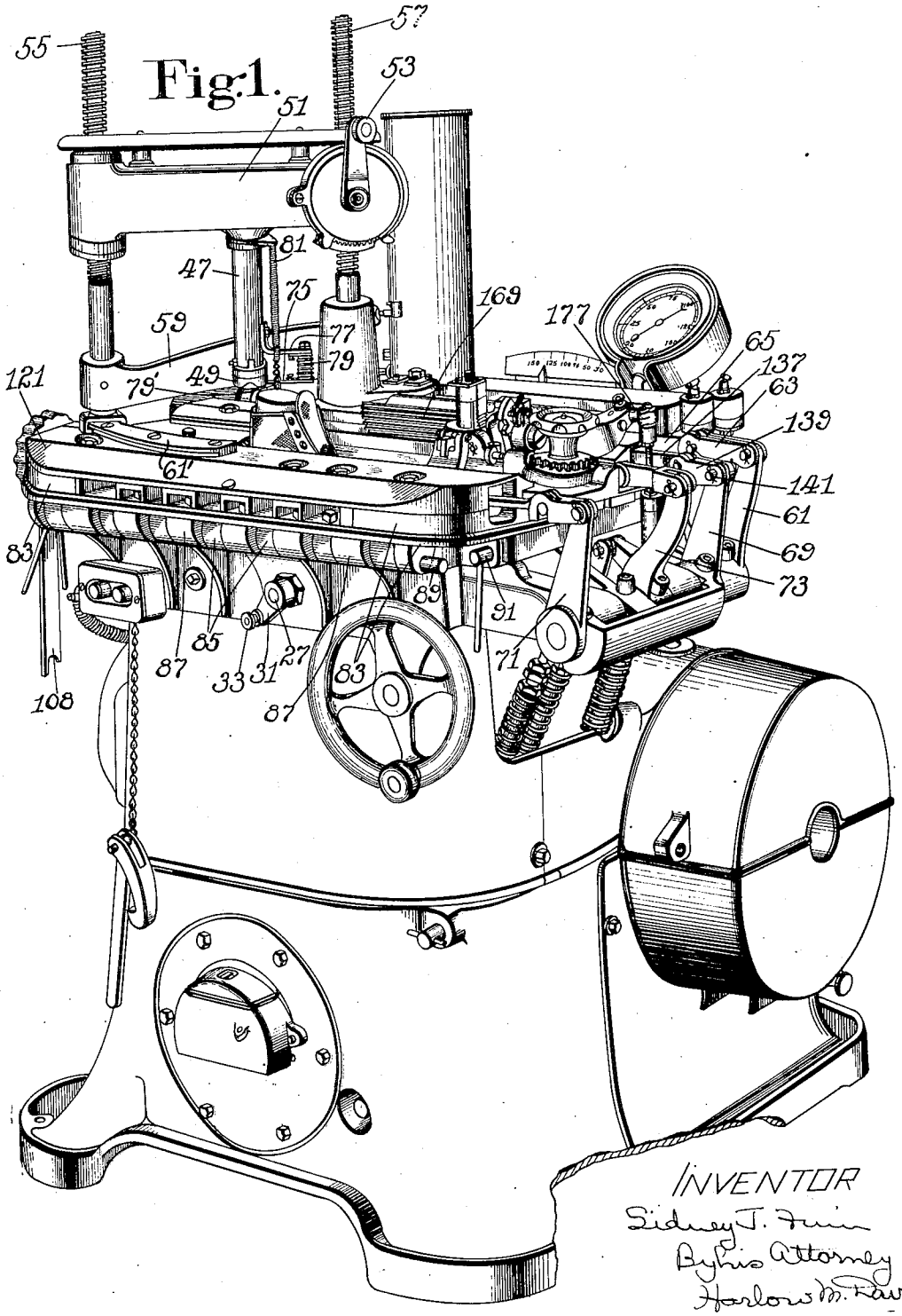
Aug. 8, 1933. S. J. FINN 1,920,977

SOLE LAYING MACHINE

Filed Sept. 12, 1931 4 Sheets-Sheet 1

Fig. 1.



INVENTOR
Sidney J. Finn
By his Attorney,
Harlow M. Fairs

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SOLE LAYING MACHINE

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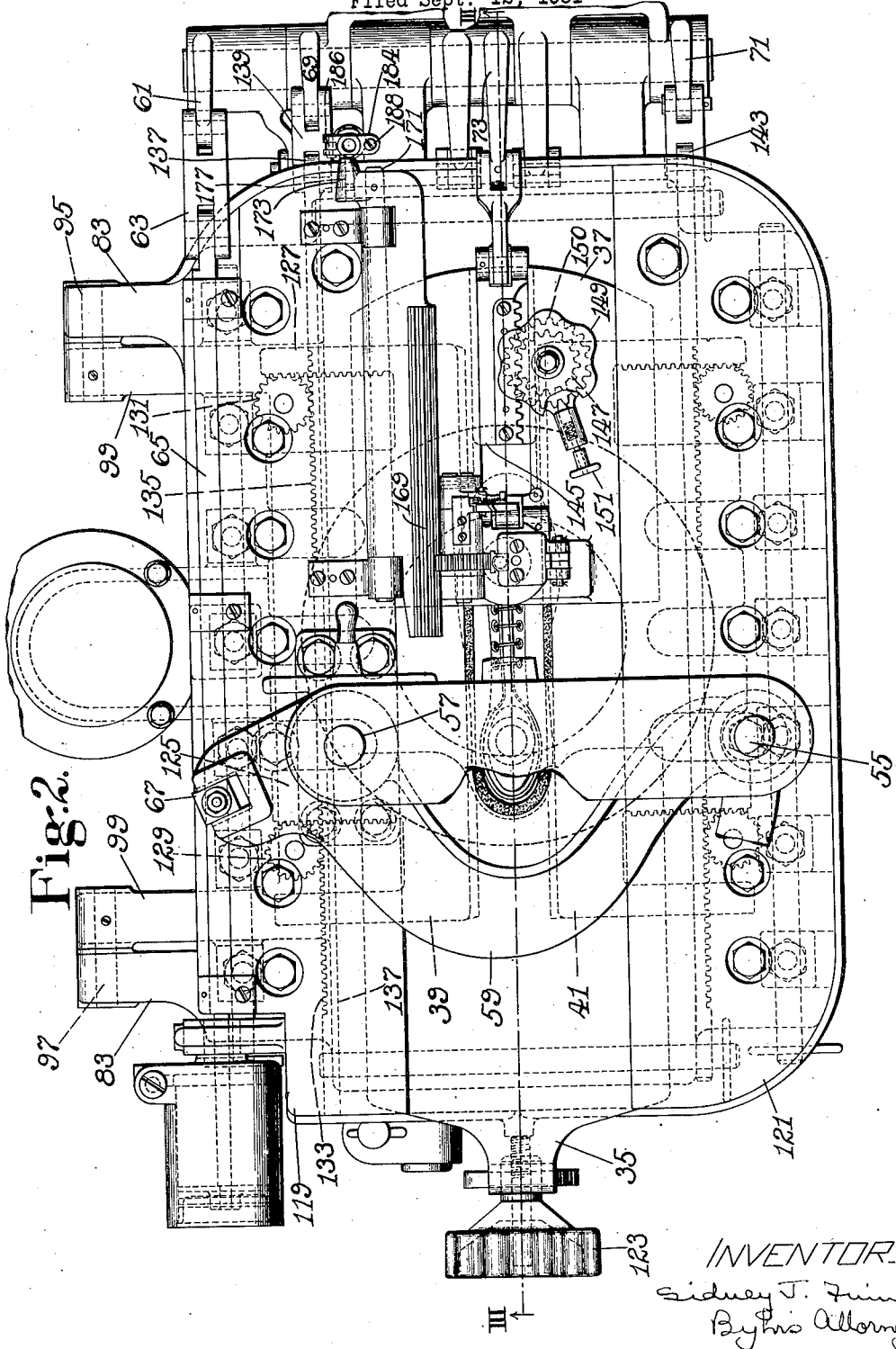

Fig. 2.

INVENTOR.
Sidney J. Finn
By his Attorney,
Harlow McDavis

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SOLE LAYING MACHINE

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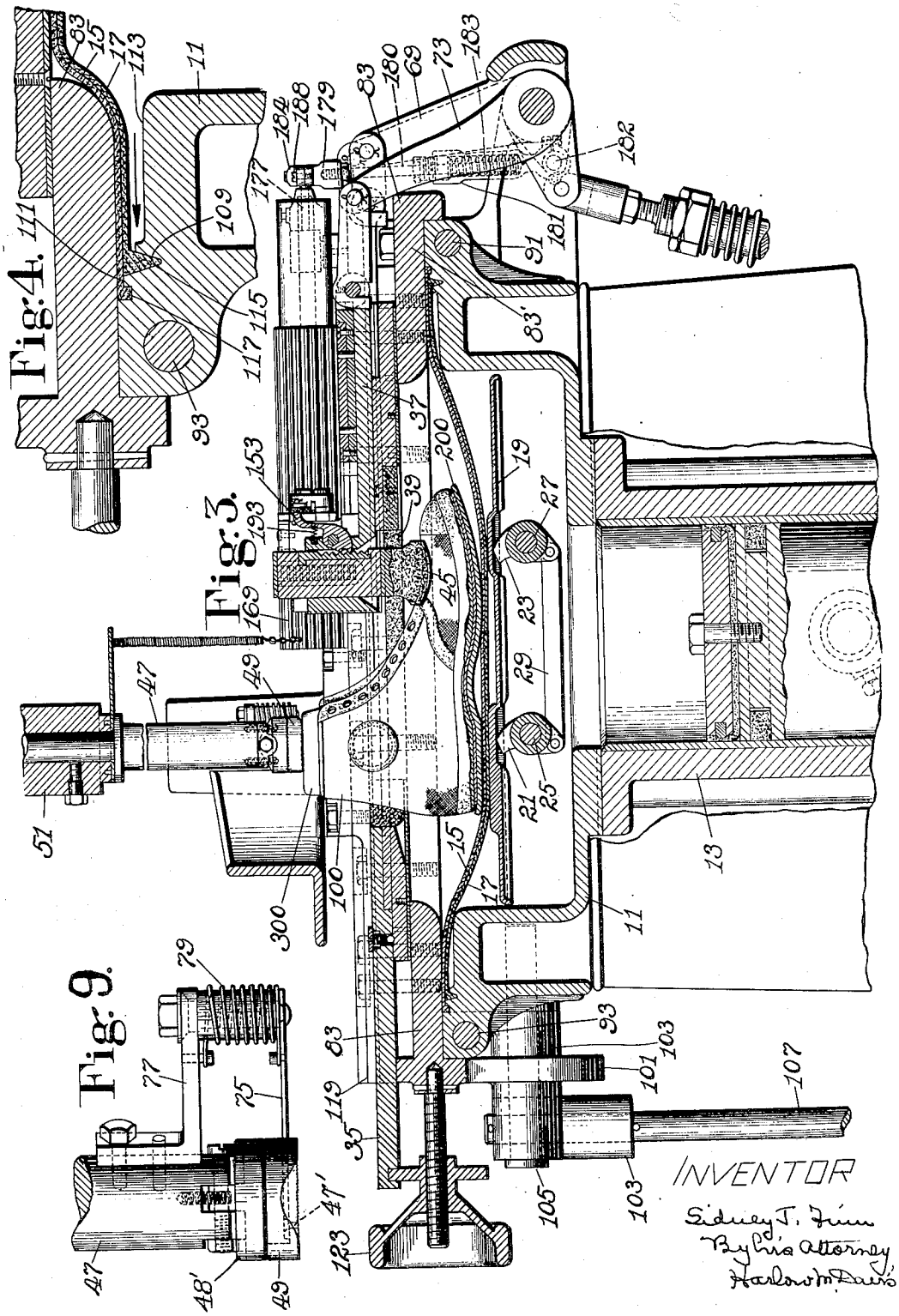


Aug. 8, 1933. S. J. FINN 1,920,977

SOLE LAYING MACHINE

Filed Sept. 12, 1931 4 Sheets-Sheet 4

Fig. 5.

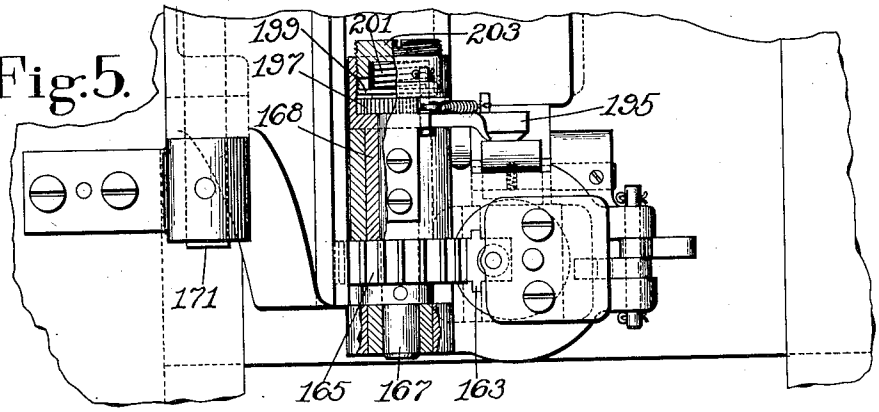


Fig. 6.

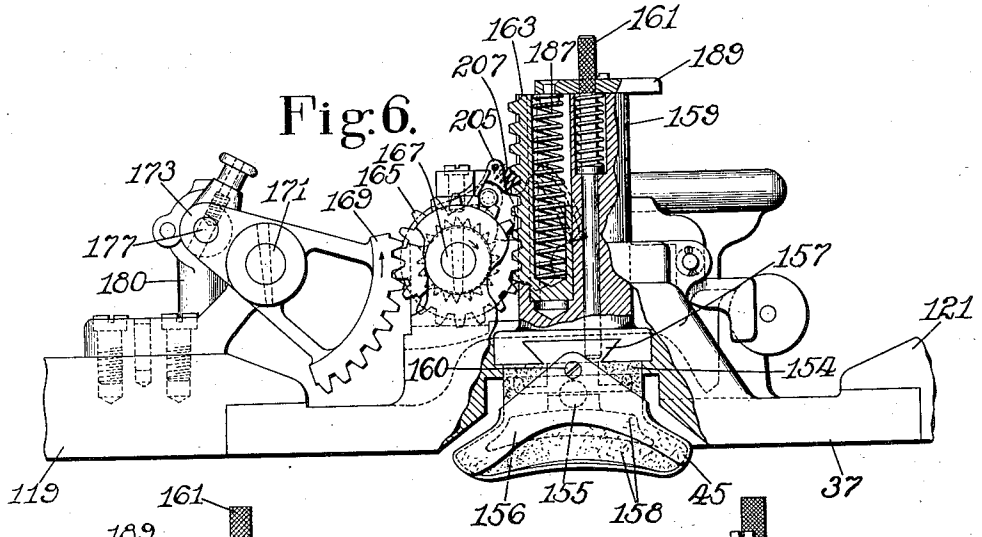


Fig. 7.

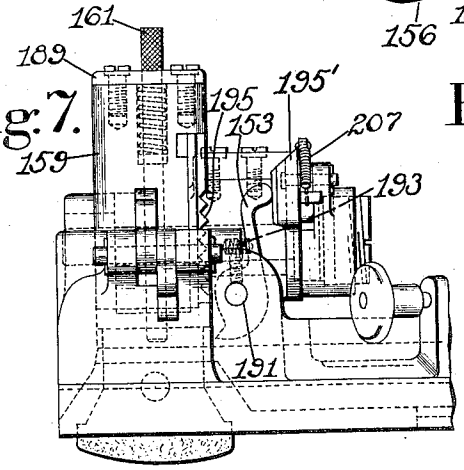
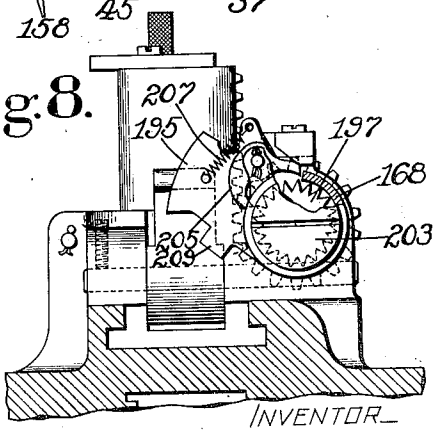


Fig. 8.



INVENTOR

Sidney J. Finn

By his Attorney,

Harlow M. Davis

Patented Aug. 8, 1933 1,920,977

UNITED STATES PATENT OFFICE

1,920,977

SOLE LAYING MACHINE

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

Application September 12, 1931
Serial No. 562,461

50 Claims. (Cl. 12—33)

This invention relates to sole laying machines and is herein illustrated as embodied in a machine particularly suitable for laying a sole of unvulcanized rubber upon the bottom of a shoe to which the sole is to be vulcanized.

After the lasted shoe is otherwise complete except for the vulcanizing step, a sole of unvulcanized rubber is placed upon the bottom of the shoe and pressed into place against said bottom, the projecting margin of the sole (if it has one) being at the same time bent up and pressed against the margin around the lower portion of the shoe. Commonly this sole laying operation is performed by a machine comprising a pressure box having a flexible diaphragm upon which the shoe is placed, a fluid under pressure being forced into the box and the shoe held against this pressure by a suitable jack, a machine of this type being disclosed in application Serial No. 209,297, field July 29, 1927 in my name.

Commonly the diaphragm has been held in place by a cap plate having an opening therein to expose the working portion of the diaphragm, said cap plate being fastened to the rigid receptacle, which forms the main portion of the box, by cap screws or bolts so that the margin of the diaphragm is clamped to the rim of the main portion of the box with sufficient force to prevent leakage of fluid. With such a construction considerable time and labor are consumed in removing and replacing the diaphragm since all of these screws or bolts, which are necessarily numerous, must be removed and replaced.

According to one feature of the invention the pressure of fluid in the box is made use of to seal the joint between the flexible diaphragm and the rigid portion of the box. To this end the cap plate is fastened to the receptacle, which forms the main portion of the box, by means which may be readily disconnected; and the receptacle and the diaphragm are formed with interengaging portions so constructed that they are forced into intimate contact to seal the joint at that locality by a component of the fluid pressure in the box. In the illustrated construction in which the flexible diaphragm forms the top wall of the box, and the rigid receptacle comprises a bottom and side walls, the rim of the receptacle is provided with a recess to receive a rib which depends from the under face of the diaphragm the recess being so formed that the inner face of the rib is exposed to the pressure of fluid in the box and the outer face is thereby pressed against the outer wall of the recess with a force which increases with rise of pressure in the box. In order still further to facilitate access to the diaphragm, the cap plate is hinged to a stationary part of the machine, and a cam with a long handle is provided for swinging it up, such lifting means being particularly desirable since the cap plate, as will presently appear, has mounted upon it various parts including a heavy jack.

In the present machine, certain plates are closed about the sides of the lasted shoe about midway of its height and the jack is swung into position above the top of the last, before fluid pressure is applied through the diaphragm. It is desirable that the toe portion of the shoe be clamped firmly in position before all of the plates close about it since otherwise a slight movement of the shoe would cause portions of the sides of the shoe to rub against the edges of the plates. According therefore, to another feature of the invention, means is provided for so clamping the toe portions of shoes with equal force irrespective of differences in thickness of said toe portions. In the illustrated machine, a stationary support located inside the pressure box takes the weight of the shoe when it is placed upon the diaphragm, and there are two side plates and a front plate which are moved in to close about the shoe. The jack moves into position over the top of the last. The front plate, which moves in at the same time as the jack, carries movably vertically with respect to it, a toe pad. This toe pad is then moved down until it clamps the toe portion of the shoe firmly against the stationary shoe support and the intervening diaphragm. When the toe portion of the shoe has thus been firmly clamped, the side plates move in, and thereafter fluid is forced into the box.

As has been explained above, the jack is swung into position above the top of the last before the shoe is engaged by the plates which close about it. The jack is adjustable vertically; and if through error it has been adjusted into too low a position it will strike the side of the top of the last and may displace the shoe so that the plates will not close properly about the shoe.

In order to avoid this possibility, the contact member of the jack, according to the present invention, is yieldingly held in place so that if it strikes the side of the last it will be pushed out of the way without displacing the lasted shoe.

These and other features of the invention, including certain details of construction and combinations of parts will be described as embodied in an illustrated machine and pointed out in the appended claims.

Referring now to the accompanying drawings,

Fig. 1 is a perspective of a machine in which the present invention is embodied;

Fig. 2 is a plan view of the machine, certain unimportant parts having been omitted;

Fig. 3 is a vertical longitudinal section through the machine showing a lasted shoe in position to have its sole laid;

Fig. 4 is a detail on a somewhat enlarged scale showing how the diaphragm is held in place;

Fig. 5 is a detail partly in plan and partly in section of the toe clamp and the mechanism for operating it;

Fig. 6 is an elevation, partly in section, of the same mechanism which is shown in Fig. 5;

Fig. 7 is an elevation of the same mechanism which is shown in Fig. 6, but viewed from a different angle;

Fig. 8 is another elevation of the same mechanism viewed from a still different angle; and

Fig. 9 is a detail of the jack structure.

Before proceeding to a detailed description of the machine, a brief description of its mode of operation will be given. Referring more particularly to Fig. 3, a receptacle 11 which forms the lower rigid portion of a pressure box is in communication with the upright cylinder 13 of a water pump by which water may be forced into the box when desired. A rubber diaphragm forms the top of the pressure box. This diaphragm is herein shown as composed of two rubber members or sections, an upper section 15 and a lower section 17. A diaphragm composed of a single sheet of rubber or other suitable material may be used if desired, but it is preferable to use two comparatively thin sections, since the principal wear is caused by contact with the shoe; and, when two sections are used, the upper one may be removed and replaced when worn while the lower one remains intact. The lower section 17 of the diaphragm has its middle portion molded to provide a depression of some depth to receive the lower portion of a shoe; and the upper section 15 has molded in it two depressions to receive respectively the heel and the toe portions of the shoe. The diaphragm is not stretched tightly over the top of the box, and the lower portion of the section 17 rests upon a plate 19. This plate is adjustably supported by two cams 21, 23 fast respectively to rock shafts 25, 27, the tails of said cams being connected by a link 29. The purpose of this construction is to facilitate adjustment of the height of the plate 19. To this end one end of the shaft 27 protrudes through a side wall of the pressure box and has a crank 31 (Fig. 1) provided with a spring-pressed locking pin 33 which may be caused to enter any one of several sockets in the wall of the pressure box. It is thus possible to adjust the plate 19 into various vertical positions to provide for shoes of different heights. Located above the diaphragm are four plates (Fig. 2), a back plate 35, a front plate 37, and side plates 39, 41. The purpose of these four plates is to support against the pressure of the fluid the portion of the diaphragm which does not engage the shoe, so that this portion will not be distended unduly during the sole-laying operation with the consequent liability of bursting. The back plate 35 is adjustable but is stationary during the operation of the machine; and normally the front plate and the two side plates are held in their outer positions so that a lasted shoe 100 with an unvulcanized rubber sole 200 on its bottom may be passed through the opening enclosed by the plates into a position in which it rests upon the diaphragm. When it has been so placed, a treadle is depressed and the following movements occur.

The front plate 37, together with toe clamp mechanism, including a toe pad 45 moves into the position shown in Fig. 3. A jack post 47 is swung from its normal position at one side of the pressure box into the position shown in Fig. 3 in which its contact member 49 is located above the top of the last 300. The side plates 39, 41 are moved into contact with the sides of the shoe as shown in Fig. 3, and the side plate 39, during this movement and before the two side plates have completed their movements pushes the toe pad 45 down and locks the pad from upward movement. The edge of the back plate is curved to correspond approximately to the curvature of the back of the shoe at the point engaged; and this edge as well as the edges of the side plates carries a layer of rubber. The toe pad 45 is made of rubber and leather or other suitable material and fits over the toe portion of the shoe at the locality shown. When the plates have been moved into their operative positions, as shown in Fig. 3, there is substantially no space whatever between the shoe and the back and side plates, and very little if any space adjacent to the front portion of the shoe, such spaces as may at times exist at the junction of the toe pad and the side plates being very small. Consequently a high water pressure may be applied to the diaphragm without danger of bursting it by forcing a portion or portions of it up between the plates and the shoe. After the shoe has been placed in the pressure box and the plates closed about it, the water pump forces water under pressure into the box to wrap the diaphragm about the lower portion of the shoe and thereby to press the body portion of the sole against the bottom of the shoe and to bend up the margin of the sole and press it against the lower margin of the shoe. The parts of the machine then return to their initial normal positions of rest.

The water pump, its reservoir, and the mechanism for operating the pump are or may be the same as are shown in my prior application referred to above, and will not be further described.

The jack and its operating mechanism, except for the construction of the jack post presently to be described, are substantially the same as those of the machine of the application. Briefly, a jack post 47 (Fig. 1) is fast to a casting 51 which may be adjusted vertically by turning a crank 53, said casting being carried at its opposite ends by sleeves which are threaded respectively upon upright threaded rods 55, 57, the lower unthreaded portions of said rods being connected by a heavy casting 59. The rod 57 is rotatable about its vertical axis, and the lower end of the rod 55 runs upon a curved track 61' which is concentric with the axis of the rod 57. The jack post 47 may thus be swung about the axis of the rod 57 to bring the jack post above the shoe. The jack is so swung at the proper time by a bell crank lever 61 connected by a link 63 to a slide bar 65, said slide bar carrying a pivoted block 67 (Fig. 2) which is embraced by a yoke formed on the casting 59. The bell crank lever 61 and its operating mechanism are or may be the same as the corresponding members of the machine of the application. It may be here stated that the bell crank levers 69 and 71 (Fig. 1), which operate the side plates, and the bell crank lever 73, which operates the front plate, together with their operating mechanisms, are also the same as the correspond-

ing members of the machine of the application. No detailed description of the manner in which these bell crank levers are mounted and the mechanism for operating them at the proper times will be given, reference being made to the application.

The jack of the present invention differs from that of the machine of the application in the construction of its jack post and in the provision of a feeler for facilitating vertical adjustment of the post. When the jack is swung from its normal position of rest shown in Fig. 1 to its operative position shown in Fig. 3, it should just clear the top of the last so that, when pressure is applied to lay the sole on the bottom of the shoe, the shoe will not rise appreciably. It has sometimes happened with previous constructions that the jack post was set too low with the result that, when the jack post was swung into operative position, it struck the last a sidewise blow thereby displacing the shoe before the plates closed about the shoe. In order to avoid thus displacing the shoe if the jack post happens to have been set too low, a contact member 49 of the present machine is mounted for yielding swinging movement. To this end it is carried at one end of a small horizontal bar 75 (Fig. 1) having at its other end an upright pin which is rotatable in a bracket 77 carried by the jack post 47, a torsion spring 79, fast at one end to the bracket and at the other end to the bar, being provided to hold the contact member normally in proper position in longitudinal alinement with the post 47. A stop pin 47' carried by the contact member 49 engages a locality on an auxiliary pivotally yielding contact member 48' and thus cooperates with the torsion spring 79 to hold the contact piece normally in the position shown. If, therefore, the jack post happens to have been set too low so that the contact member 49 strikes the side of the last, this member will be swung out of the way without displacing the shoe, and the auxiliary contact member 48' will take the thrust of the water pressure.

In order to facilitate setting the jack post at just the right height, a feeler is provided in the form of a small chain 79' suspended by its upper end from the lower end of a small coiled spring 81 carried by the jack structure. The free lower end of this hanging chain is on a level with the bottom of the contact member 49 so that, by manipulating the crank 53 until the lower end of the chain just clears the top of the last, the jack may be adjusted into the proper position. When the jack occupies its normal position of rest, as shown in Fig. 1, the chain is directly above the top of the last.

The diaphragm of the machine of the prior application is held in place by a cap plate having an oval-shaped opening therein, said cap plate resting upon the margin of the diaphragm and being clamped to the rim of the pressure box by a series of cap screws, the pinching of the margin of the diaphragm between this cap plate and the rim serving to hold the diaphragm in place with sufficient force to prevent leakage of water. With such a construction considerable time and labor are consumed in removing and replacing a diaphragm, since all of these numerous cap screws must be removed, the cap plate with all the heavy parts which are mounted upon it must be lifted off from the pressure box, and finally the heavy plate and the numerous screws must be replaced. In the present construction the cap plate is hinged to the frame so that it may be quickly raised, the cap screws have been dispensed with, and a construction is provided whereby the pressure of the water in the pressure box serves to seal the joint between the diaphragm and the rigid receptacle against leakage of water, this seal becoming more positive as the pressure of water in the box increases. The cap plate 83 (Fig. 3) has a flat under-face to rest upon a flat portion of the rim of the rigid portion or receptacle 11 of the pressure box and has depending from its outer margin a series of spaced lugs 85 (Fig. 1) which, when the cap plate is in operative position, extend into spaces between similar spaced lugs 87 formed on the walls of the pressure box. There are four rows of the spaced lugs 85 which are arranged in the form of a rectangle on the under side of the cap plate, and there are four cooperating rows of spaced lugs 87 on the box. The lugs on the cap plate and on the box have holes which are in alinement when the cap plate is in position on the box, and through these holes locking rods are thrust. There are four of these rods, two of which are shown respectively at 89 and 91 in Fig. 1. The locking rod 91 and the one 93 at the opposite end of the pressure box appear in Fig. 3. The cap plate 83 (Fig. 2) has two rearwardly projecting lugs which are hinged respectively upon alined pivots 95, 97 carried by lugs 99 formed on one wall of the pressure box. This cap plate 83, like that of the one of the application, supports directly or indirectly the jack structure and the plates which close about the shoe; and these members must, of course, be disconnected from the four bell crank levers 61, 69, 71, 73 which operate them before the cap plate can be swung up about the pivots to which it is hinged. The upright arms of these bell crank levers are detachably connected, in a manner presently to be described, with the various members operated by them and carried by the cap plate. When they have thus been disconnected, and the four locking rods withdrawn, the cap plate may be swung up to give access to the rubber diaphragm. Inasmuch as the cap plate with the parts which it supports is heavy, a lifting cam 101 (Fig. 3) of a shape to lift the cap plate when it is rotated is integral with a short sleeve 103 rotatable on a short shaft 105, said sleeve having an extension provided with a socket to receive the upper end of a handle in the form of a long rod 107. When this rod is swung up the cam 101, by engagement with a locality on the under side of the cap plate 83 swings said plate up. In order to hold the cap plate up, a prop 108 (Fig. 1) is pivoted at its upper end to the cap plate 83 and has a curved notch at its lower end to be placed over a stud (not shown) carried by a wall of the pressure box.

Although when the cap plate 83 is in its operative position, the margin of the diaphragm is more or less clamped between the under side of the cap plate and the top of the rim of the pressure box, this clamping action is not sufficient to prevent leakage when water is forced into the pressure box to lay the sole on the shoe, such pressure being commonly more than one hundred pounds per square inch. In order to seal the joint between the diaphragm and the receptacle of the pressure box, the construction best shown in Fig. 4 is provided. Formed on the top of the rim of the receptacle is an endless groove 109 extending all around the rim, the top 111 of the outer wall of said groove being at a higher level than the top 113 of the inner wall; and there is formed upon the under side of the section 17 of the diaphragm a downwardly projecting rib 115

which is received in the groove or recess. With this construction a certain component of the water pressure will travel, so to speak, beneath the diaphragm in the direction indicated by the arrow and will tend to force the rib 115 outwardly (to the left as viewed in the figure) so as to press its outer face against the outer wall of the groove 109 with a force which increases with increase in the water pressure. The up-and-down components of the water pressure can at most effect only a very slight separation of the cap 83 from the box 11. Assuming that such a slight separation is possible, a limit is presently reached, after which the effect of increasing the water pressure is to seal with greater force the joint between the pressure box and the diaphragm. It should be understood that, so far as this feature of the invention is concerned, the diaphragm may just as well be in one piece. The section 15 is provided, as has been explained, merely to take care of the wear caused by contact with the shoe. The downwardly projecting rib 117 on the section 15, which projects into a small groove in the rim of the box, acts principally as a means for properly locating the section 15 in place.

The back plate 35 (Fig. 2) and the side plates 39, 41 are substantially like those of the machine of the application, and consequently their construction and mounting will be only briefly described. The back plate 35 is slidable in guideways formed in opposite edges of plates 119, 121 which are fastened to the cap plate 83 by cap screws. It is stationary during the operation of the machine but may be adjusted for different sizes of shoes by turning a screw 123. The front plate 37 (later to be described) is at the same level as the back plate and is also slidable in guideways in the stationary plates 119, 121. The side plates 39, 41 are located below the front and top plates. They rest upon the cap plate 83 and are slidable crosswise of the pressure box in guideways formed in the under sides of the stationary plates 119, 121. The side plate 39 has two projections 125, 127 provided with racks. Gears 129, 131 mesh respectively with these racks so that, when these gears are rotated, the side plate 39 is moved in and out. Each gear 129, 131 is mounted upon the upper end of a small shaft and has directly below and rigid with it a gear of the same size, said lower gears meshing respectively with racks 133, 135 formed on a slide bar 137. Reciprocation of this bar thus moves the side plate 39 in and out. The right-hand end of this slide bar is connected by a link 139 with the bell crank lever 69 which has been previously described. This link (Fig. 1) is pivoted at its rear end to the bell crank lever 69 by a pin 141, but at its forward end is detachably pivoted to the slide bar 137 by a hook opening downward which is hooked over a pin carried by the slide bar. The bell crank lever 69 may thus be readily disconnected from the slide bar 137 by swinging the hook up about the pivot pin 141. The other three bell crank levers 61, 71 and 73 are similarly connected to their respective slide bars and slide plate by similar pivoted hooked links so that the upright arms of all four bell crank levers may readily be disconnected preparatory to swinging up the cap plate with the members mounted upon it preparatory to replacing a diaphragm. The other side plate 41 is mounted in substantially the same manner as is the side plate 39 and is actuated by a slide bar 143 similar to the slide bar 137.

The front plate 37 is adjustably connected with its actuating bell-crank lever 73 (Fig. 2) so that the location of its path of reciprocation may be varied to provide for shoes of different lengths or of different lengths of vamps. To this end there is formed in the plate a longitudinally extending open-sided guideway to receive a short slide bar 145 having a rack on its side which meshes with a gear 147 fast to an upright shaft rotatably carried by the front plate 37. On the upper end of this shaft is a hand wheel 149 and below the hand wheel is a circular rack 150 between any selected two adjacent teeth of which a spring-pressed locking pin 151 may engage. Thus by pulling out the locking pin and turning the hand wheel 149, the initial position of the plate 37 may be adjusted to vary the location of the path of reciprocation of said plate.

The toe pad 45, which is mounted on the front plate 37, is adapted to be moved into the position shown in Fig. 3 before the water pressure is applied to the diaphragm. This pad is held locked down in clamping position during the sole-laying operation by a pawl 153, the front plate being at that time in its forward or inner position. Before the front plate is withdrawn to its outer position, the toe pad is lifted so that it will clear the cap plate 83 when the front plate is fully withdrawn.

Referring now more particularly to Figs. 5 to 8, the toe pad comprises a body of rubber 154, molded about a metal core 156, and a facing of leather 158. The rubber body is fastened to a metal holder 157 by means of an over-hanging circular flange at the top of the rubber body, there being a ball 155 between the metal core 156 and the holder to permit the pad to rock to some extent so as to engage firmly the toe portions of shoes of different shapes. The leather facing 158 is fastened to the holder 157 by two alined screws one of which is shown at 160. The holder 157 has a dove-tailed slide at its upper portion which is received in a dove-tailed guideway formed in the lower end of the stem 159 of the toe clamp structure, a spring-pressed locking pin 161 serving to hold the slide in position in the guideway. Vertically slidable in a guideway in the side of the stem 159 is a slide 163 having a rack which meshes with a gear 165 fast to one end of a small rock-shaft 167, said shaft being rotatable in a sleeve 168 which in turn is rotatable in a bearing rigid with the front plate 37. Also meshing with this gear is a segmental gear 169 carried by a rock shaft 171 mounted in brackets which are fastened to the stationary plate 119. This segmental gear 169 is an elongated one so that the segmental gear will always be in mesh with the small gear 165 in any position which the slidable front plate 37 may occupy. The elongated casting upon which the elongated segmental gear 169 is formed has at its end remote from the observer, as viewed in Fig. 6, a lug 173 in which is fastened one end of a short rod 177 having a ball at its outer end which is received in a split spherical socket at the upper portion of a member 179 (Fig. 3). Threaded into the lower end of the member 179 is the upper end of a rod 180 having a headed lower end received in a socket in a member 181 pivoted at 182 to a short horizontal arm integral with the bell crank lever 69 which operates the side plate 39. A compression spring 183 connects the rod 180 and the socketed member 181 so that these two members form a yielding link through which the segmental gear 169 is rocked.

In order to permit the member 179 to be disconnected from the ball on the end of the small rod 177, the socket at the upper end of the member 179 is a split one, including an upper part 184 (best shown in Fig. 2) pivoted at 186 to the lower part and held in operative position by a screw 188. When the screw has been removed, the upper part may be swung up about its pivot to free the ball and thereby to disconnect the segmental gear 169 from its driving mechanism.

With this construction, when the bell crank lever is rocked to move the side plate 39 in toward the shoe, the segmental gear 169 is swung up, the small gear 165 (Fig. 6) is rotated clockwise, and the slide 163, which is in contact with the bottom of its guideway in the stem 159, pushes the toe clamp down. When the toe clamp has thus pushed the toe portion of the shoe firmly down upon the diaphragm and its supporting plate 19, the compression spring 183 (Fig. 3) permits further movement of the bell crank lever 69. When, after the sole has been laid, the segmental gear 169 is swung down, the toe clamp is lifted through a compression spring 187 which is located in a hollow in the slide 163 and bears with its upper end against the under side of a cap 189 fastened to the top of the stem 159. As will presently be explained, this spring is compressed during the first part of the upward movement of the slide since the stem 159 is at that time locked from upward movement by the pawl 153, the upper portion of the slide 163 rising above the level of the cap 189. The pawl 153 is urged at all times to swing in a clockwise direction about its pivot 191 by a small compression spring 193 so as to engage teeth 195 formed on one side of the stem 159. The shape of the nose of the pawl and that of the teeth are such that the stem 159 may be pushed down at any time but cannot rise when the pawl is in engagement with the teeth. The pawl is swung to the inoperative position shown in Fig. 7 to permit the toe pad to rise and is held in that position at the proper time by a cam 195'. The hub of this cam is fast to the sleeve 168 in which the shaft 167 is rotatable. The sleeve has an enlarged bore at one end providing a shoulder against which one face of a ratchet 197, fast to the shaft 167, is frictionally held by a washer 199, a compression spring 201, and a cap 203 threaded into the enlarged bore in the sleeve. The cam 195' is thus driven frictionally by the rock-shaft 167 but may be arrested in its movement when desired. Pivoted to the cam is a pawl 205 which is held at all times by a spring 207 in engagement with the ratchet 197. Due, however, to the shape of the nose of the pawl and that of the teeth of the ratchet, the ratchet can overrun the pawl when rotated in a counterclockwise direction, as viewed in Fig. 8, this being its direction of rotation when the cam 195' is being swung down from the position shown in Fig. 7 to release the locking pawl 153. Since the ratchet is fast to the shaft 167, and since the cam 195' is driven frictionally from the shaft by the sleeve 168, the ratchet 197 and the cam 195' swing together in a counterclockwise direction, as viewed in Fig. 8, when the toe clamp is being moved down, until a stop 209 on the cam encounters a stationary part. The ratchet, during its further counterclockwise movement while the side plate 39 is completing its inward movement toward the shoe, overruns the pawl. As soon, however, as the ratchet is rotated in a clockwise direction and the side plate 39 begins to move out, the cam 195' is swung up. Before the shaft 167 completes its rotation to raise the toe pad, the pawl 205 (Fig. 8) is disengaged from the teeth of the ratchet 197 by engagement of the tail of the pawl with a stationary cam, as shown in that figure.

The operation of the machine is as follows, assuming that the parts are in their normal positions as shown in Fig. 1, a lasted shoe having an unvulcanized rubber sole located on the bottom thereof is placed upon the diaphragm and the crank 53 manipulated, if necessary, so that the contact member 49 of the jack is just above the level of the top of the last. A treadle, not shown, is then depressed whereupon the following movements take place. The jack and the toe plate start their movement at the same time, the jack being swung into the position shown in Fig. 3 and the toe plate being also moved into the position shown in that figure. The side plates 39 and 41 are then moved in, the toe clamp being operated from the bell crank lever 69 which operates the side plate 39. During a part of the inward movement of the side plate 39 the elongated segmental gear 169 (Figs. 5 to 8) is rocked up thereby rotating the small gear 165 and forcing the toe pad 45 down firmly upon the toe portion of the shoe. Before this position has been reached, the cam 195' has swung down below the projection on the tail of the pawl 153, and the spring 193 has caused the pawl to engage the teeth 195 on the side of the stem 159 so that the toe pad cannot rise. The stop 209 on the cam 195' has encountered a stationary part of the machine; and the ratchet 197 has overrun the pawl 205. The toe clamp and the plates are now in engagement with the shoe so as to afford a support for the diaphragm when it shall be distended and wrapped about the shoe. The water pump now acts to force water under pressure into the pressure box so as to wrap the diaphragm about the lower portion of the shoe, thereby pressing the body portion of the sole against the shoe and bending up the margin of the sole about the lower side portions of the shoe. This pressure is maintained for a short interval, and then water is withdrawn from the box to relieve the pressure. The side plates are then withdrawn. As soon as the side plate 39 starts its movement of withdrawal the ratchet 197 through the pawl 205 swings the cam 195' up and thereby disengages the locking pawl 153 from the toe clamp. Before this unlocking takes place the slide 163 has moved up somewhat and thereby compressed the spring 187 which lifts the toe clamp as soon as the locking pawl 153 is disengaged. By the time the side plate 39 has been completely withdrawn, the toe pad 45 has been lifted above the level of the cap plate 83. The front plate 37 is now withdrawn and the jack swung back so that the parts once more occupy the positions shown in Fig. 1.

If at any time it is desired to change the diaphragm, the locking rods 89, 91, 93 and the fourth rod, not shown, are removed, the bell crank levers 61, 69, 71, 73 are disconnected from the members which they operate by swinging up the hooked links at their upper ends, and the rod 180 is disconnected from the elongated segmental gear 169 by lifting up the upper portion of the split spherical socket at the top of the member 179. The handle 107 is then pulled up to swing up the cap plate 83 together with everything mounted upon it; and the prop 108 is engaged with a stationary stud to hold the cap plate in raised position. The diaphragm may now be removed and replaced. The cap plate is now permitted to swing down, the locking rods are replaced, and the various

parts are connected once more with their driving mechanisms.

As has been stated above, the present machine is similar in many respects to the machine shown in my prior application; and reference is made to that application for a detailed description of parts which are not described in this application.

Although the invention has been set forth as embodied in a particular machine, it should be understood that the invention is not limited in the scope of its application to the particular machine which has been shown and described.

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

1. A machine of the class described having, in combination, a pressure box comprising a rigid receptacle for fluid and a flexible diaphragm, a cap member resting upon the margin of the diaphragm and held from movement with respect to the receptacle, and means for forcing fluid under pressure into the box into contact with the diaphragm, the diaphragm and the receptacle being formed with interengaging portions located beneath the cap member constructed and arranged to be pressed into intimate contact by a component of the fluid pressure to prevent leakage of fluid from the box.

2. A machine of the class described having, in combination, a pressure box comprising a rigid receptacle for fluid and a flexible diaphragm, and means for forcing fluid under pressure into the box into contact with the diaphragm, said diaphragm having a rib one face of which rests against a portion of the receptacle and the other face of which is exposed to the pressure of the fluid to seal the joint between the diaphragm and the receptacle.

3. A machine of the class described having, in combination, a pressure box comprising a rigid receptacle for fluid and a flexible diaphragm the margin of which rests upon the rim of the receptacle, means for forcing fluid under pressure into the box, said diaphragm having a rib one face of which rests against a portion of the receptacle and the other face of which is exposed to the pressure of the fluid to seal the joint between the diaphragm and the receptacle, and a member resting upon the margin of the diaphragm for preventing separation of the rim of the receptacle and the margin of the diaphragm.

4. A machine of the class described having, in combination, a pressure box and means for forcing fluid under pressure into the box, said box comprising a receptacle for fluid and a flexible diaphragm against which fluid is forced, there being formed respectively upon these two members a rib and a recess to receive the rib such that one face of the rib is exposed to the pressure of fluid in the box whereby the other face is forced against a wall of the recess to seal the joint between the diaphragm and the receptacle.

5. A machine of the class described having, in combination, a pressure box, means for forcing fluid under pressure into the box, said box comprising a receptacle for fluid and a flexible diaphragm against which fluid is forced, there being formed respectively upon these two members a rib and a recess to receive the rib such that one face of the rib is exposed to the pressure of fluid in the box whereby the other face is forced against a wall of the recess to seal the joint between the diaphragm and the receptacle, and a member for holding the margins of the diaphragm against the rim of the receptacle and thereby preventing the rib from being forced out of the recess.

6. A machine of the class described having, in combination, a pressure box, and means for forcing fluid under pressure into the box, said box comprising a receptacle for fluid having an opening, and a flexible diaphragm covering the opening, there being formed respectively upon the receptacle and upon the diaphragm a recess and a rib adapted to lie in said recess, a portion at least of one face of the rib being exposed to a component of the pressure of the fluid acting in a direction substantially parallel to the plane of the diaphragm so as to press the other face of the rib against a wall of the recess to seal the joint between the diaphragm and the receptacle.

7. A machine of the class described having, in combination, a pressure box comprising a receptacle for fluid provided with an endless recess in the top of its rim, a flexible diaphragm having its margin resting upon the rim and provided with a rib extending into said recess, one face of said rib being exposed to the interior of the box, a cap resting upon the diaphragm above the rib, and being held from movement with respect to the box, and means for forcing fluid under pressure into the box.

8. A machine of the class described having, in combination, a pressure box, means for forcing fluid under pressure into the box, said box comprising a receptacle having an opening, the rim of the receptacle having a groove extending around said opening, the inner wall of the groove being of a height less than that of the outer wall, a flexible diaphragm having its margin resting upon the rim and provided with a rib extending into the groove, a cap having an opening to expose a portion of the diaphragm, said cap resting upon the diaphragm above the rim and being held from movement away from the diaphragm whereby the pressure of the fluid acts upon the rib to prevent leakage of fluid.

9. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, means for forcing fluid under pressure into the box, a pivoted cap plate resting upon the margin of the diaphragm, and means for detachably fastening the cap plate to the box, there being interengaging portions formed on the diaphragm and on the box adapted to be forced into firm contact by the pressure of the fluid.

10. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a pivoted cap plate resting upon the margin of the diaphragm, means for detachably fastening the cap plate to the box, and means for swinging the cap plate about its pivot, after the fastening means has been rendered inoperative, to permit removal and replacement of the diaphragm.

11. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, means for forcing fluid under pressure into the box, a pivoted cap plate resting upon the margin of the diaphragm, a series of spaced perforated lugs on said cap plate, a series of similar spaced perforated lugs on a rigid wall of the box, and a removable rod extending through the alined perforations in the two series, there being interengaging portions formed on the diaphragm and on the box adapted

to be forced into firm contact by the pressure of the fluid.

12. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a pivoted cap plate resting upon the margin of the diaphragm, a series of spaced perforated lugs on said cap plate, a series of similar spaced perforated lugs on a rigid wall of the box, a removable rod extending through the alined perforations in the two series, and means for swinging up the cap plate to expose the diaphragm after the rod has been removed.

13. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, means for forcing fluid under pressure into the box, a pivoted cap plate resting upon the margin of the diaphragm, a jack and a plurality of shoe-engaging plates carried by the cap plate, and means for detachably connecting the cap plate to the box, there being interengaging portions formed on the diaphragm and on the box adapted to be forced into firm contact by the pressure of the fluid.

14. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a pivoted cap plate resting upon the margin of the diaphragm, a jack and a plurality of shoe-engaging plates carried by the cap plate, means for detachably connecting the cap plate to the box, and means adapted to be operated after the cap plate has been disconnected from the box to swing the cap plate so as to expose the diaphragm.

15. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a pivoted cap plate resting upon the margin of the diaphragm, a jack and a plurality of shoe-engaging plates carried by the cap plate, operating mechanism detachably connected to the jack and to the shoe-engaging plates, and means for detachably fastening the cap plate to the box.

16. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a pivoted cap plate resting upon the margin of the diaphragm, a jack and a plurality of shoe-engaging plates carried by the cap plate, operating mechanism detachably connected to the jack and to the shoe-engaging plates, means for detachably fastening the cap plate to the box, and means adapted to be operated, after the cap plate has been disconnected from the box and the operating mechanism has been disconnected from the jack and the shoe-engaging plates, for swinging the cap plate to expose the diaphragm.

17. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a pivoted cap plate resting upon the margin of the diaphragm, and means for detachably fastening the cap plate to the box, there being formed upon the diaphragm a rib and upon a rigid portion of the box a recess to receive the rib, the shape of the recess being such that a portion of the inner face of the rib is exposed to the pressure of fluid in the box.

18. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting lasted shoes against pressure applied through the diaphragm, clamping members for clamping the toe portions of all shoes with substantially the same force irrespective of differences in thickness of said toe portions, and means for forcing fluid into the box.

19. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting lasted shoes against pressure applied through the diaphragm, clamping members operating before the jack becomes effective for clamping the toe portions of all shoes with substantially the same force irrespective of differences in thickness of said toe portions, and means for forcing fluid into the box.

20. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting lasted shoes against pressure applied through the diaphragm, clamping members for clamping the toe portions of all shoes with substantially the same force irrespective of differences in thickness of said toe portions, means for locking the clamping members from separation, and means for forcing fluid into the box.

21. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, clamping members operating before the jack engages the last for clamping each shoe in place by engagement with its toe portion, and means for forcing fluid into the box.

22. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, clamping members operating before the jack engages the last for clamping each shoe in place by engagement with its toe portion and for locking the clamping members from separation, and means for forcing fluid into the box.

23. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, a shoe support located inside the box, a toe pad located outside the box and independent of the jack, means for causing relative movement of approach between the toe pad and the shoe support to an extent determined by the thickness of the toe portion of the shoe to clamp the shoe and for then preventing separation of said members, and means for forcing fluid into the box.

24. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, a shoe support located inside the box, a toe pad, means for moving the toe pad toward the support a distance determined by the thickness of the toe portion of the shoe to clamp the toe portion of the shoe to the support and the intervening diaphragm, and means for forcing fluid into the box.

25. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, a shoe support located inside the box, a toe pad, means for moving the toe pad toward the support a distance determined by the thickness of the toe portion of the shoe to clamp the toe portion of the shoe to the support and the intervening diaphragm, means for lock-

ing the toe pad from movement away from the support, and means for forcing fluid into the box.

26. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, said jack being normally above and at one side of the box to permit free access to the diaphragm, means for moving the jack into operative position above but out of contact with the last, a shoe support located inside the box, a toe pad, means for moving the toe pad automatically toward the support a distance determined by the thickness of the toe portion of the shoe to clamp the toe portion of the shoe to the support and the intervening diaphragm, and means for forcing fluid into the box.

27. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, a plurality of members movable to close about the shoe, and a clamping pad mounted upon one of said members and movable with respect to the member upon which it is mounted.

28. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, a plurality of members located outside the diaphragm and movable to close about the shoe, and a clamping pad mounted upon one of said members and movable with respect to the member upon which it is mounted.

29. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, a front plate movable over the toe portion of the shoe, and a toe clamp carried by the front plate and movable with respect thereto to engage the top of the toe portion of the shoe.

30. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a lasted shoe against pressure applied through the diaphragm, a plurality of members adapted to close about the shoe, and a clamping pad mounted upon one of said members and movable in a direction at an angle to the path of closing movement of the member.

31. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a lasted shoe against pressure applied through the diaphragm, a plurality of members located outside the diaphragm and adapted to close about the shoe, and a clamping pad mounted upon one of said members and movable in a direction at an angle to the path of closing movement of the member.

32. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a lasted shoe against pressure applied through the diaphragm, a front plate movable over the toe portion of the shoe, and a toe clamp carried by the front plate and movable with respect to it heightwise of the shoe.

33. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, members adapted to close about the shoe to support that portion of the diaphragm which does not engage the shoe, a shoe support inside the box, a toe pad, and means for causing the toe pad to move heightwise of the shoe to clamp the shoe to the support and the intervening diaphragm.

34. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, members adapted to close about the shoe to support that portion of the diaphragm which does not engage the shoe, a shoe support inside the box, a toe pad, and means for causing the toe pad to move heightwise of the shoe to clamp the shoe to the support and the intervening diaphragm before the members have completely closed about the shoe.

35. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, members adapted to close about the shoe to support that portion of the diaphragm which does not engage the shoe, a stationary shoe support inside the box, a toe pad, and means for causing the toe pad to move heightwise of the shoe to clamp the shoe to the support and the intervening diaphragm.

36. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a shoe against pressure applied through the diaphragm, members adapted to close about the shoe to support that portion of the diaphragm which does not engage the shoe, a stationary shoe support inside the box, a toe pad, and means for causing the toe pad to move heightwise of the shoe to clamp the shoe to the support and the intervening diaphragm before the members have completely closed about the shoe.

37. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a plurality of members including front and side plates movable to close about the shoe, a toe pad mounted on the front plate, means for moving the front plate to operative position, means for thereafter moving the side plates to operative positions and, during their movement, moving the toe pad to operative position, and means for forcing fluid into the box.

38. A toe clamp member comprising a base of rubber, a metal core therein, a holder to which the rubber base is fastened, and a ball between the core and the holder.

39. A toe clamp member comprising a base of rubber, a metal core therein, a holder to which the rubber base is fastened, a ball between the core and the holder, and a leather facing for the rubber base.

40. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for supporting a lasted shoe against pressure applied through the diaphragm, a plurality of slidably mounted members, means for reciprocating said members first to cause them to close about the shoe, and then to be withdrawn, and means for varying the location of the path of reciprocation of one of said members.

41. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack for sup-

porting a lasted shoe against pressure applied through the diaphragm, a slidable front plate, means for reciprocating said plate first to cause it to move over the toe portion of the shoe and then to be withdrawn, and means for varying the location of the path of reciprocation of the plate.

42. A machine of the class described having, in combination, a member through which pressure is applied to the bottom of a shoe, and a jack for supporting the shoe against pressure applied through the member, and mounted for movement in a path the plane of which is transverse to the direction of application of pressure to the shoe to bring the jack into operative relation to the shoe, said jack comprising a post, and a contact member carried thereby and mounted for yielding movement with respect to the post in a path also extending transverse to the direction of application of the pressure.

43. A machine of the class described having, in combination, a member through which pressure is applied to the bottom of a lasted shoe, and a jack for supporting the shoe against said pressure, said jack being normally at one side of the member and being mounted for movement in one direction to bring it into operative relation to the shoe and in another direction to withdraw it from the shoe, said jack comprising a contact member yieldingly mounted for movement wtih respect to the main portion of the jack in the direction of movement of withdrawal of the jack.

44. A machine of the class described having, in combination, a pressure box one wall of which comprises a flexible diaphragm, a jack adapted to support a lasted shoe against pressure applied to the shoe through the diaphragm, said jack being normally located above and at one side of the box to permit the shoe to be placed upon the diaphragm, and being movable into position above the top of the last, said jack comprising a post and a contact member mounted at the end of the post for yielding movement in a path transverse to the axis of the post to prevent displacing the shoe in case the jack has been set too low.

45. A machine of the class described having, in combination, a member through which pressure is applied to the bottom of a shoe, a jack adapted to support a shoe against pressure applied through the member, said jack being normally above and at one side of the shoe when it is placed upon the member and being movable into a position above the shoe, means for adjusting the jack to provide for shoes of different heights, and a feeler adjustable with the jack and having its operative surface substantially on a level with the operative surface of the jack and normally located above the shoe.

46. A machine of the class described having, in combination, a member through which pressure is applied to the bottom of a shoe, a jack adapted to support a shoe against pressure applied through the member, said jack being normally above and at one side of the shoe when it is placed upon the member and being movable into a position above the shoe, means for adjusting the jack to provide for shoes of different heights, and a feeler adjustable with the jack and having its operative surface substantially on a level with the operative surface of the jack and normally located above the shoe.

47. A machine of the class described having, in combination, a pressure box for fluid comprising a rigid receptacle open at the top and a flexible diaphragm having its margin resting upon the rim of the receptacle, means for forcing fluid into the box to contact with the diaphragm and to apply pressure through it to a piece of work held upon said diaphragm, and a cap member resting upon the margin of the diaphragm and holding said diaphragm against the rim but without sufficient pressure to prevent leakage of fluid from the box, the diaphragm and the receptacle being formed with interengaging portions located beneath the cap member adapted to be pressed into intimate contact by a component of the fluid pressure to prevent leakage of fluid.

48. A machine of the class described having, in combination, a pressure box comprising a rigid receptacle for fluid and a flexible diaphragm, means for holding a shoe with its bottom resting upon the diaphragm, a cap member resting upon the margin of the diaphragm and held from movement with respect to the receptacle, and means for forcing fluid into the box to apply pressure through the diaphragm to the shoe in a direction substantially perpendicular to the plane of the diaphragm, the diaphragm and the receptacle at a locality beneath the cap member being formed with interengaging portions constructed and arranged to be pressed into intimate contact by a component of the fluid pressure which acts in a direction substantially parallel to the plane of the diaphragm.

49. A machine of the class described having, in combination, an open-sided rigid receptacle, a flexible diaphragm having its margin resting upon the rim of the receptacle, means for forcing fluid into the receptacle and a rigid cap member exerting a force upon the margin of the diaphragm sufficient to maintain the diaphragm in place but insufficient to prevent leakage of fluid from the receptacle, there being formed respectively upon the diaphragm and upon one of the rigid members a rib and a recess such that one face of the rib but not the other is exposed to the fluid under pressure whereby the other face of the rib is forced against a wall of the recess to prevent leakage of fluid.

50. A machine of the class described having, in combination, an open-sided rigid receptacle, a flexible diaphragm having its margin resting upon the rim of the receptacle, a cap member exerting a force upon the diaphragm sufficient to maintain it in place but insufficient to prevent leakage of fluid from the receptacle, and means for forcing fluid into the receptacle, there being formed respectively upon the diaphragm and upon one of the rigid members a rib and a recess such that one face of the rib but not the other is exposed to a component of the fluid pressure acting in a direction substantially parallel to the plane of the diaphragm whereby the other face of the rib is forced against a wall of the recess to prevent leakage of fluid.

SIDNEY J. FINN.