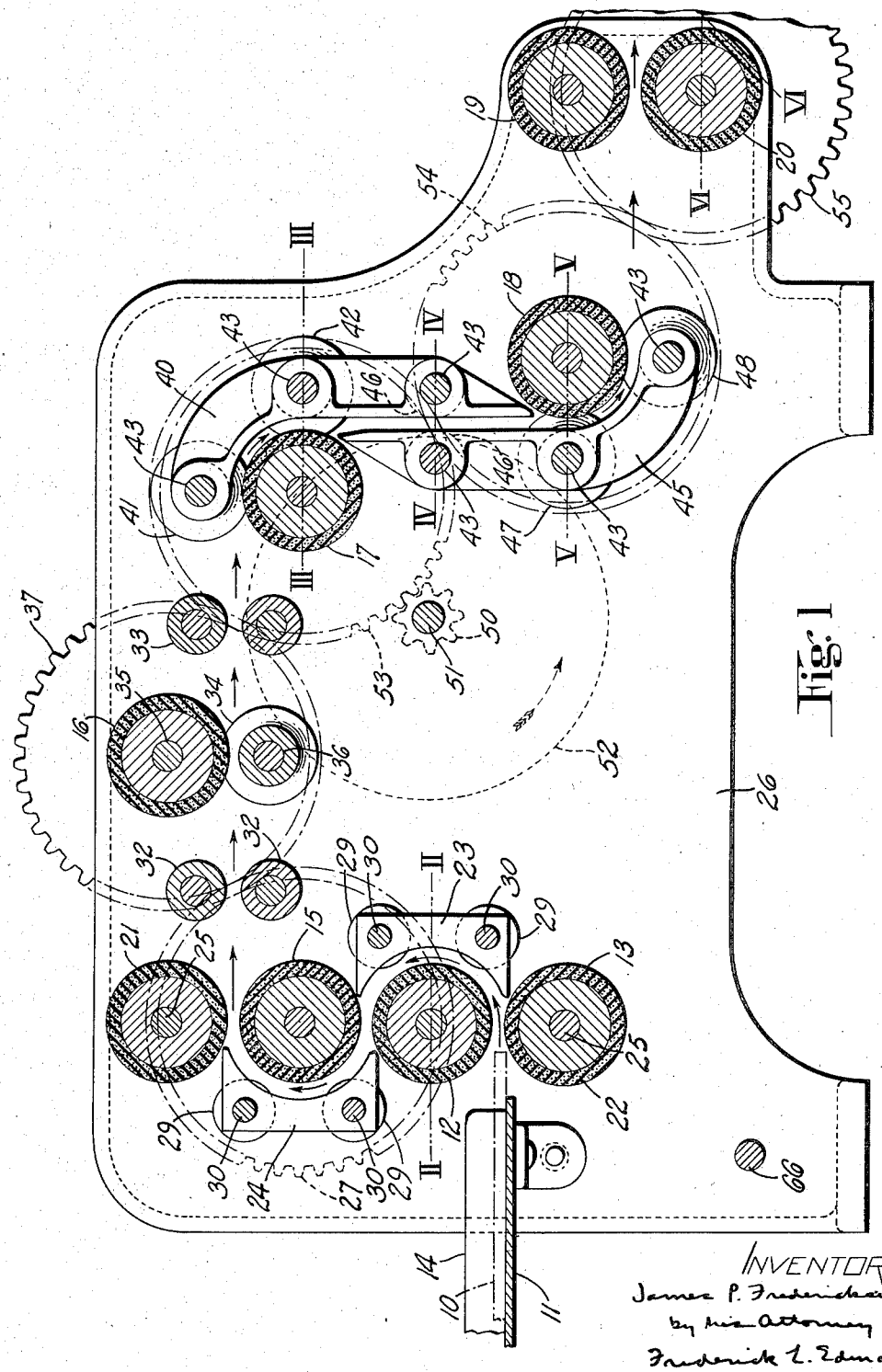


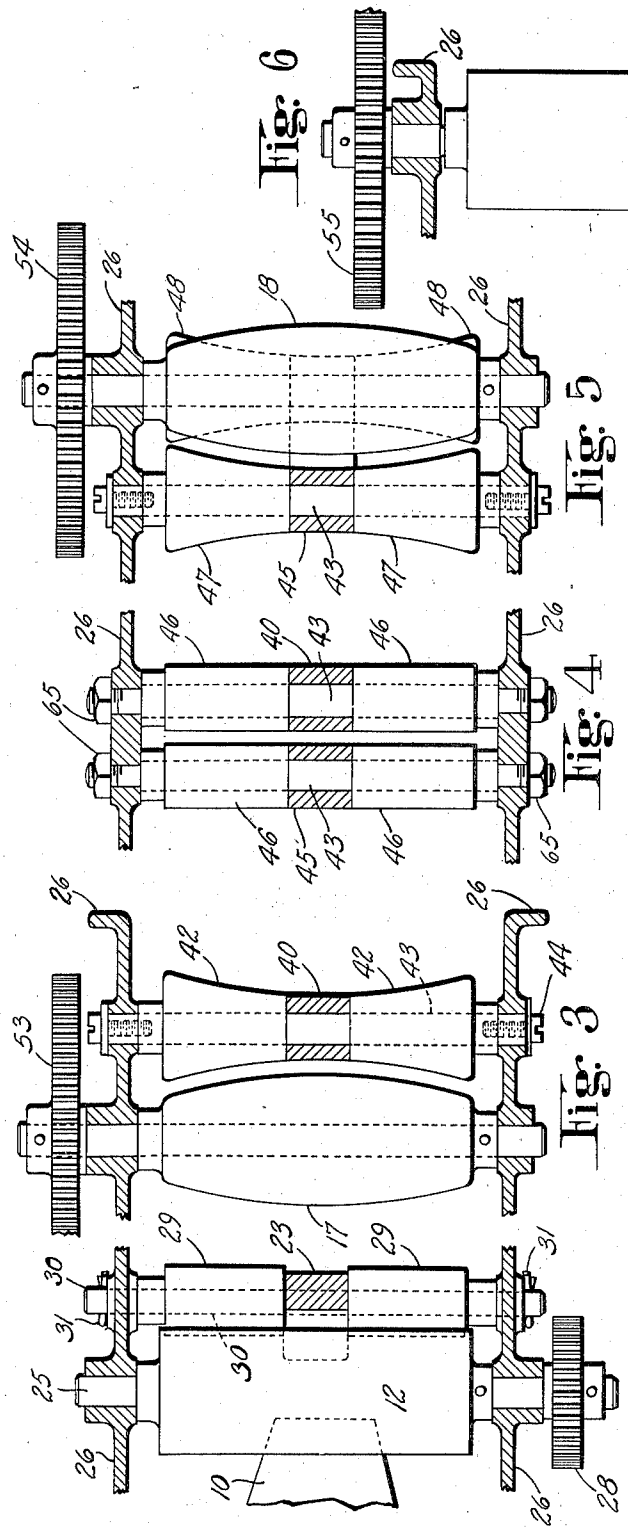
Fig. 1

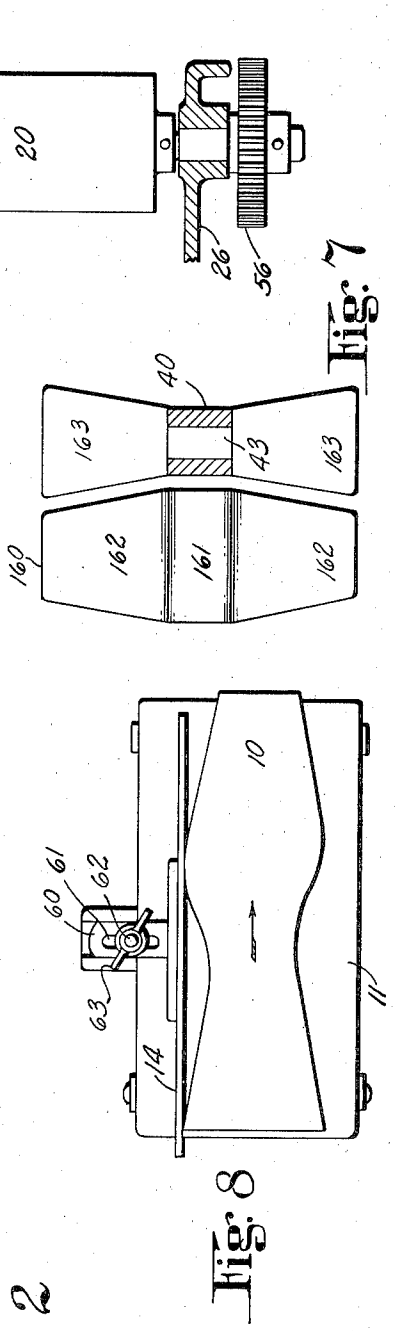
INVENTOR:
James P. Fredericksen
by his Attorney
Frederick L. Edmonds

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INVENTOR:
James P. Fredericksen
by his attorney
Frederick L. Edmonds

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METHOD OF AND MEANS FOR FLEXING SOLES

James P. Fredericksen, Wollaston, Mass., assignor to United Shoe Machinery Corporation, Borough of Flemington, N. J., a corporation of New Jersey

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19 Claims. (Cl. 12—41.2)

This invention relates to methods of and means for mechanically working fibrous sheet material such as sole leather to remove stiffness by loosening the fibers thereof. The accompanying drawings illustrate a machine designed to utilize the principles of the invention for flexing unattached leather outsoles.

One object of the invention is to provide improvements in methods of flexing soles, and another is to provide improved apparatus to expedite such methods.

Considering the method, one improvement consists in combining a bend extending lengthwise and a bend extending widthwise of a sole to form a compound bend, and relatively moving the sole and such compound bend to loosen and work the fibers of the sole progressively. Additional flexibility may be obtained thereafter with a compound bend of reverse components and repeating the relative movement to work the fibers progressively.

Another improvement consists in subjecting the sole to preliminary working with one or more simple bends and thereafter subjecting it to working with one or more compound bends as above set forth, the simple preliminary bends serving to work out enough of the initial stiffness to render the sole capable of withstanding the effects of subsequent compound working without being damaged thereby.

The illustrated machine provides an organization by which all such workings of a sole may be accomplished successively in one run of a sole through the machine. The working members comprise anvil-rolls, conforming rolls and deflectors arranged in various combinations according to the various bending operations desired at successive stages. Preferably, and as herein shown, the working members are arranged to perform their functions without subjecting the soles to compression, thus leaving the fibers of the soles free to creep or respond to the demands of the working stresses.

For the purposes of this description a lengthwise bend is one that curves the length of a sole, and a widthwise bend is one that curves its width.

The above mentioned and other novel features of the invention are hereinafter described and claimed and are illustrated in the accompanying drawings in which:

Fig. 1 is a longitudinal vertical section of a sole-flexing machine embodying a preferred organization of successive groups of flexing members;

Figs. 2, 3, 4, 5, and 6 are horizontal sections indicated respectively by lines II—II, III—III, IV—IV, V—V, and VI—VI in Fig. 1;

Fig. 7 represents an alternative form of co-operative flexing members comparable to those included in Figs. 3 and 5; and

Fig. 8 is a top plan view on a reduced scale including a feed-table, a block-sole lying thereon and an edge-guide to control the presentation of the sole to the first group of feed-rolls.

A sole 10 to be flexed will be placed first on the feed-table 11 as shown in Fig. 8 and as represented in dotted lines in Fig. 1. From this point the sole will be advanced manually to thrust its leading end between the first pair of feed-rolls 12 and 13, whereupon the sole will be fed lengthwise by successive feed-rolls and will be subjected to a variety of flexing operations before it is ultimately discharged from the opposite end of the machine. A laterally adjustable guiding strip 14 that lies on the table 11 provides for guiding the sole by one edge to insure the desired presentation of the sole to the first pair of feed-rolls.

The path to be traversed by the sole from the feed-table and through or past the successive flexing stations includes sinuous portions and straight portions and is indicated by a series of arrows. In traversing this path, the sole is bent and wrapped progressively around and against a segment of the feed-roll 12, thereafter around and against a segment of a feed-roll 15, thereafter against the peripheries of feed-rolls 16, 17, and 18 and is finally fed out and discharged by a pair of co-operative feed-rolls 19 and 20. The rolls 12, 15, 16, 17, and 18 may be termed "anvil rolls" because the sole is bent against each of them in one manner or another to work the stiffness out of it. Moreover, the roll 13 co-operates with the roll 12 not only to feed the sole but also to play a part in the first bending operation. Likewise, a roll 21 co-operates with the anvil roll 15 not only to feed the sole but also to play a part in a subsequent bending operation.

All the rolls of the machine are of circular cross-section, but not all are cylindric. The rolls 12, 13, 15, 21, 19, and 20 are all cylindric, are all driven, and are all provided with thick covers 22 of friction material such as soft elastic rubber, but their cores or bodies may be made of hard material such as wood or metal. Once the leading end of a sole has passed the nip of the rolls 12 and 13, it engages a smooth polished segmental deflector 23 that extends around a segment of the roll 12 and is spaced therefrom to provide a channel as deep as the thickest sole likely to be presented for flexing. In like manner, a similar de-

flector 24 is arranged to extend around a segment of the roll 15 and is likewise spaced therefrom. Consequently, the deflector 23 will bend the sole progressively around the corresponding segment of the roll 12, and the deflector 24 will act in a similar manner to bend the sole around the corresponding segment of the roll 15, but whereas the roll 12 and the deflector 23 will produce a longitudinal bend in one direction, the roll 15 and the deflector 24 will produce a longitudinal bend in the opposite direction. The frictional resistance of the deflector 23 is overcome in part by the roll 13, and in part by the roll 15, while that of the deflector 24 is overcome in part by the roll 12 and in part by the roll 21. These rolls are affixed to individual shafts 25 each journaled in bearings in two confronting frame members 26 between which all the rolls are arranged. The bearings for all the rolls are preferably fixed to maintain fixed axes of rotation. The shaft of the roll 15 is provided at one end with a driven gear 27 and at the opposite end with a smaller gear such as that indicated at 28 in Fig. 2. In the latter figure, the gear 28 is affixed to the shaft of the roll 12 but a train of such gears affixed respectively to the shafts of the rolls 12, 13, 15, and 21 are arranged in intermeshing relation and cause all these rolls to rotate with equal peripheral speed to feed the sole.

The deflectors 23 and 24 are preferably narrower than the narrowest sole and are arranged midway between the lateral limits of the path of the sole. Consequently, they have only limited contact with the sole but are none the less effective to bend the sole progressively around and against the anvil rolls with which they co-operate. Their frictional resistance to the feeding movement of the sole, though slight, may be minimized by flanking them with idle rolls 29. The illustrated construction provides for four pairs of idle rolls 29, two of said pairs being combined with the deflector 23 and two pairs with the deflector 24, each deflector being arranged between the two rolls of each pair as shown in Fig. 2. For convenience in assembling these parts and maintaining their co-operative relations, each deflector is mounted on two parallel cylindric rods 30 and each pair of rolls 29 is mounted on one of these rods. The ends of the rods project through holes bored in the frame members 26 and may be retained therein by cotter-pins 31. The peripheries of the rolls 29 preferably project slightly beyond the incurved work-engaging surfaces of the deflectors but such projection need not be as great as that pictured in Fig. 1 in which it is exaggerated merely to make it apparent.

As the sole progresses beyond the rolls 15 and 21, it travels between a pair of cylindric guide-rolls 32, thence under the rubber-covered anvil-roll 16 and thence between another pair of cylindric guide-rolls 33. Both of these pairs of guide-rolls may be freely rotatable and may be made of wood or metal without any covering of friction material. The pair 33 is preferably spaced from the pair 32 a distance less than the length of the shortest sole likely to pass through the machine and these rolls are arranged to maintain two portions of the sole in a common plane while the group of flexing members including the anvil-roll 16 bends the intermediate portion of the sole widthwise. The roll 16 has a bulging profile which may be curved in duplication of the roll 17 as represented in Fig. 3 or, instead of being curved, it may be like that of the alternative type of anvil roll 160 pictured in Fig. 7. The latter type of roll comprises a cylindric middle zone 161 between two frusto-conical zones 162 which, conjointly, provide a bulging profile capable of producing a widthwise bend in a sole. Whether the anvil-roll 16 has a curved profile or a composite angular profile, a conforming roll 34 of complemental profile is arranged to co-operate therewith to bend the sole widthwise. The roll 34 may be made of hard material and since its profile is a counterpart of the roll 16 it will bend the sole against the periphery of the latter and thereby develop traction incidentally to loosening the fibers of the sole. As a sole passes between the rolls 16 and 34, its longitudinal median band is maintained in the general plane of travel by the relatively large middle portion of the upper roll while its margins are deflected upwardly by the roll 34, the bend thus produced being transverse with respect to those produced at the rolls 12 and 15. The roll 16 is affixed to a driven shaft 35, but the shaft 36 that supports the roll 34 need not be driven. These shafts are journaled in the frame members 26, and a gear 37 is affixed to the shaft 35.

As the leading end of the sole passes beyond the guide-rolls 33, it engages the rubber-covered anvil-roll 17 which may have a bulging profile as represented in Fig. 3 or one of the alternative form provided by the roll 160 in Fig. 7. The idle rolls 41 and the anvil-roll 17 are formed to produce initially a simple widthwise bend the opposite of that produced by the rolls 16 and 34, but a longitudinal bend is immediately compounded therewith. For this purpose the members that co-operate with the roll 17 are divided and comprise a stationary median deflector or guiding member 40 and two pairs of idle rolls 41 and 42 that flank it. The deflector 40 is mounted on three parallel supporting rods 43 the ends of which are arranged in holes bored in the frame members 26. These rods may be secured in the frame members by any suitable means such as screws 44 and washers as represented in Fig. 3, and it is immaterial whether they are fixed against rotation. The deflector 40 may be made of metal and its work-engaging surface will preferably be smooth and polished. Its upper portion extends around a segment of the anvil-roll 17 to wrap the longitudinal median portion of the sole around and into conformity with this segment. As shown in Fig. 3 the two idle rolls 42 and the intermediate portion of the deflector 40 provide, in effect, a hollow profile that is a counterpart of the bulging profile of the anvil-roll 17. A similar hollow profile is likewise provided by the idle rolls 41 and the intermediate portion of the deflector 40.

Since the portion of the sole lying between the idle rolls 41 and the rubber-covered anvil-roll 17 will have been subjected to at least two opposite lengthwise bending operations and at least two opposite widthwise bending operations, its fibers will be sufficiently workable to undergo compound flexing. In the illustrated machine, the first stage of compound flexing occurs incidentally to the passage of the sole around a segment of the roll 17, and the second stage of compound flexing occurs incidentally to its passage around a segment of the rubber-covered anvil roll 18.

Since the sole is bent widthwise and confined against the roll 17 at two successive points by the conforming rolls 41 and 42, and is also wrapped around the intervening segment of the roll 17, the widthwise bends are compounded with the lengthwise bend, and since the sole continues to

travel ahead its fibers are subjected to progressive compound working between the points specified. Moreover, since the margins of the sole are unconfined between these points, the lengthwise bend tends to eliminate the widthwise bend, the margins being thereby sprung away from the roll 17 only to be brought back to it by the rolls 42. Consequently, the margins are worked "in the air."

The lower portion of the deflector 40 overlaps and confronts a corresponding portion of a similar deflector 45 arranged to be engaged by the opposite face of the median band of the sole. The gap between the deflectors 40 and 45 is preferably equal to the thickness of the thickest sole to be worked. If desired, these confronting portions of the deflectors may be flanked by cylindric guide-rolls 46 which may be freely rotatable on the two supporting rods 43 in the plane of the line IV—IV. These idle rolls need not have rubber covers and they need not project beyond the guiding surfaces of the deflectors.

As the margins of the sole run between the rolls 46, they are brought to the plane of the median band of the sole, the latter being thereby flattened to facilitate its entrance between the rubber-covered anvil-roll 18 and the next successive pair of conforming rolls 47. At this point (line V—V) a simple widthwise bend is produced by the rolls 18 and 47, this bend being the opposite of that produced by the rolls 17 and 42, but immediately this widthwise bend becomes compounded with a lengthwise bend produced by a segmental portion of the deflector 45 which wraps the sole around a segment of the roll 18. The sole next encounters a pair of idle conforming rolls 48 similar to the conforming rolls 47, 42, and 41. The group of flexing members 18, 45, 47, and 48 is similar to the group comprising the members 17, 40, 41, and 42, but the effects of the lower group are the opposite of those of the upper group.

As the leading end of the sole advances from the rolls 18 and 48, it is of trough-shaped cross-section and is therefore not subject to sagging, although it has been flexed in four different ways with four preliminary simple bends and thereafter in two different ways with two opposite compound bends. The sole will therefore run between the cylindric rubber-covered feed-rolls 19 and 20 by which it will be flattened while being discharged from the machine. If very short soles for children's shoes are to be run through the machine, it may be in the interest of insuring their passage between the rolls 19 and 20 to provide a horizontal supporting plate between the rolls 48 and the roll 20.

The illustrated gearing for driving those rolls that require driving to feed the soles may be derived from a pinion 50 affixed to a primary power-shaft 51 journaled in bearings in the frame members 26. This shaft may also be provided with a pulley 52 to receive rotation from a belt (not shown). The pinion 50 is arranged to drive a train (reading from left to right in Fig. 1) of gears 27, 37, 53, 54, and 55, all of equal size. These gears are affixed to the shafts of the feed rolls 15, 16, 17, 18 and 20. At the opposite side of the machine, one train of four gears 28 (Fig. 2) affixed to the shafts of the rolls 21, 15, 12, and 13, and a train of two gears 56 (Fig. 6) affixed to the shafts of the rolls 19 and 20 transmit rotation among these groups of rolls.

Referring to Fig. 7, if anvil-rolls having the form of the roll 160 (Fig. 7) are to be used in preference to the anvil-rolls 17 and 18, the conforming rolls provided to co-operate with them will preferably be frusto-conical in accordance with the rolls 163 in that figure, and they may be combined with the deflectors 40 and 45 as represented therein.

The edge-guide 14, as shown in Fig. 8, is provided with a shank 60 in which a slot 61 is formed to receive a clamping bolt 62. A wing-nut 63 co-operates with the bolt to clamp the shank against the table 11 in various positions of adjustment widthwise of the table.

The several rods, shafts, rolls and gears cooperate to maintain the frame members 26 in the desired relation to each other, but rigidity may be imparted to the frame assemblage by making some of the non-driven rods or shafts to serve as tie-rods and spacers. For example, as shown in Fig. 4, the ends of the rods 43 are reduced in diameter to provide spacing shoulders and are provided with screw-threads to receive clamping nuts 65. A similarly shouldered and threaded rod 66 (lower left of Fig. 1) may also be provided with clamping nuts to brace the frame members rigidly in that region.

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 flexing unattached soles which consists in forming two similar and closely related widthwise bends in a sole and a lengthwise bend connecting them, and relatively moving the sole and said bends while maintaining all three of the latter.

2. That improvement in methods of flexing unattached soles which consists in bending a sole with a simple lengthwise bend and with a simple widthwise bend, one after the other, and thereafter bending the sole with a compound bend the components of which are similar to said simple bends, and relatively moving the sole and said compound bend to loosen and work the fibers of the sole progressively.

3. That improvement in methods of flexing unattached soles which consists in bending a sole lengthwise in opposite directions and widthwise in opposite directions in four successive stages to loosen the fibers thereof, and thereafter forming a compound bend in the sole and relatively moving the sole and said compound bend to work the fibers of the sole progressively.

4. That improvement in methods of flexing unattached soles which consists in bending a sole both widthwise and lengthwise to form a compound bend, thereafter bending the sole both widthwise and lengthwise in the opposite direction to form an opposite compound bend, and relatively moving the sole and said compound bends to loosen and work the fibers of the sole progressively.

5. A sole-flexing machine comprising an anvil-roll having a bulging profile to be engaged by one face of a sole, co-operative members arranged to bend a portion of the sole around and against a segment of said anvil-roll, said members including rolls arranged to conform the sole to said bulging profile at the extremities of said segment, and means for driving said anvil-roll to feed the sole.

6. A sole-flexing machine comprising a series of groups of co-operative flexing members arranged at succesive flexing stations and including rolls arranged to be engaged by opposite faces of a sole, and means for driving some of said rolls to feed the sole lengthwise through said stations,

the flexing members at two of said stations being organized to bend a sole progressively in opposite directions by wrapping it around segments of two successive rolls and those at two other stations to bend it successively in opposite directions crosswise of its path of travel.

7. A sole-flexing machine comprising a series of groups of co-operative flexing members arranged at successive flexing stations and including rolls arranged to be engaged by opposite faces of a sole, and means for driving some of said rolls to feed the sole lengthwise, the flexing members of one of said groups being formed and arranged to bend a sole lengthwise of its path of travel by wrapping it around a segment of a roll and those of another group to bend it widthwise, but each with lengthwise progression.

8. A sole-flexing machine comprising a series of groups of co-operative flexing members arranged to be engaged by opposite faces of a sole traveling lengthwise along a certain path, said members including feed-rolls and idle rolls, and means for driving said feed-rolls to feed the sole along said path, said groups differing one from another in the arrangement of said flexing members to produce successively four different progressive bending effects including two lengthwise bends in opposite directions and two widthwise bends in opposite directions.

9. A sole-flexing machine comprising a series of groups of co-operative members arranged to be engaged by opposite faces of a sole traveling lengthwise along a certain path, one member of each of said groups being an anvil roll, and means for driving said anvil rolls to feed the sole, said groups differing, one from another, in the arrangement of their sole-engaging members to bend the sole lengthwise first in one direction and thereafter in the opposite direction, and to bend it widthwise first in one direction, and thereafter in the opposite direction.

10. A sole-flexing machine comprising co-operative flexing members arranged to provide a series of flexing stations and including a series of driven rolls of circular cross-section by which a sole may be fed past said stations successively, said flexing members being organized to wrap a sole progressively in opposite directions around segments of two of said rolls and to bend it widthwise in opposite directions at two of said stations.

11. A sole-flexing machine comprising anvil rolls of bulging profile arranged one at each of a series of stations to be engaged by opposite faces of a sole, means arranged to cooperate with said rolls respectively to conform successive portions of the sole to said bulging profiles, and means for rotating said anvil rolls to feed the sole.

12. A sole-flexing machine comprising cylindric anvil rolls arranged one at each of a series of stations to be engaged by opposite faces of a sole, means arranged to bend successive portions of a sole progressively in opposite directions around segments of said rolls, anvil rolls of bulging profile arranged one at each of a series of other stations to be engaged by opposite faces of the sole, means of concave profile arranged to conform successive portions of the sole progressively to said bulging profiles, and means for rotating said anvil rolls to feed the sole past all said stations.

13. A sole-flexing machine comprising a series of at least four driven feed-rolls arranged to be engaged succesively by a sole fed by them, two of said rolls being cylindric and arranged to be engaged by opposite faces of the sole and two of them having bulging profiles and being arranged to be engaged by opposite faces of the sole, means arranged to bend successive portions of the sole around and against segments of said cylindric rolls, and means arranged to bend successive portions of the sole against and into conformity with said bulging profiles.

14. A sole-flexing machine comprising a plurality of anvil rolls having bulging profiles arranged one at each of a series of stations to be engaged by opposite faces of a sole, conforming rolls arranged adjacent to said anvil rolls respectively to bend successive portions of the sole progressively against said anvil rolls and thereby conform said portions to said bulging profiles, and means for driving some of said rolls to feed the sole.

15. A sole-flexing machine as defined in claim 14 in which intermediate members are arranged to be engaged by opposite faces of the sole between two of said stations to unbend the sole and guide it to the next station.

16. A sole-flexing machine comprising, in combination, two spaced pairs of confronting sole-guiding members arranged to be engaged simultaneously by opposite faces of a sole traveling lengthwise from one pair to the other, said members being formed and arranged to maintain the engaged portions of the sole in a common plane, co-operative sole-engaging members arranged at a station between said pairs of guiding members to bend the intermediate portion of the sole widthwise, one of said bending members being a feed-roll, and means for rotating said feed-roll.

17. A sole-flexing machine comprising an anvil-roll, a narrow segmental deflector having an incurved operating surface confronting but spaced from a segment of said anvil-roll to bend a longitudinal median band of a sole against said segment, and two series of short rolls flanking said deflector to be engaged by the margins of the sole and thereby relieve the sole from some of the friction due to feeding it along said incurved surface.

18. A sole-flexing machine comprising the combination of elements recited in claim 17 and a plurality of supporting rods on which said short rolls and said deflector are strung and thereby maintained in cooperative relation.

19. A sole-flexing machine comprising the combination of elements recited in claim 17 of which said anvil-roll has a bulging profile and said short rolls are arranged to conform successive portions of the sole to said profile by bending the margins of the sole relatively to said median band.

JAMES P. FREDERICKSEN.