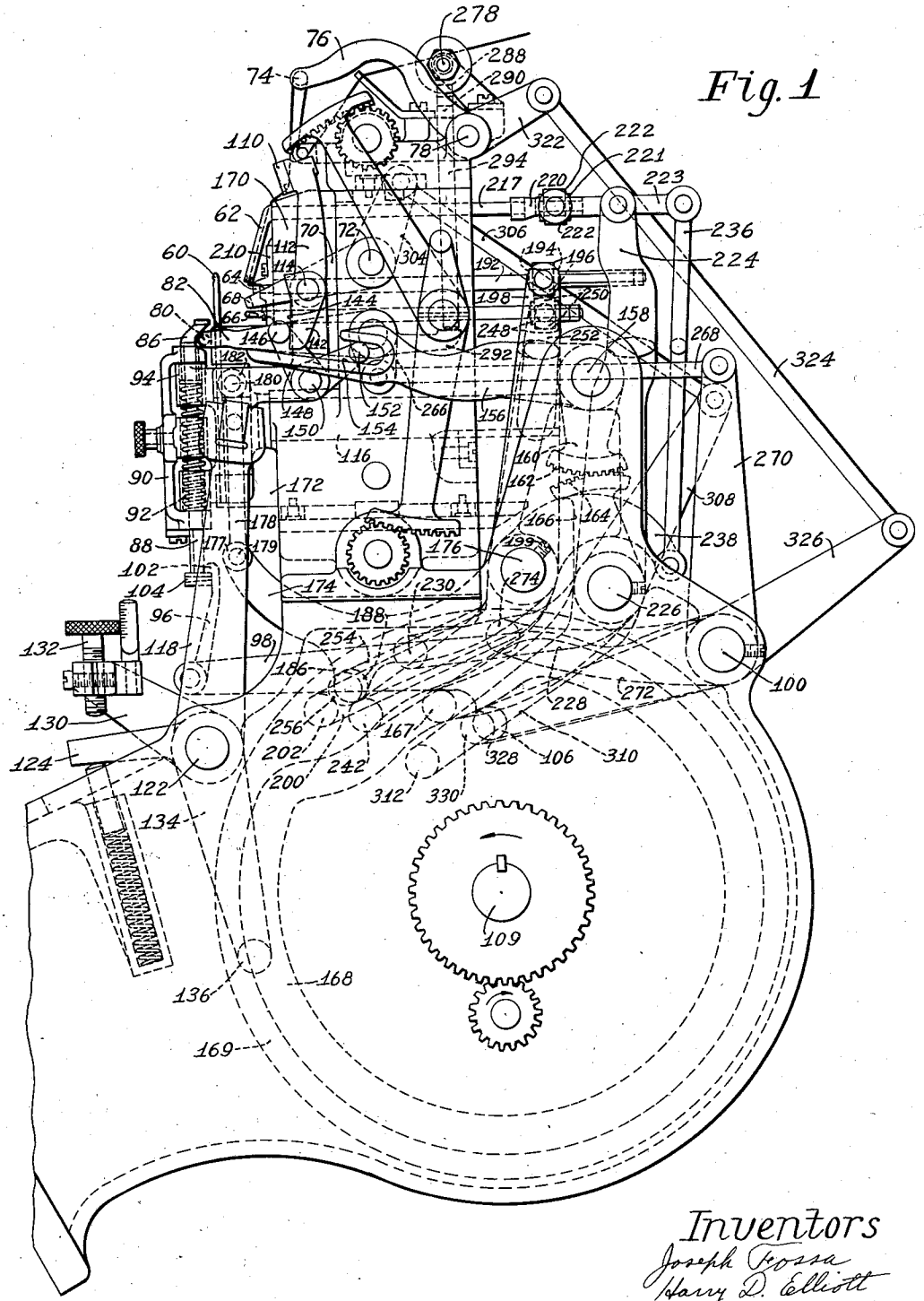
Oct. 13, 1936. J. FOSSA ET AL 2,056,962

METHOD OF LACING SHOE UPPERS

Original Filed May 10, 1930 7 Sheets-Sheet 1

Fig. 1



Witness
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METHOD OF LACING SHOE UPPERS

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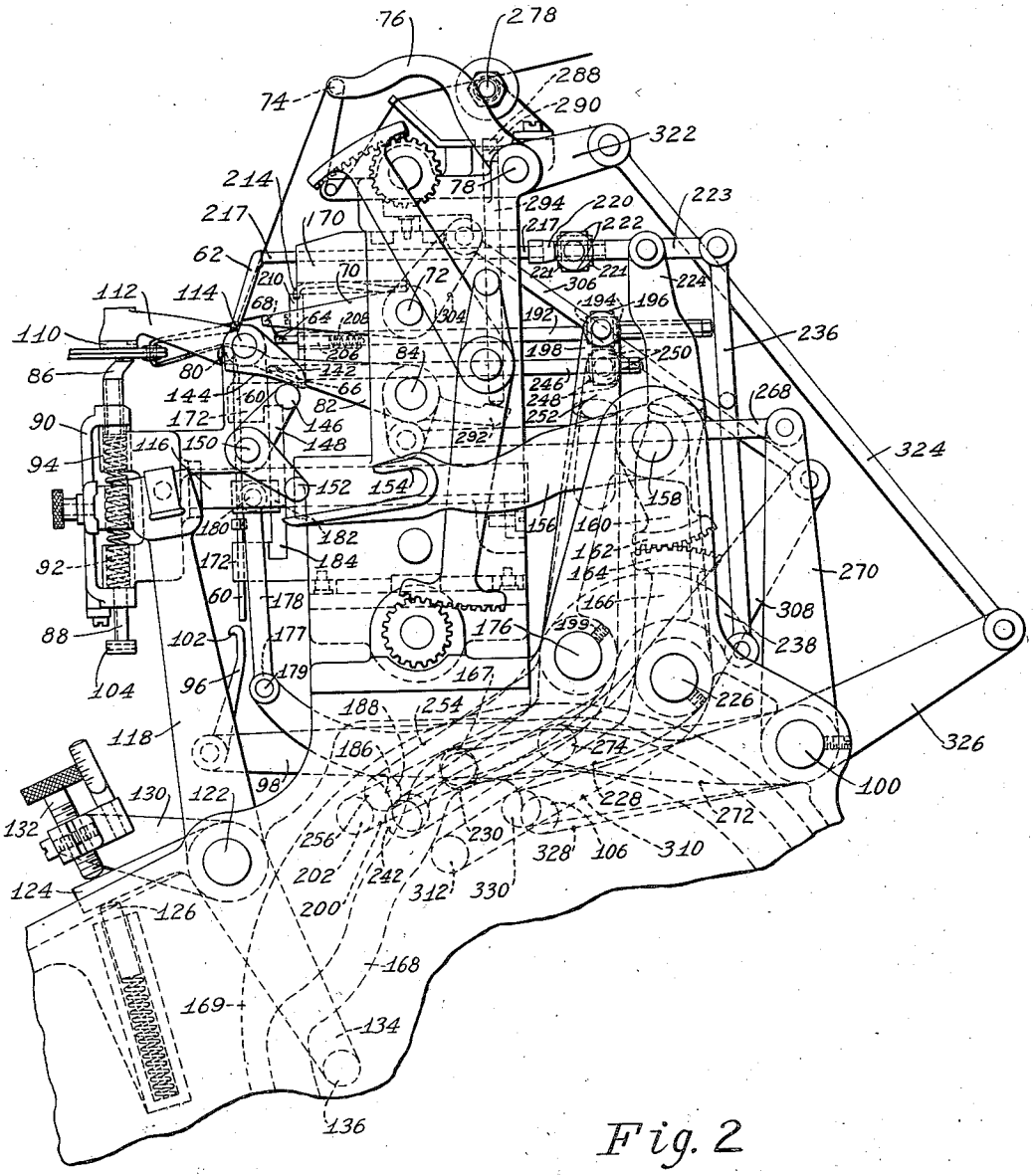


Fig. 2

Witness
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METHOD OF LACING SHOE UPPERS

Original Filed May 10, 1930 7 Sheets-Sheet 3

Fig. 3

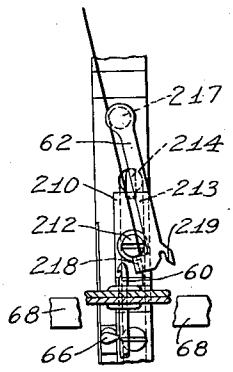


Fig. 11

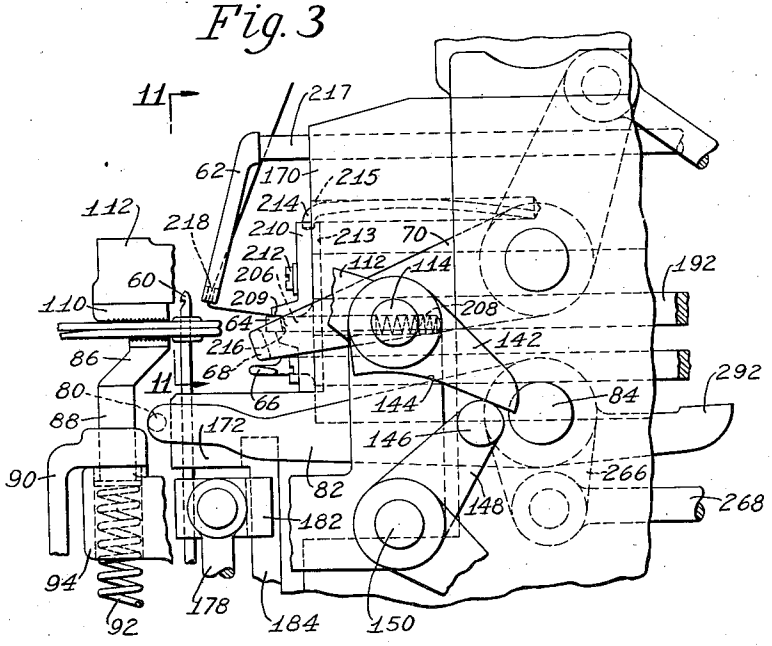


Fig. 12

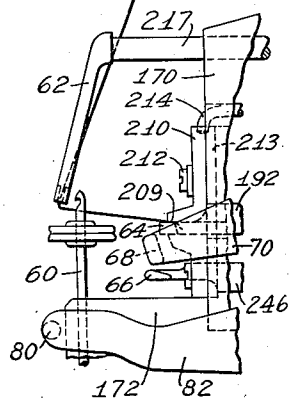


Fig. 13

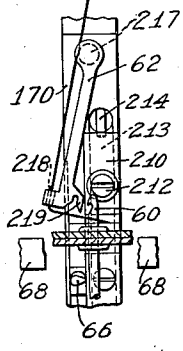


Fig. 14

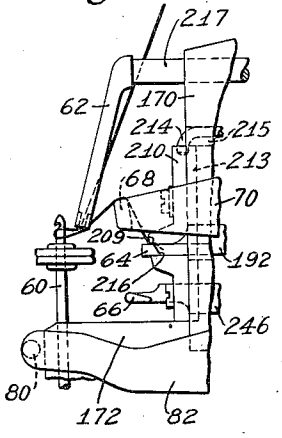
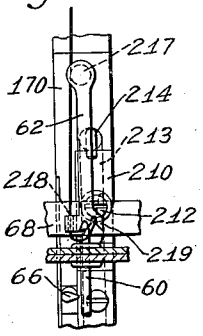


Fig. 15



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METHOD OF LACING SHOE UPPERS

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Fig. 5

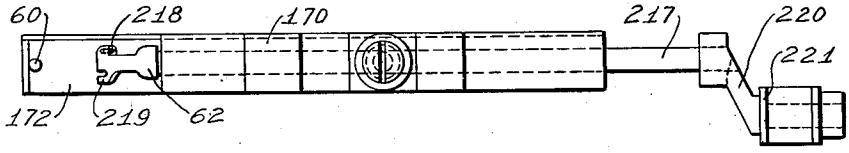


Fig. 4

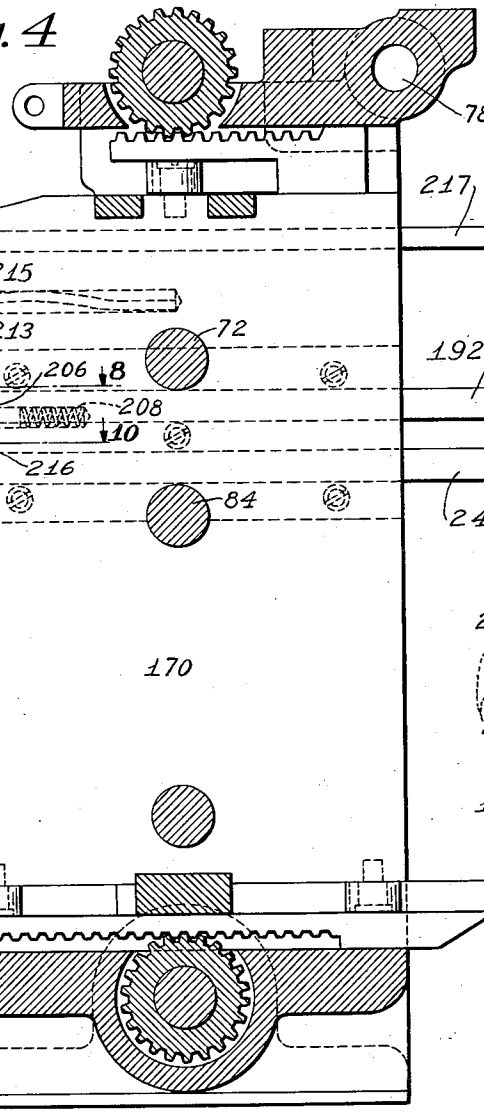
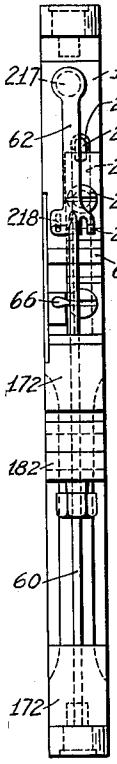


Fig. 6



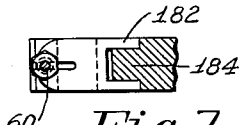


Fig. 7

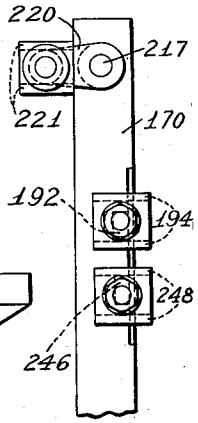


Fig. 9

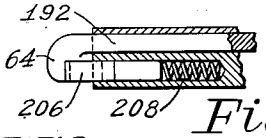


Fig. 8

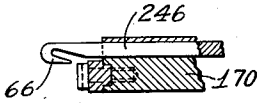


Fig. 10

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METHOD OF LACING SHOE UPPERS

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Fig. 16

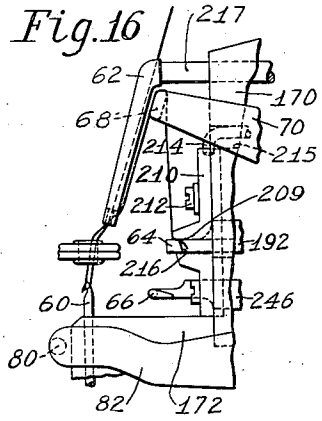


Fig. 17

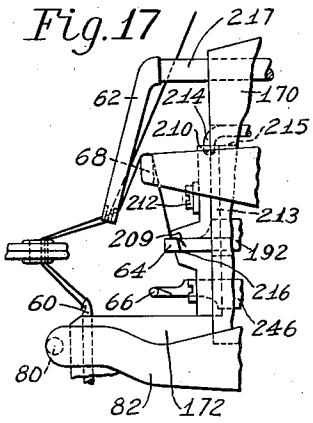


Fig. 18

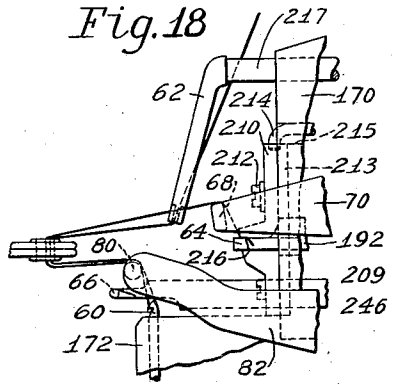


Fig. 19

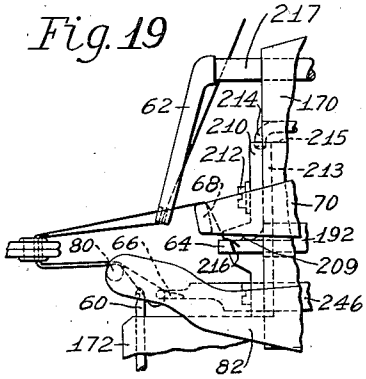


Fig. 20

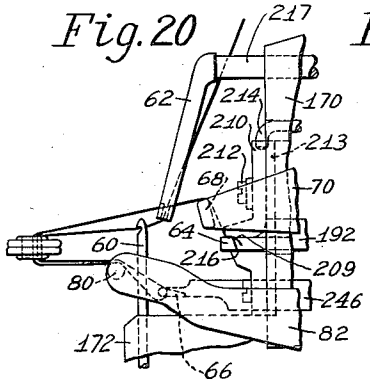


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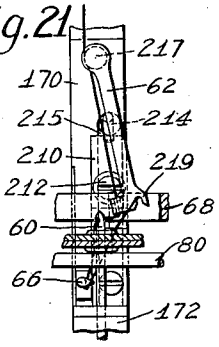


Fig. 22

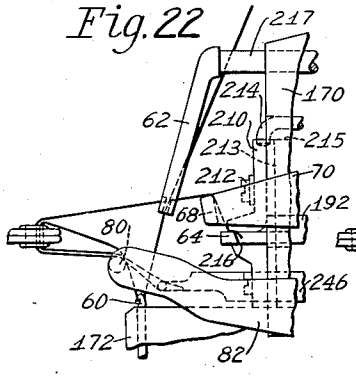


Fig. 23

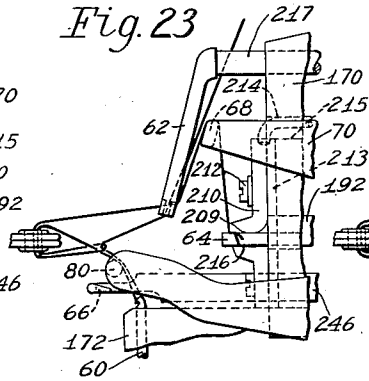
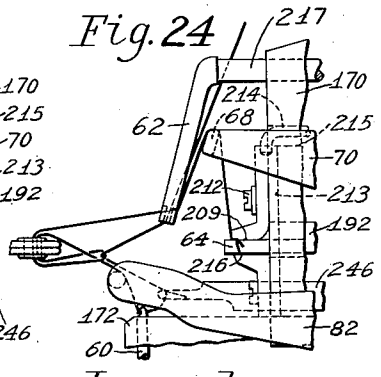


Fig. 24



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METHOD OF LACING SHOE UPPERS

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Fig. 25

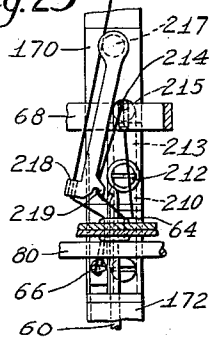


Fig. 26

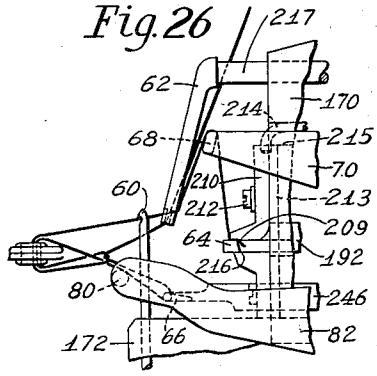


Fig. 27

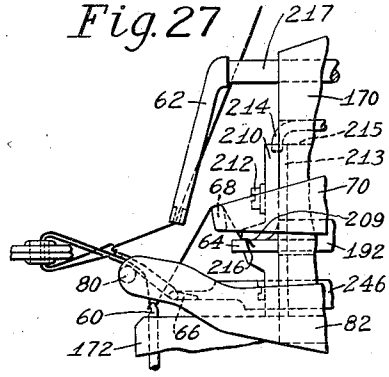


Fig. 28

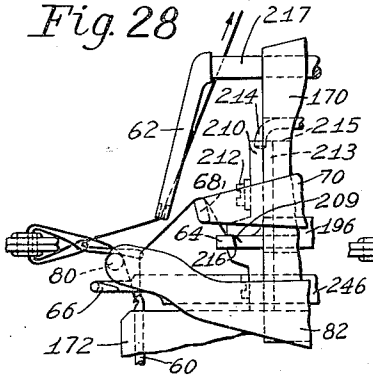


Fig. 29

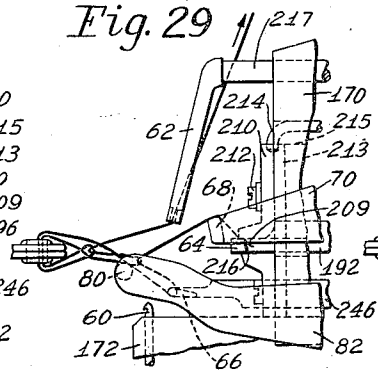


Fig. 30

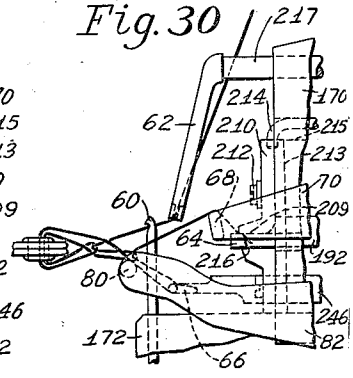


Fig. 31

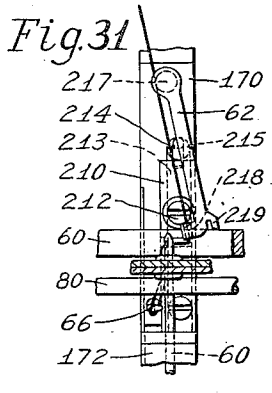


Fig. 32

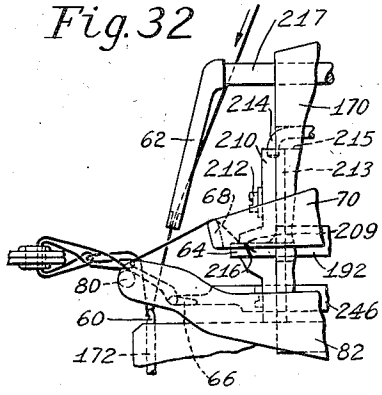
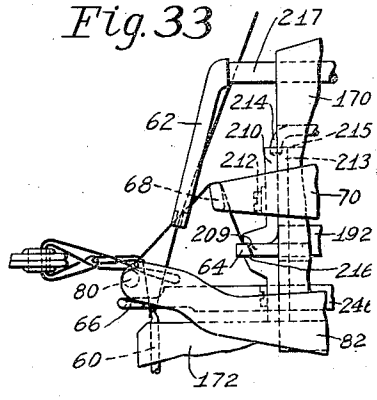


Fig. 33



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METHOD OF LACING SHOE UPPERS

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Fig. 34

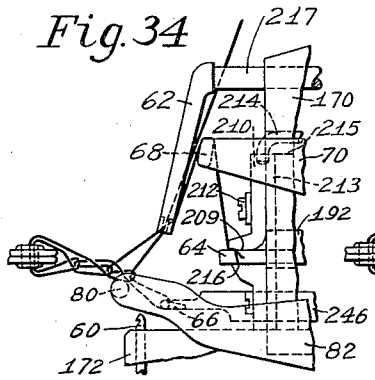


Fig. 35

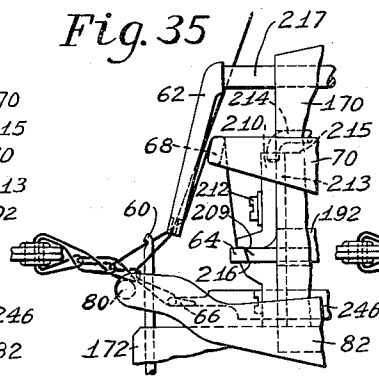


Fig. 36

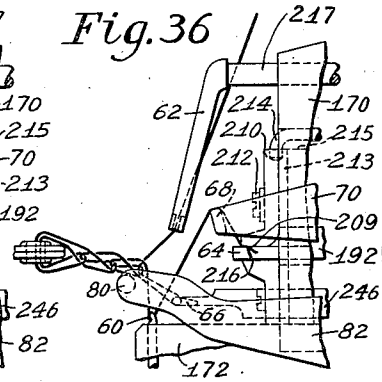


Fig. 37

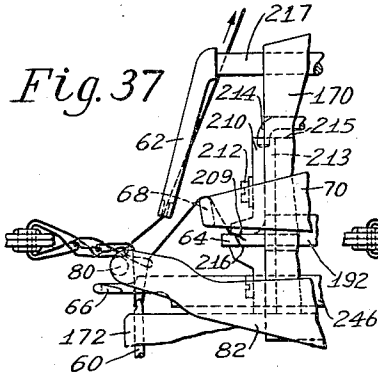


Fig. 38

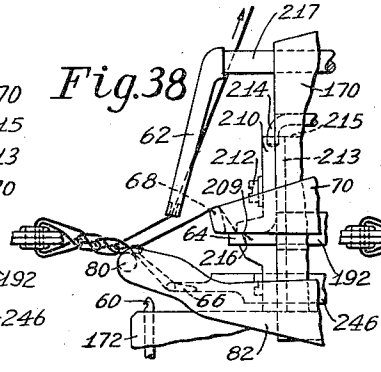


Fig. 39

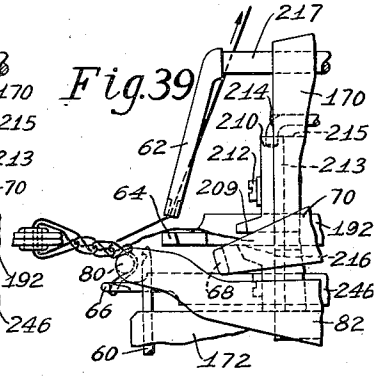


Fig. 40

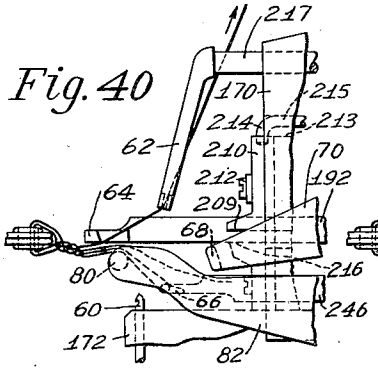


Fig. 41

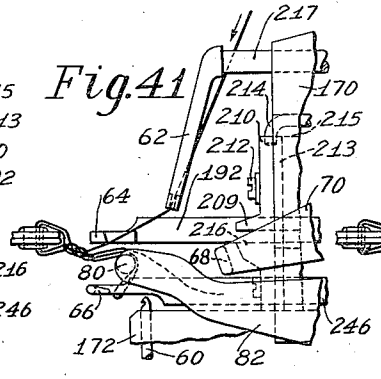
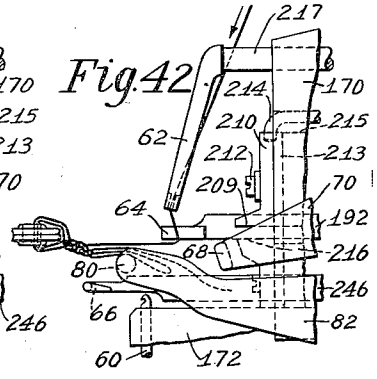


Fig. 42



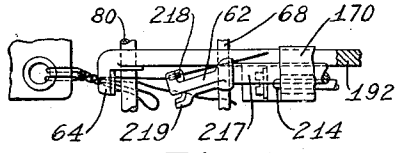


Fig. 43

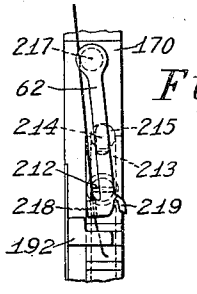


Fig. 44

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by Fish Hildreth
Cary & Jenney, Attys.

Patented Oct. 13, 1936

2,056,962

UNITED STATES PATENT OFFICE

2,056,962

METHOD OF LACING SHOE UPPERS

Joseph Fossa, Danvers, and Harry D. Elliott, Beverly, Mass., assignors to United Shoe Machinery Corporation, Paterson, N. J., a corporation of New Jersey

Original application May 10, 1930, Serial No. 452,764. Divided and this application May 10, 1934, Serial No. 724,916

7 Claims. (Cl. 112—262)

The invention relates to a method of lacing shoe uppers.

In lacing machines heretofore devised intended to tie individual lacings through each pair of eyelets, carefully adjusted as to length to cause the upper to fit accurately and snugly on a last, difficulty has been encountered in fastening together the two ends of the cord in such a manner as to form a sufficiently short lacing which will not stretch when the upper is opened out and pulled down over the last. The knots previously developed for fastening together the ends of the lacings on these machines tend to slip or turn over and give up a portion of the cord when the upper is opened out and pulled down over the last.

It is an object of the present invention to provide a novel and improved method of tying lacings in shoe uppers preparatory to the lasting operation which will result in the formation of a particularly strong lacing which may be made as short as desired and will not stretch when opened out and pulled down over the last.

A further object of the invention is to provide a novel and improved method of the character indicated for lacing shoe uppers, the several steps of which are particularly well adapted to be carried out by an automatic machine such as hereinafter described.

With these and other objects in view, the several features of the invention consist in the several steps and series of steps, hereinafter described and claimed, performed in passing a cord through the eyelets of a shoe upper and securing the cord to form a lacing.

The several features of the present invention will be clearly understood from the following description taken in connection with the accompanying drawings which illustrate a novel and improved machine for lacing shoe uppers in the manner contemplated by the present invention.

Referring to the drawings, Figure 1 is a view in right side elevation of the machine, showing the parts in rest position ready to receive an upper to be lasted; Figure 2 is a view similar to Figure 1 with an upper clamped in position and moved forwardly out of line with the needle preparatory to tying a knot; Figure 3 is a view similar to Figures 1 and 2 with the parts at an intermediate step in the operation prior to the passing of the first loop around the needle hook; Figure 4 is a detail view partly in section of one of the knot tying units; Figure 5 is a plan view of the unit, illustrating particularly the looper; Figure 6 is a view in front elevation of the unit shown in Figure 4; Figure 7 is a detail view partly in section taken on the line 7—7 of Figure 4 and looking upwardly; Figure 8 is a detail sectional view taken on the line 8—8 of Figure 4; Figure 9 is a view in rear elevation of the upper portion of the unit illustrated in Figure 4; Figure 10 is a sectional view taken on the line 10—10 of Figure 4; and Figures 11 to 44 inclusive illustrate the relative positions taken by the cord handling elements at successive steps in the operation of tying the knot.

The gang lacing machine herein disclosed comprises a series of knot tying units which are adapted to tie individual lacings in each pair of eyelets of a folded upper. This machine forms the subject-matter of pending application Serial No. 452,764 filed May 15, 1930 of which the present application is a division. The instrumentalities by means of which the upper is held and the knot is tied comprise a pair of clamping jaws for gripping the work, a hook needle adapted to draw a loop of cord through the eyelets and thereafter to tie the knot, a looper for guiding the cord into the needle hook, a hook for holding down the loops or bights drawn down by the needle, a gripper and cutter for cutting off and holding the end of the cord, a cord tension to prevent additional cord from being drawn off from the supply, and two take-ups adapted to cooperate with the other knot tying elements to form the knot.

Before starting the machine, the folded upper is placed in position with the needles extending upwardly through the superimposed eyelets. Upon starting the machine, the clamps are caused to clamp the work securely in position, and then the loopers are brought forward to place a loop of cord in each needle hook. The needles are then retracted, each needle drawing a loop of cord through two superposed eyelets, and the upper is moved laterally away from the machine by the movement of the slide on which the work clamping devices are carried. By the cooperation of the knot tying elements, as will be hereinafter more fully described, a bight is taken by a needle in one of the legs of the loop on the upper side of the eyelets and is drawn down through the loop which is then tightened up by taking up the cord forming the second leg of the loop. The needle is then advanced again through the bight thus formed and takes a bight in the second leg of the loop which is now drawn through the first bight which is tightened up by taking up the cord forming the opposite or first leg of the loop. In this manner, two bights are

taken alternately in each of the two legs of the original loop extending through the eyelets and are drawn each in turn through the next preceding bight to form a firm unyielding knot.

Referring to the drawings, the hook needle provided with each knot tying device is indicated at 60, the looper at 62, the cord gripper at 64, and a hook for holding the loops or bights drawn down by the needle is indicated at 66. The knot tying devices also include a lower take-up bar 68 extending laterally across the machine and secured at each end to lever arms 70 sleeved on the shaft 72, and an upper take-up bar 74 which is similarly supported on the lever arms 76 on a shaft 78. In order to assist in the locating of the knot as it is formed by the operation of the knot tying devices, a knot locater bar provided at 80 is supported at each end on lever arms 82 which are in turn sleeved on a shaft 84.

The folded upper is held in position in the machine during the knot tying operation by means of a clamping device which comprises a series of lower clamping members 86 formed on the upper end of vertically situated plungers 88 which are mounted to slide in a frame 90 and are pressed yieldingly upward by means of the compression springs 92 coiled about the plungers and resting at their lower ends against a portion of the frame and at their upper ends against corresponding collars 94 on the plungers.

When the machine is in rest position, the clamping members 86 and plungers 88 are held in a retracted position by means of a latch plate 96 formed on the forward end of a lever 98 which is sleeved on the shaft 100 on the machine frame. The latch plate 96 is provided with a ledge 102 which is adapted to engage with a series of collars 104 formed on the lower ends of the plungers 88. The latch lever 98 is held in a retracted position, when the machine is at rest, to hold the lower clamp members 86 in a depressed position against the pressure of their springs by the engagement of a cam roll 106 mounted on the latch lever 98 with a corresponding cam groove in a cam disk on the main cam shaft 109 of the machine.

The corresponding upper clamp for holding the upper in position comprises a bar 110 which extends laterally of the machine and is supported at each end on lever arms 112 secured to short stub shafts 114 which are rotatably mounted at each side of the machine in the frame 90.

In order to enable the upper to be moved laterally to bring the superimposed edges of the upper out of the path of the needle movement during the knot tying operation, the frame 90 is supported on two horizontal bars 116 which extend rearwardly in the machine and are mounted to slide axially. The mechanism for moving the frame 90 and clamps away from the knot tying devices comprises the levers 118 at each side of the machine which are formed on sleeves to turn on the shaft 122. The sleeves are further provided with forwardly extending arms 124 which are engaged at their under sides by the spring pressed plungers 126 which tend to rotate the sleeves and the lever arms 118 in a clockwise direction, as shown in Figure 1, to hold the frame 90 and the clamping devices in a retracted position toward the knot tying devices. In order to advance the frame against the pressure of the spring pressed plungers 126, a sleeve is interposed between the two sleeves on the rock shaft 122 and is provided at each end with the short lever arms 130 which carry adjustable set screws 132 adapted to engage with the upper side of the arms 124. A downwardly extending cam lever 134 formed on the sleeve is provided at its lower end with a cam roll 136 adapted to engage a corresponding cam formed in the face of the cam disk 138 on the main cam shaft 109 of the machine. As the cam lever 134 is moved inwardly, or to the right, as shown in Figure 1, the lever arms 130 and set screws 132 are depressed into contact with the arms 124 to rotate the levers 118 in a counter-clockwise direction, to move the frame 90 and the clamping devices away from the knot forming devices.

The upper clamping bar 110 and lever arms 112 are normally held raised in rest position by means of a spring which is coiled about the shaft 114 and is attached at one end to the lever arm 112 and at its other end to a fixed point on the machine frame. In order to move the upper clamping bar 110 downwardly toward the lower spring pressed clamp members 86, a short depending member 142 is secured to the outer end of each rock shaft 114 and is provided with a cam surface 144 which is adapted to be engaged by a roll 146 on one arm of a bell crank lever 148 pivoted at 150 on the frame 90, one such lever being mounted on each side of the frame below the corresponding lever 112. The other arm of each bell crank lever 148 is similarly provided with a roll 152 which rides in a groove 154 formed in the forward end of a clamp actuating lever 156 loosely sleeved at each side of the machine on the shaft 158. There is also formed on the hub of each lever 156 a downwardly extending arm 160 provided with a gear segment 162 which meshes with a corresponding arm of a cam lever 166 which at its free end carries the cam roll 167 which engages with a corresponding cam groove 168 in the face of the cam disk 169. After the upper has been placed in position on the needles and the machine has been put in operation, the clamp actuating lever 156 is depressed under the influence of its cam through the connections above described, causing the bell crank lever 148 to be rotated in a clockwise direction about its pivot, and through the engagement of the roll 146 with the cam surface 144 causing the upper clamping bar 110 to be moved downwardly into clamping position against the pressure of its spring 140. As the cam roll 146 moves to its furthest position to the right, as clearly shown in Fig. 2, past the line of centers of the pivot 150 and the rock shaft 114, the clamp is automatically locked in its depressed position.

At the same time that the upper clamp is moved down into clamping position, the latch lever 98 is raised, allowing the lower clamping members 86 to move upwardly under the pressure of their springs 92 into yielding engagement with the upper clamping member 110. At the end of the knot tying operation, when the frame 90 and the clamps are returned to their original positions, the latch lever 98 is again depressed, bringing the ledge 102 into engagement with the collars 104 to move the lower clamping members 86 downwardly against the pressure of their springs 92.

With the present machine, a number of loop tying units is provided corresponding to the number of pairs of eyelets in the upper and are adapted to act simultaneously to put individual lacings in the eyelets. Each unit comprises a block or panel 170 in which is mounted a needle, a looper, and a thread gripper.

A straight hook needle 60 is mounted to move vertically in bearings formed in two forwardly extending brackets 172 which comprise an integral part of each panel 170. Vertical reciprocatory movements are imparted to the needles of the several units in unison by means of a horizontally arranged cam lever 174 which is centrally located in the machine to turn on a shaft 176 and at its forward end is provided with a sleeve portion 177 adapted to receive a rod 179 which is connected at each end to the lower ends of two corresponding links 178. At their upper ends, the links are secured to opposite ends of a rod 180 which extends transversely of the machine and is journaled through a series of blocks 182 which are clamped to the needles and are adapted to ride in corresponding guideways 184 formed on the front edges of the panels 170. The needles are advanced and retracted as a unit through the movement of the lever 174 which is provided intermediate its length with an offset portion 186 forming a support for a cam roll 188 adapted to ride in a groove formed in the face of the cam disk 108. With the construction and arrangement of the parts here disclosed, it will be seen that the needles will be advanced and retracted as a unit under the influence of the cam lever 174 and may further be adjusted laterally with the panels 170 to fit the width of the eyelets through which lacings are being inserted.

After each knot tying operation, the end of the cord leading from the supply to each knot tying unit is cut, and the loose end is held securely by means of the cord gripper 64 which is best shown in detail in Figs. 4 and 8. The cord gripper comprises the hook-shaped member on the forward end of a rod 192 which extends rearwardly through the panel 170. Each gripper rod 192 is provided near its rear end with a flanged collar 194 which engages between two bars 196 which run transversely of the machine and are supported at each end by two vertically situated lever arms 198 which are secured by set screws 199 to a rock shaft 176 which is further provided with a downwardly extending arm 200 provided with a cam roll 202 adapted to ride in a cam groove in the face of the disk 204. Cooperating with the gripper 64 is a spring pressed plunger 206 which is mounted in a recess 208 in the panel 170 and is adapted to engage with the hook portion of the gripper as this is retracted to cut and grip the thread. A second cooperating gripping surface 209 is provided to cooperate with the gripper 64 and is formed on the lower end of a short bar or plate 210 which is adapted to slide vertically in a corresponding groove formed in the front of the panel 170. A screw bolt 212 extending through a slot 213 in the plate 210 holds the plate in position and a spring 214 mounted in a recess 215 in the front of the panel engages the upper end of the plate 210 to hold the gripping surface 209 yieldingly in engagement with the upper surface of the gripper 64. The cutting surface 216 is provided in the panel on the under side of the gripper and cooperates with the lower edge of the gripper to sever the cord. At the end of the knot tying operation, the gripper is advanced through the connections above described, releasing the end of the old cord and taking the end of the cord leading from the supply which is severed against the cutting surface 216 as the gripper is retracted to the position shown in Fig. 4, while the loose end is at the same time gripped tightly between the gripping surfaces above described preparatory for the next knot tying operation.

A looper 62 is provided with each knot tying unit and comprises a depending arm which is rigidly secured to the forward end of a bar 217 journaled in the panel 170. At the lower end of the looper arm on the left side as seen, for instance, in Fig. 13, a guide 218 is provided for the cord leading from the supply, and on the right side of the looper is provided a downwardly facing notch or hook 219 which is adapted to receive and guide into the needle hook the cord forming the second leg of the lacing loop which leads over the lower take-up 68 to the gripper 64. In order to give to the looper the advancing and lateral movements necessary to lay cord in the needle hook, each looper bar 217 is provided at its rear end with an offset section 220 having a flanged collar 221 which engages between two parallel bars 222 extending laterally across the machine and supported at each end on two horizontally situated levers 223. These levers 223 are pivotally secured intermediate their lengths to the two arms of a vertically arranged yoke 224, which is loosely sleeved to a shaft 226 and is further provided with a downwardly extending arm 228 which carries the cam roll 230 to engage with a corresponding groove in the face of the cam disk 108. The levers 223 are oscillated about their pivot on the cam yoke 224 to raise and lower the bars 222 and thus to impart lateral movements to the loopers through connections comprising a link 236 which is forked at its upper end, the arms of the fork being connected respectively to the rear ends of the two levers 223. At its lower end, the link 236 is connected to a horizontally arranged cam lever arm 238 which is loosely sleeved on the shaft 176, and is provided with a downwardly extending arm 240 which carries a cam roll 242 adapted to ride in a cam groove formed in the face of the cam disk 204.

Each hook 66 for holding the bights of cord pulled down by the needles in forming the knot, as best shown in Figs. 4 and 10, is formed on the forward end of a rod 246 which is journaled in the panel 170 and is provided at its rear end with a flanged collar 248 which engages between two bars 250 extending laterally of the machine. These bars are supported at each end on the two arms of a vertically situated yoke 252 which is loosely sleeved on the shaft 176 and is further provided with a downwardly extending arm 254 which carries a cam roll 256 adapted to engage in a corresponding cam groove formed in the cam disk 138.

The knot locater bar 80 which is brought to rest position during the knot tying operation, extends laterally across the machine and is supported at each end on the forwardly extending lever arms 82 which are secured at each end of the shaft 84, as above described. The shaft 84 and the lever arms 82 are rotated to raise and lower the locater bar 80 through connections which comprise a depending arm 266 which is connected to the forward end of a link 268. The link is connected also to the upper end of a vertically arranged lever 270 which is loosely sleeved on the shaft 100 and is provided with a depending arm 272 which carries a cam roll 274 adapted to ride in a corresponding groove in a cam disk 169.

The machine is also provided with a series of tensioning devices to control the supply of cord to each loop forming and knot tying device.

Each of these tensioning devices comprises a stud 278 over which the cord is guided between a fixed disk and a disk loosely held on the stud 278 and forced yieldingly into engagement with the fixed disk to tension the cord by means of a compression spring. In order to release the tension on the cord passing over the stud 278, wedges 288 are mounted on a laterally extending bar 290 and are adapted to be inserted between each pair of disks to spread the disks against the pressure of their springs and thus to release the tension on the cord. In order to control the operation of the tensioning devices, two rearwardly extending arms 292 are formed on the sleeve portions of the lever arms 82 supporting the locater bar 80 and are adapted to engage with the lower ends of two downwardly extending rods 294 formed on each end of the crossbar 290 carrying the wedges 288. Compression springs coiled about the rods 294 and secured at their lower ends to the rods and at their upper ends adapted to bear against fixed portions of the machine frame tend to hold the rods 294 depressed into engagement with the arms 292 and with the wedges 288 depressed out of contact with the tensioning disks. With this construction and arrangement of the parts, it will be seen that the movement of the lever arms 270 to raise the locater bar 80 into operative position will cause the bar 290 carrying the wedges 288 to be depressed to place the required tension on the cord. Conversely, the movement of the locater bar downwardly into inoperative position causes the rods 294 and bar 290 to be raised against the pressure of the springs 296, causing the wedges 288 to be inserted between the tensioning disks to release the tension on the cord.

The machine is further provided with two take-up devices, one of which is adapted to take up the cord coming from the tensioning device and cord supply forming one leg of the lacing loop drawn through the eyelets in forming the lacing. The other or lower take-up is adapted to take up the cord terminating in the gripper and forming the other leg of the lacing loop. The lower take-up, as above pointed out, comprises the take-up rod 68 which extends laterally of the machine and is supported at each end on a lever arm 70 rigidly secured to the shaft 72. At the left-hand end of the shaft, as shown in Fig. 1, there is also secured a lever arm 304 which is connected by means of a link 306 to the free end of a cam lever 308 which is loosely sleeved on the shaft 226 and is further provided with a downwardly extending arm 310 provided with a cam roll 312 adapted to ride in a cam groove formed in the face of the disk 204.

The upper take-up, as above pointed out, similarly comprises the take-up rod 74 extending transversely of the machine and supported at each end by the lever arm 76 loosely sleeved on the shaft 78 mounted on the machine frame. There is also secured to the sleeve portion of one of the arms 76 a short lever arm 322 which is connected by means of a link 324 to the free end of a cam lever 326 loosely sleeved on the shaft 100 and provided with a downwardly extending arm 328 which carries a cam roll 330 adapted to engage in a cam groove formed in the face of the cam disk 204.

The operation of the machine is as follows:

With the machine in rest position, as shown in Fig. 1 the needles are in advanced position, the looper, hook, and gripper are retracted, the frame 90 carrying the clamping devices is in its retracted position, the upper clamping jaw is in raised position and the lower clamping jaws are held in a retracted position to facilitate the placing of the eyelets of the folded upper over the needles preparatory to starting the machine.

Upon starting the machine, the lever 156 is depressed and acts through the bell crank lever 148 to move the upper clamping bar 110 down into clamping position against the pressure of its spring 140 where it is locked by the bell crank lever 148. At the same time, the lever 98 is raised, carrying with it the latch member 96 and allowing the lower clamping jaws 86 to be raised under the influence of their springs 92 to clamp the work yieldingly between the jaws. The looper is now advanced and moved laterally past the needle to lay a loop of cord in the needle hook. At this time, the cord end is securely held by the gripper 64 and the thread tensioning devices cooperating with each knot tying unit are released to permit the requisite amount of cord for the new lacing to be drawn from the supply. The several steps thus far described in the operation of the machine are illustrated in Figs. 2 to 15 inclusive. Succeeding Figs. 16 to 44 inclusive illustrate in detail the successive steps in the operation of the knot tying devices to form the lacing and tie a firm unyielding knot. As illustrated in the drawings, the needle is now retracted to draw a loop of cord through the eyelets and the upper and lower take-up devices are both raised to their utmost limits to draw off a sufficient amount of cord from the supply to form the lacing. This movement of the lower take-up also causes the length of thread leading from the needle to the gripper to be engaged by the notch 219 in the looper arm. The clamp support 90 carrying the upper is now advanced away from the knot tying devices preparatory to the formation of the knot, the lower take-up at this time being brought down to give up sufficient cord for this purpose without the necessity of reeving the cord through the eyelets and the needle hook, the upper take-up remaining at this time in its upper position. The knot locating bar 80 is now raised to its operative position, as shown in Fig. 18, and the tensioning devices are simultaneously rendered operative to prevent further cord from being drawn off from the supply. The parts are now in position for the formation of the knot. At this time, the hook 66 is advanced and slightly retracted to take the loop from the needle and the needle is advanced through the loop held down in this fashion. The looper is now moved to the right, as shown in Fig. 21, to bring the leg of the loop leading from the supply into the needle hook and the needle is then retracted, causing a bight of cord to be drawn through the loop held on the hook member 66. At the same time, the upper take-up member is depressed to give up a corresponding amount of cord for this purpose. The hook member is now advanced to release the first loop, as shown in Fig. 23, and the lower take-up bar 68 is raised to take up the cord on the leg of the loop leading to the gripper and thus to tighten up the loop, as shown in Fig. 23. The hook 66 is again retracted to take the bight of cord from the needle hook which is now advanced to its upper position as shown in Figs. 25 and 26. At the same time, the looper is moved to the left, as shown in Fig. 25, to cause the leg of the loop leading from the eyelet through the notch 219 of the looper to the gripper to be brought into the needle hook. The needle is then retracted,

causing a bight to be formed in the gripper leg of the loop and drawing this bight of cord through the first bight, as shown in Fig. 27, the lower take-up at the same time being depressed to provide the requisite cord for this purpose. The hook **66** is now advanced to release the first bight formed in the leg of the loop leading from the supply and the upper take-up is raised to take up the cord on the supply leg of the loop and thus to tighten the bight formed in this leg of the loop about the second bight now held on the needle hook, as best shown in Fig. 28. At this stage in the formation of the knot, it will be noted that one bight has been taken in each leg of the original loop passing through the eyelets, the first bight being passed through the loop itself and the second bight in the second leg of the loop being passed through the first bight. Preparatory to the next step in the formation of the knot, the hook **66** is again retracted to take the bight held on the needle hook, the needle again being advanced, as shown in Fig. 30. The looper is now moved to the right, as shown in Fig. 31, to bring the cord forming the supply leg of the original loop into the path of the needle hook which acts on the retracting stroke of the needle to form a second bight of cord in the leg of the original loop leading from the supply and to pass this bight through the bight held on the hook **66**, as shown in Fig. 32. The upper take-up is at the same time depressed to provide the requisite cord for this purpose. The hook **66** is again advanced to release the bight held thereon and the lower take-up **68** is raised to tighten up this bight formed in the gripper leg of the original loop about the bight held on the needle hook, as best shown in Fig. 33.

In order to form a tight knot which will not become loosened or untied, a fourth bight is now taken in the cord on the gripper leg of the loop and is pulled through the bight last formed in the supply side of the original loop which is then tightened to complete the formation of the knot. As shown in Fig. 34, the third bight held on the needle hook is taken by the hook **66** and the needle is advanced through the loop to take the cord passing over the lower take-up to the gripper. The needle is now retracted, drawing the fourth bight through the previously formed bight held on the hook **66**, the hook is advanced to release this bight, and the upper take-up is raised as indicated by the arrows in Figs. 37 to 40 inclusive to tighten up the third bight about the fourth bight. Finally, the thread gripper is advanced, releasing the end of the old cord, and moving into position to engage with the cord leading from the knot to the supply while at the same time, the upper take-up is retracted to allow the cord to be readily drawn off by the gripper in its retracting movement to sever the cord and to grip the free end.

The invention having been described, what is claimed is:

1. A method of lacing shoe uppers which comprises drawing a loop of cord through a pair of eyelets, forming a bight in one leg of said loop on the cord supply side of the eyelets, passing said bight through the said loop, taking up the cord on the second leg of the loop to tighten the loop about the said bight, forming a bight in the second leg of the said loop on the cord supply side of the eyelets, passing said bight through the first formed bight, taking up the cord on the first-mentioned leg of the loop to tighten the first formed bight about the second bight, forming a second bight in the first-mentioned leg of the loop, passing the said bight through the bight formed on the second leg of the loop, and taking up the cord on the second-mentioned leg of the said loop to tighten the second bight about the last formed bight.

2. A method of lacing shoe uppers which comprises drawing a loop of cord through a pair of eyelets, forming a bight in one leg of said loop on the cord supply side of the eyelets, passing said bight through the said loop, taking up the cord on the second leg of the loop to tighten the loop about the said bight, forming a bight in the second leg of the said loop on the cord supply side of the eyelets, passing said bight through the first formed bight, taking up the cord on the first-mentioned leg of the loop to tighten the first formed bight about the second bight, forming a second bight in the first-mentioned leg of the loop, passing the said bight through the bight formed on the second leg of the loop, taking up the cord on the second mentioned leg of the said loop to tighten the second bight about the last formed bight, forming a second bight on the second leg of the said loop, passing said bight through the last formed bight on the first-mentioned leg of the loop, and taking up the cord on the first-mentioned leg to tighten the third bight about the last formed bight.

3. A method of lacing shoe uppers which comprises drawing a loop of cord through a pair of eyelets, forming a bight in one leg of said loop on the cord supply side of the eyelets, passing said bight through the said loop, taking up the cord in the second leg of the loop to tighten the loop about the said bight, and thereafter successively forming bights on each leg of the said loop, passing said bights in each instance through the last formed bight, and taking up the cord on the opposite leg of the loop in each instance to tighten each preceding bight around each successive last formed bight.

4. A method of lacing shoe uppers which comprises passing a loop of lacing cord through a pair of aligned eyelet holes of a folded shoe upper, passing a bight of the cord across the edges of the shoe upper and through the bight of the loop, passing another bight of the cord through the last formed bight, taking up on the cord to tighten the bights and acting on the cord during the tightening of the bights to leave sufficient slack in the lacing to permit opening out of the upper for application to a last.

5. A method of lacing shoe uppers which comprises passing a loop of lacing cord through a pair of aligned eyelet holes of a folded shoe upper, passing a bight of the cord across the edges of the upper and through the bight of the loop, passing another bight of the cord through the last formed bight, taking up on the cord after the passing of each bight through the preceding bight to tighten the bights and acting on the cord during the tightening of the bights to leave sufficient slack in the lacing to permit opening out of the upper for application to a last.

6. A method of lacing shoe uppers which comprises passing a loop of cord through a pair of aligned eyelet holes of a folded shoe upper, forming a bight in one leg of the said loop on the cord supply side of the eyelets, passing said bight across the edges of the folded upper and through the said loop, forming a bight in the other leg of the said loop on the cord supply side of the eyelets, passing the said bight across the edges of the folded upper and through the first formed

bight, and taking up on the cord to tighten the bights while leaving sufficient slack in the lacing to permit opening out of the upper for application to a last.

7. A method of lacing shoe uppers which comprises passing a loop of cord through a pair of aligned eyelet holes of a folded shoe upper, forming a bight in one leg of the said loop on the cord supply side of the eyelets, passing said bight across the edges of the folded upper and through the said loop, forming a bight in the other leg of the said loop on the cord supply side of the eyelets, passing the said bight across the edges of the folded upper and through the first formed bight, and taking up on the cord after the passing of each bight to tighten the bights while leaving sufficient slack in the lacing to permit opening out of the upper for application to a last.

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