Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

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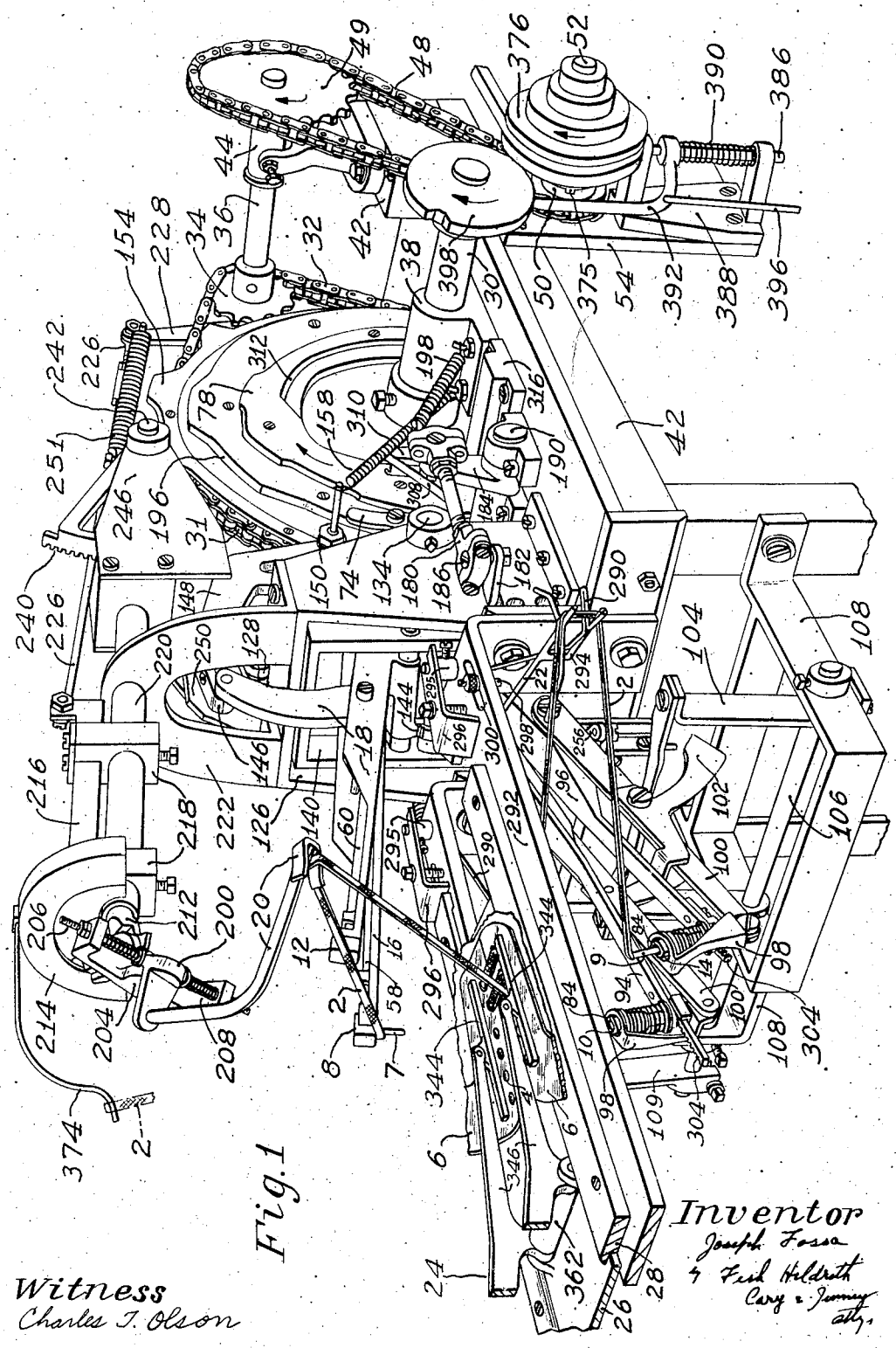


Fig. 1

Witness
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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

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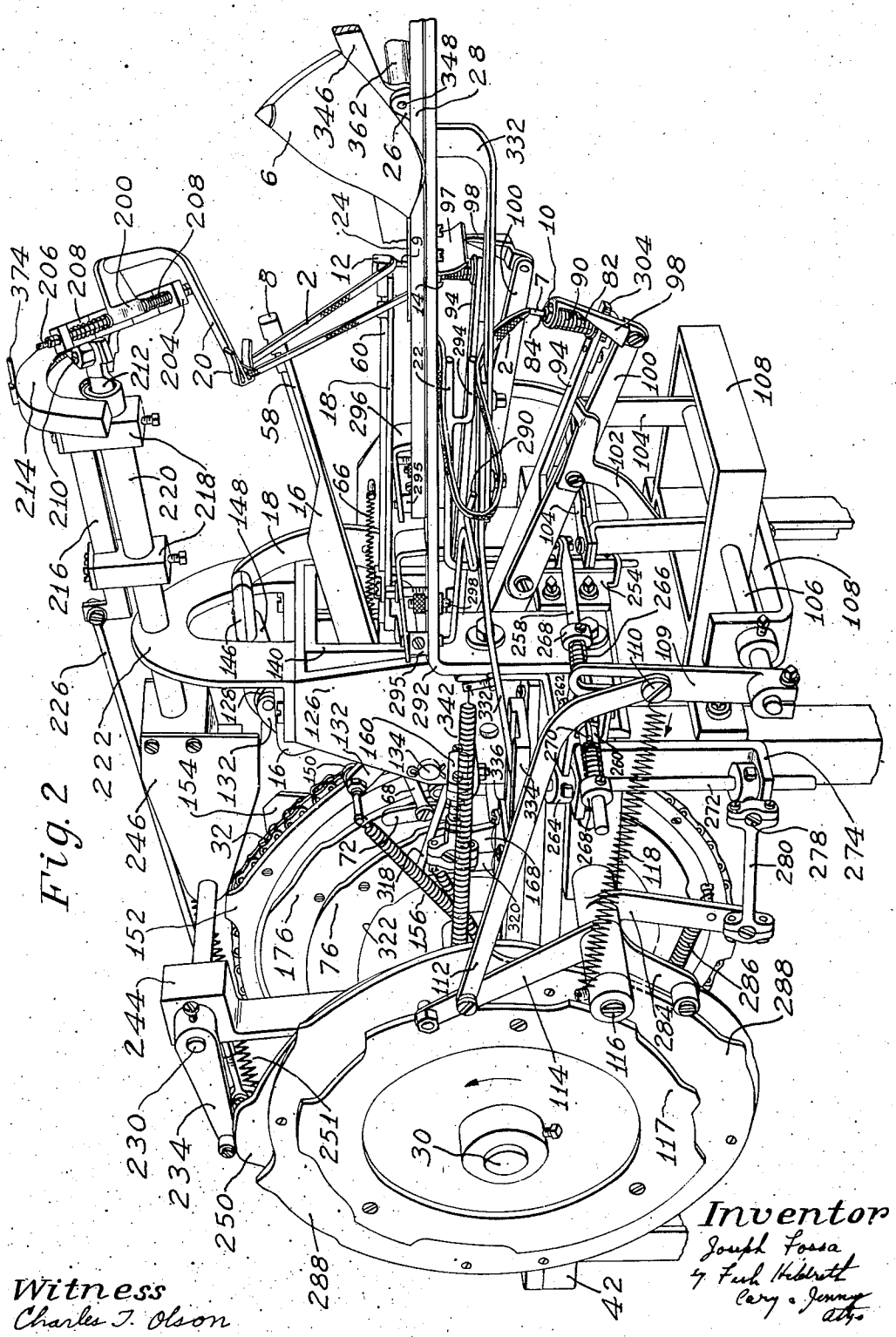


Fig. 2

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SHOE UPPER LACING MACHINE

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Fig. 3

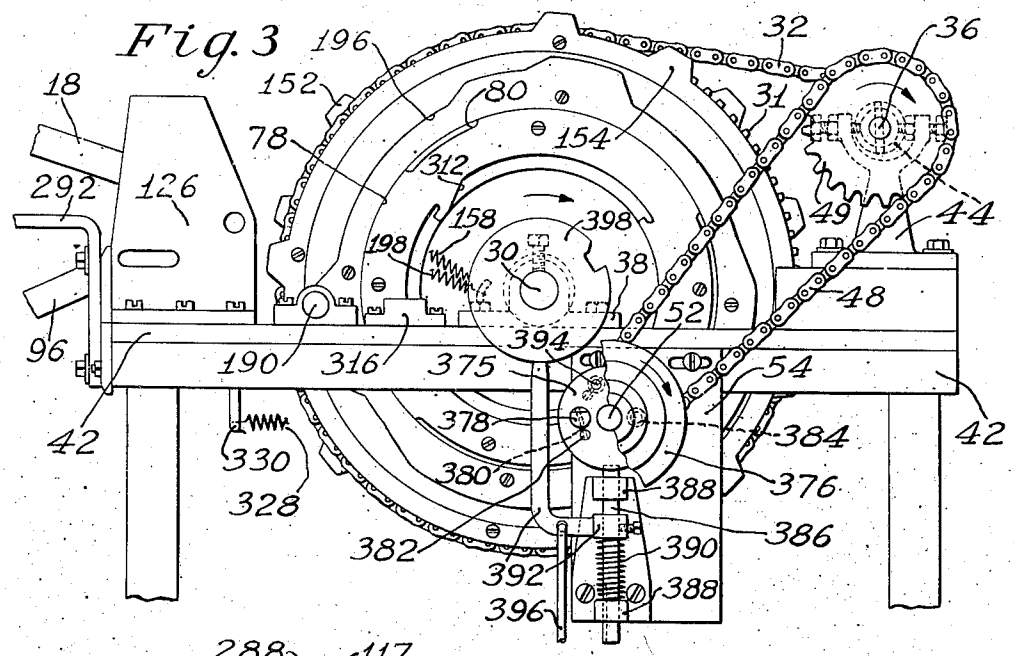


Fig. 4

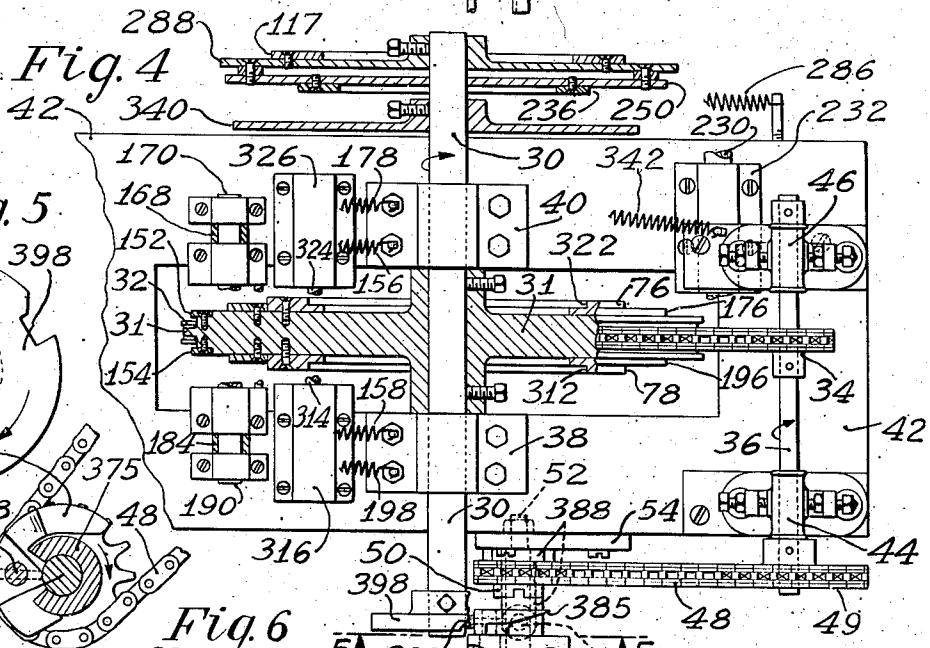
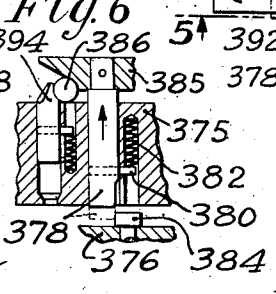
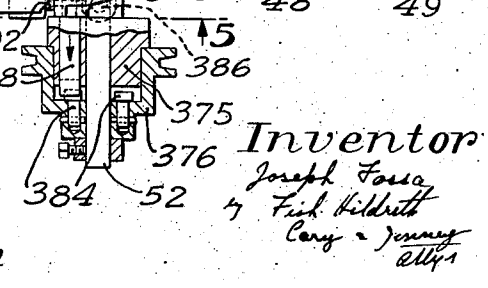


Fig. 5

Fig. 6





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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

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Fig. 7

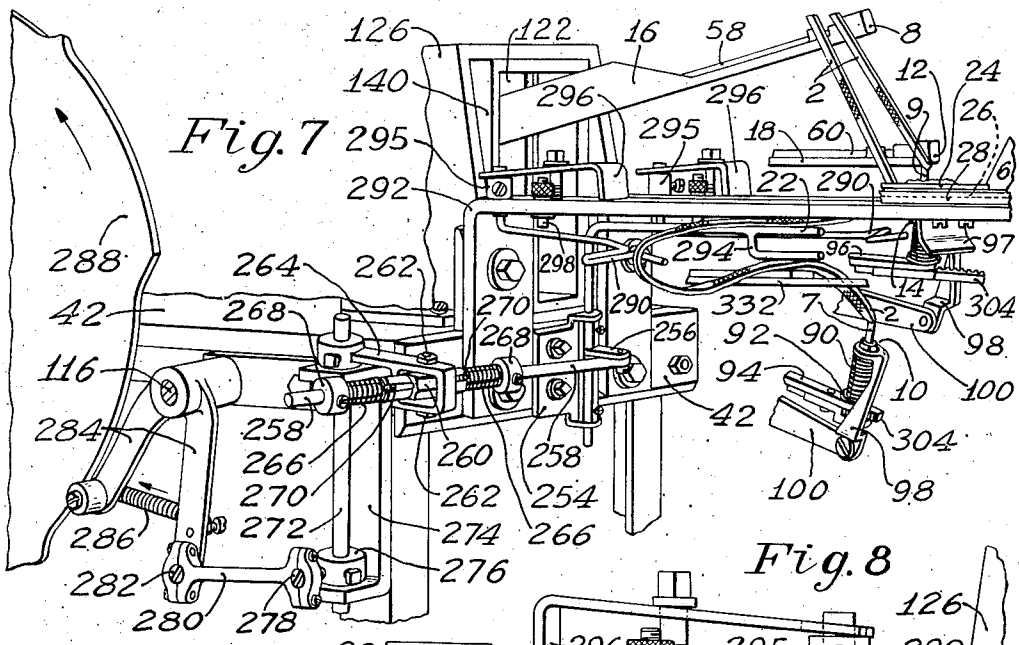


Fig. 8

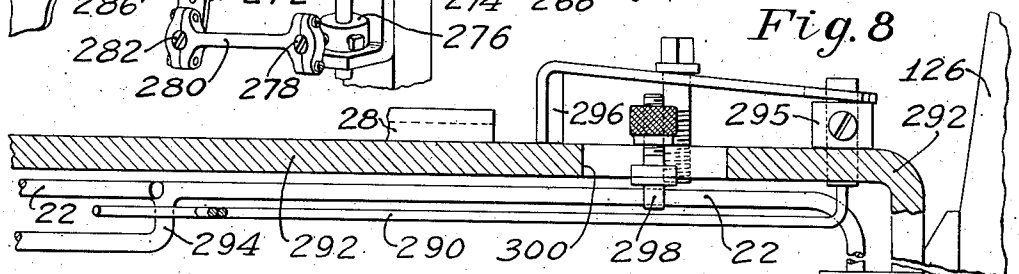
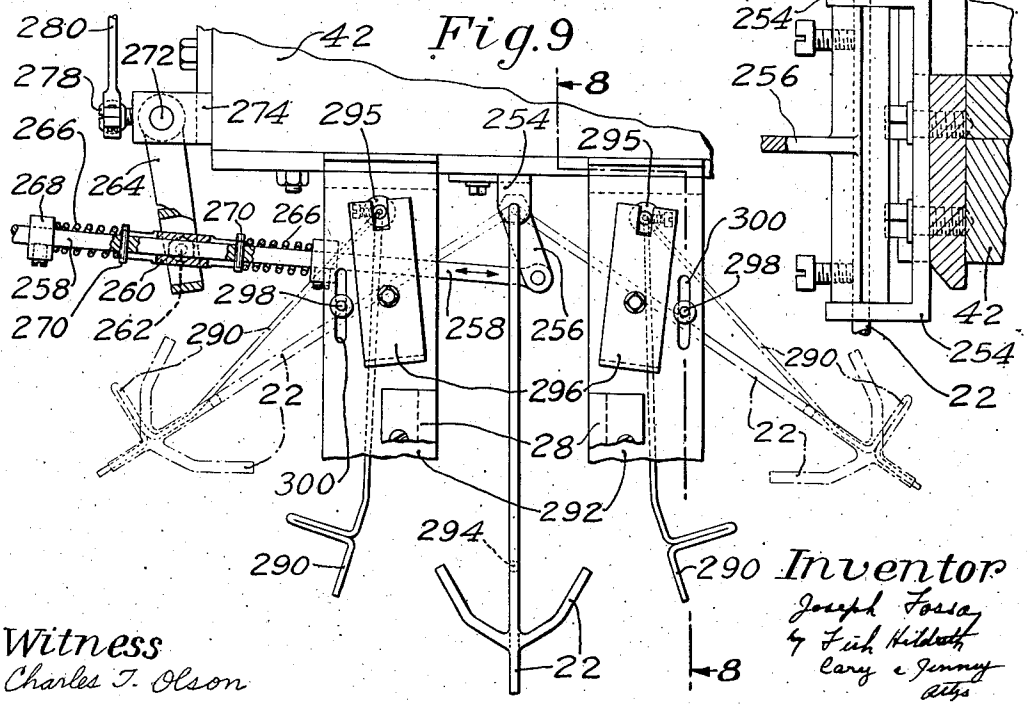


Fig. 9



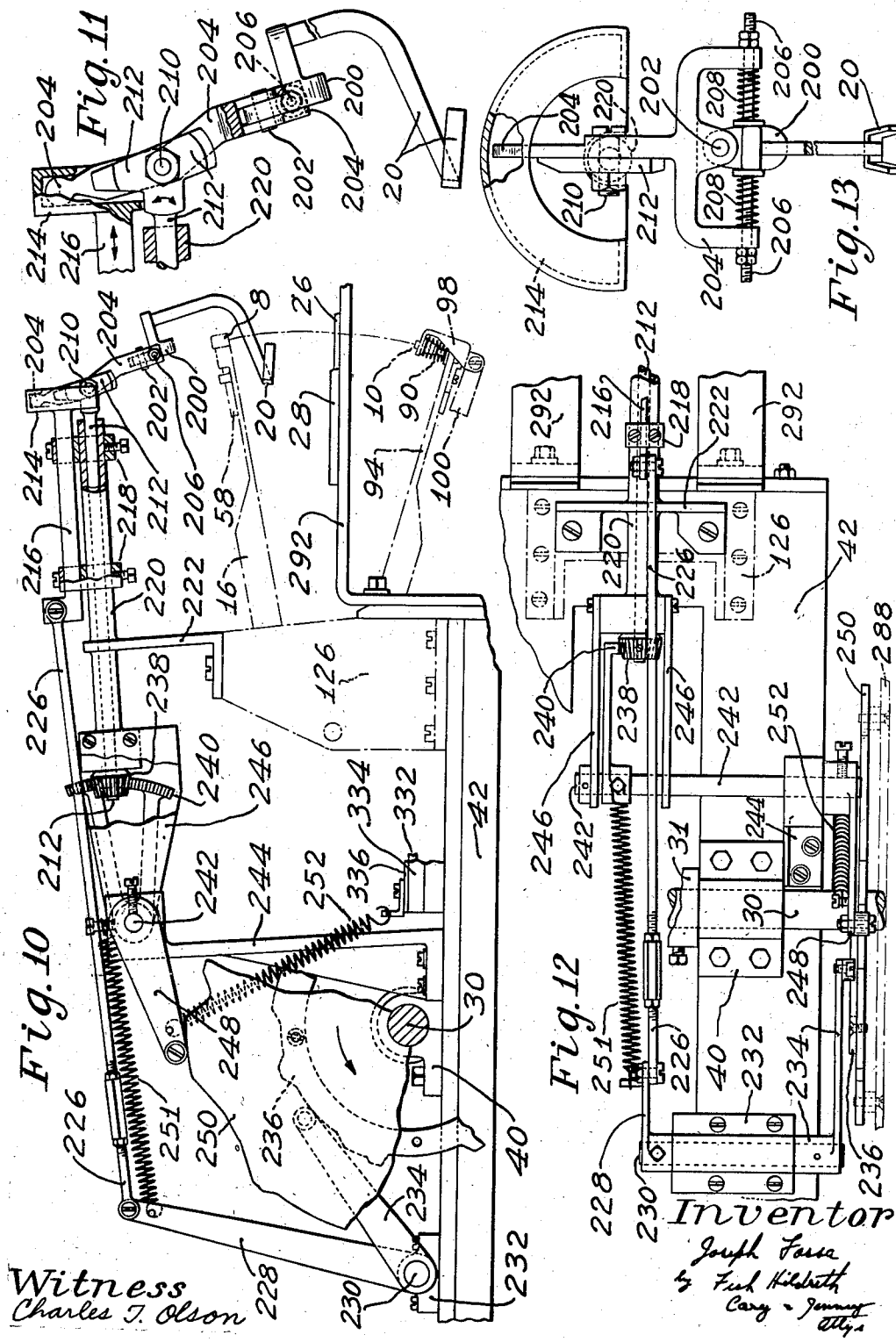
Witness
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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

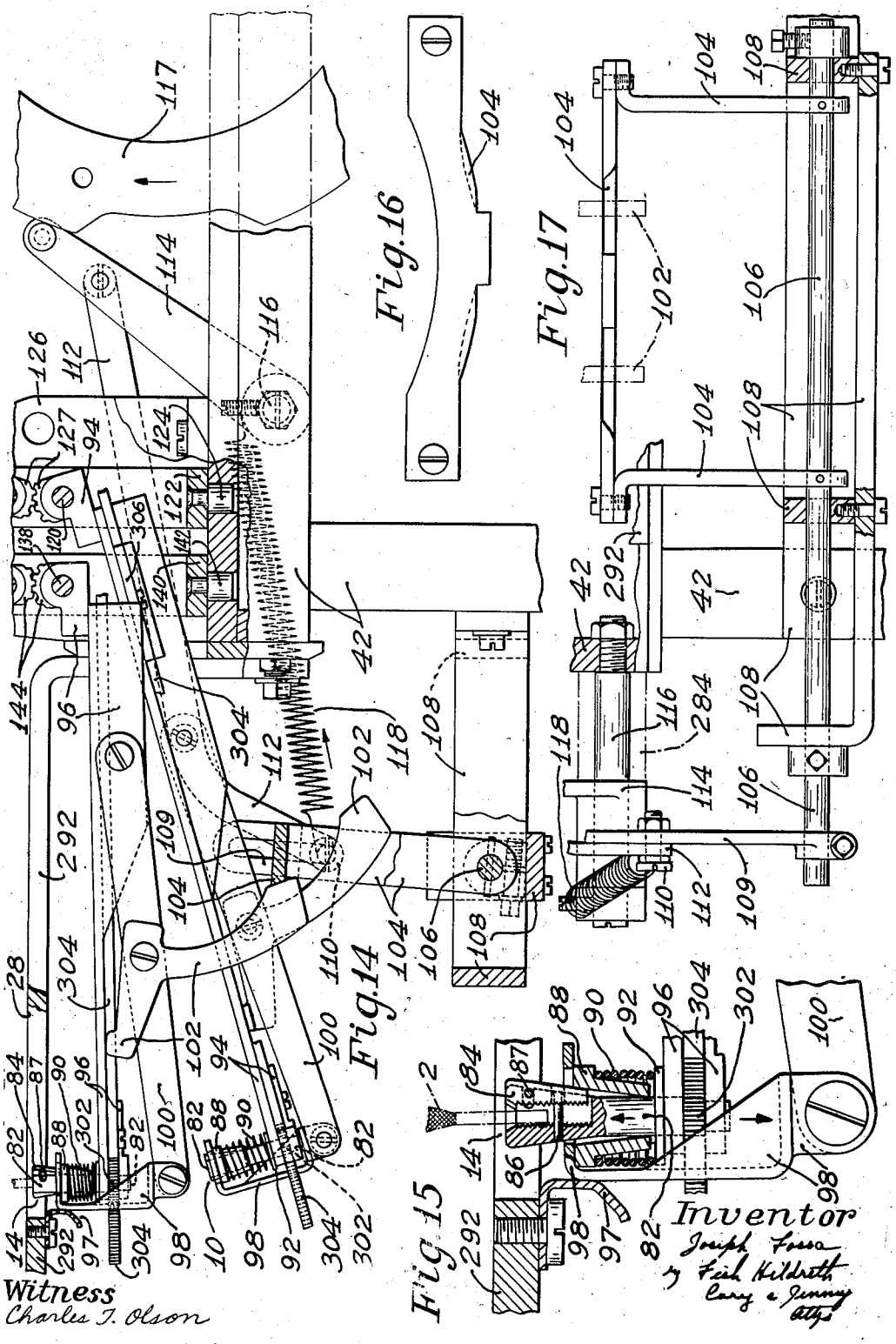
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SHOE UPPER LACING MACHINE

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Fig. 18

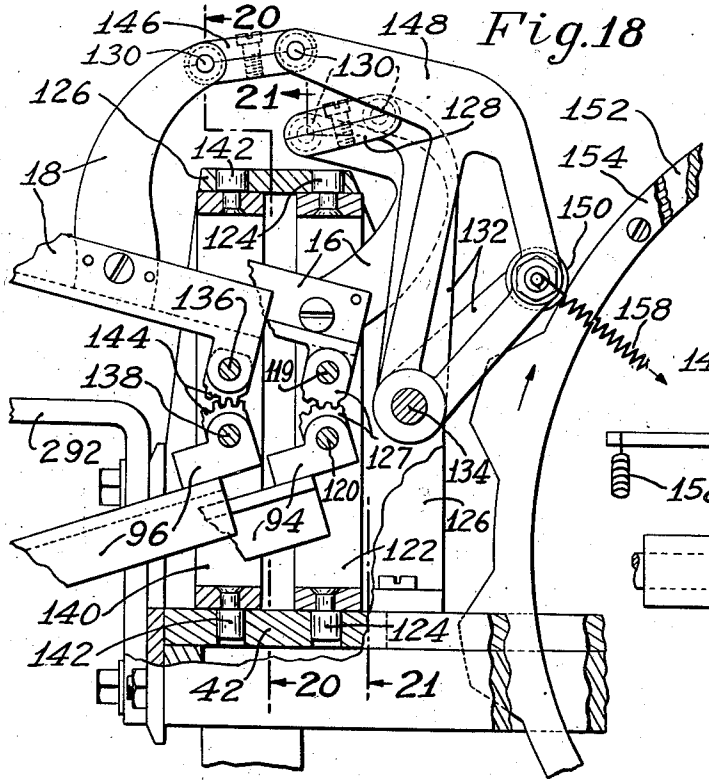


Fig. 19

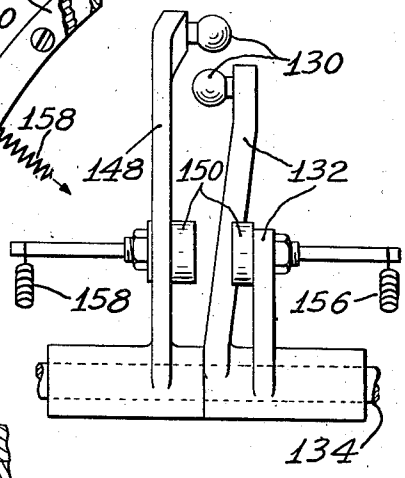


Fig. 20

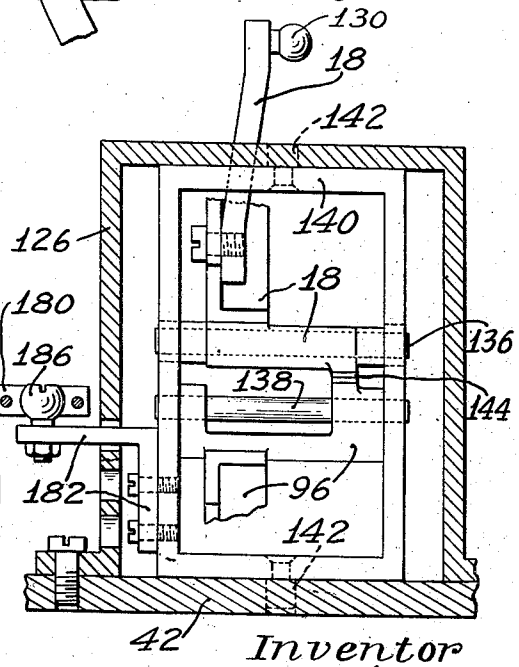
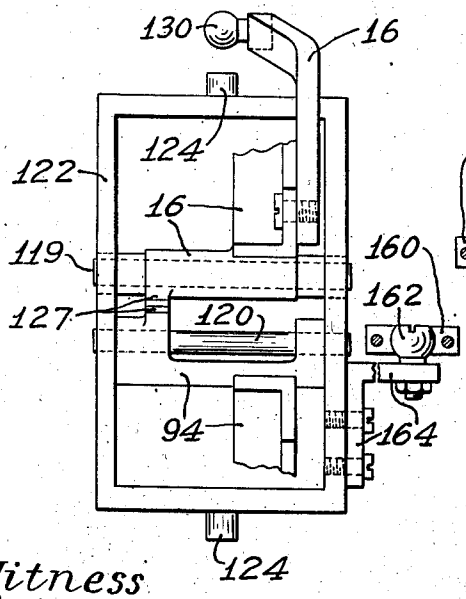


Fig. 21



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Aug. 28. 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

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Fig. 22

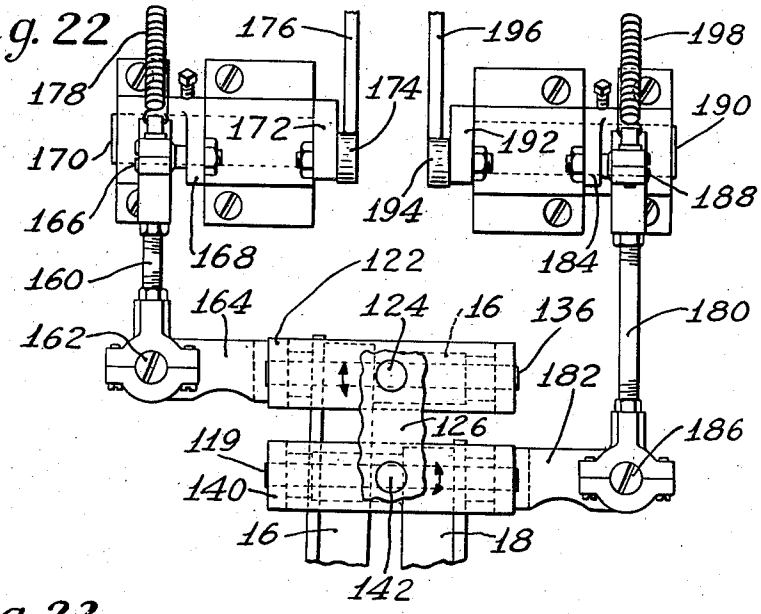


Fig. 23

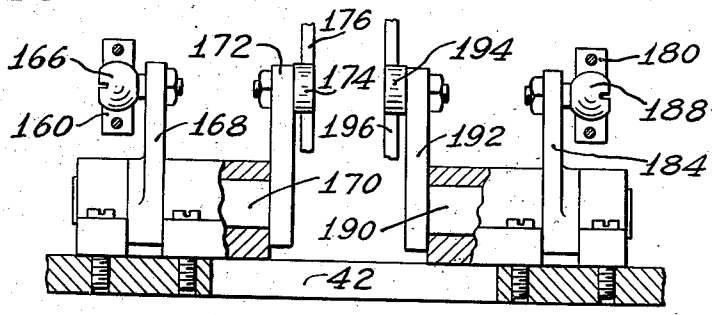
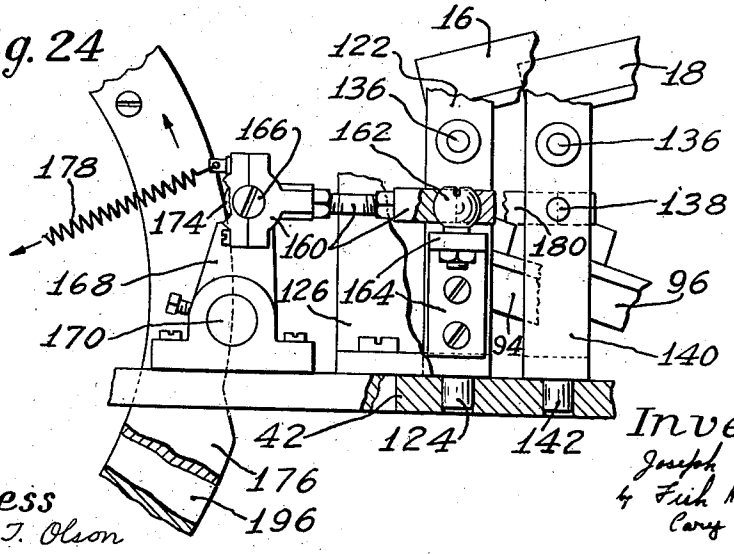


Fig. 24



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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

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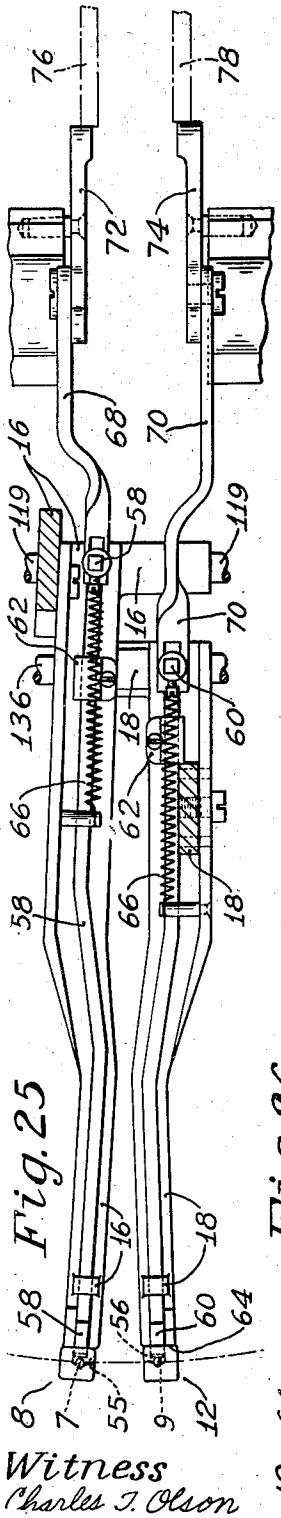


Fig. 25

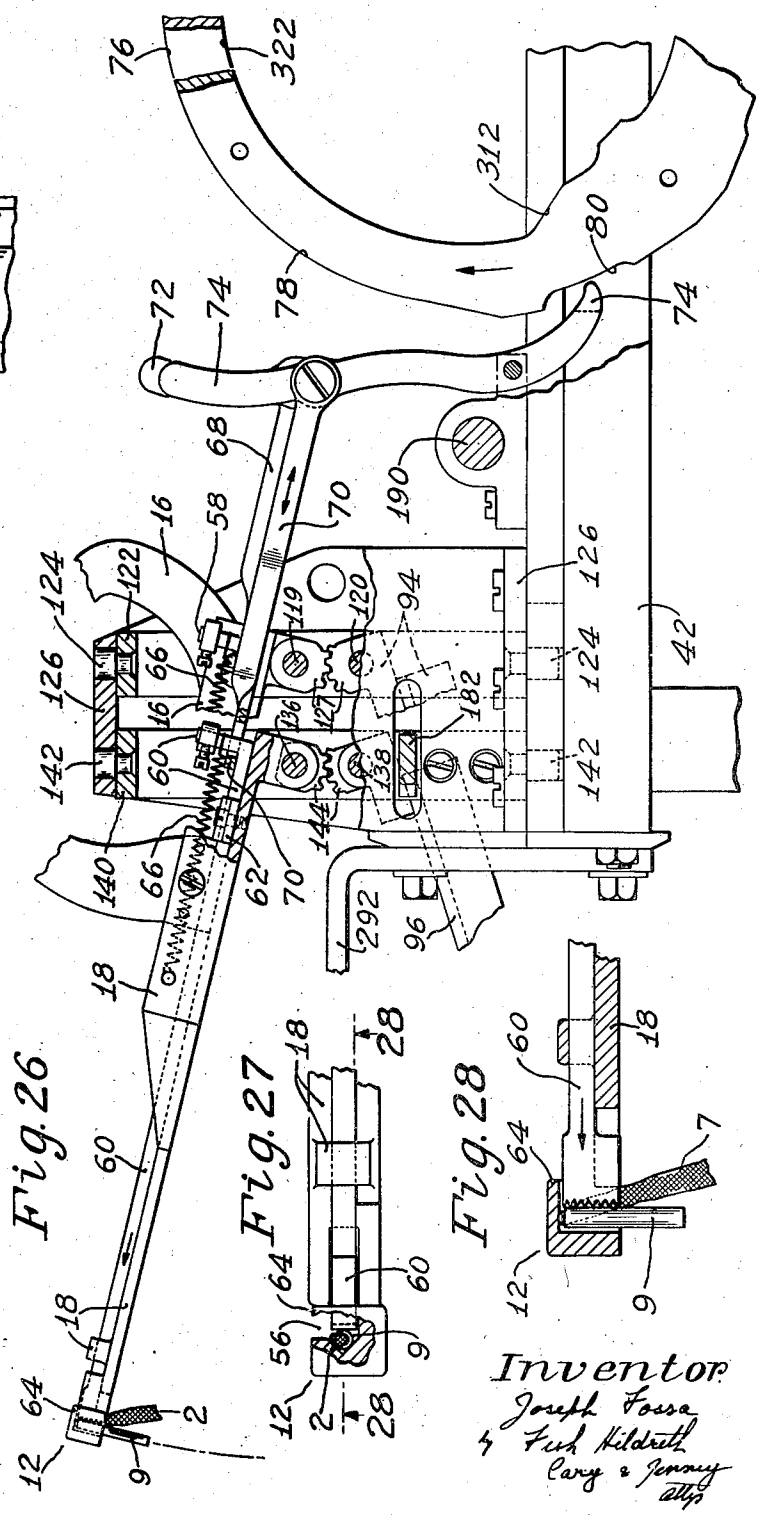


Fig. 26

Fig. 27

Fig. 28

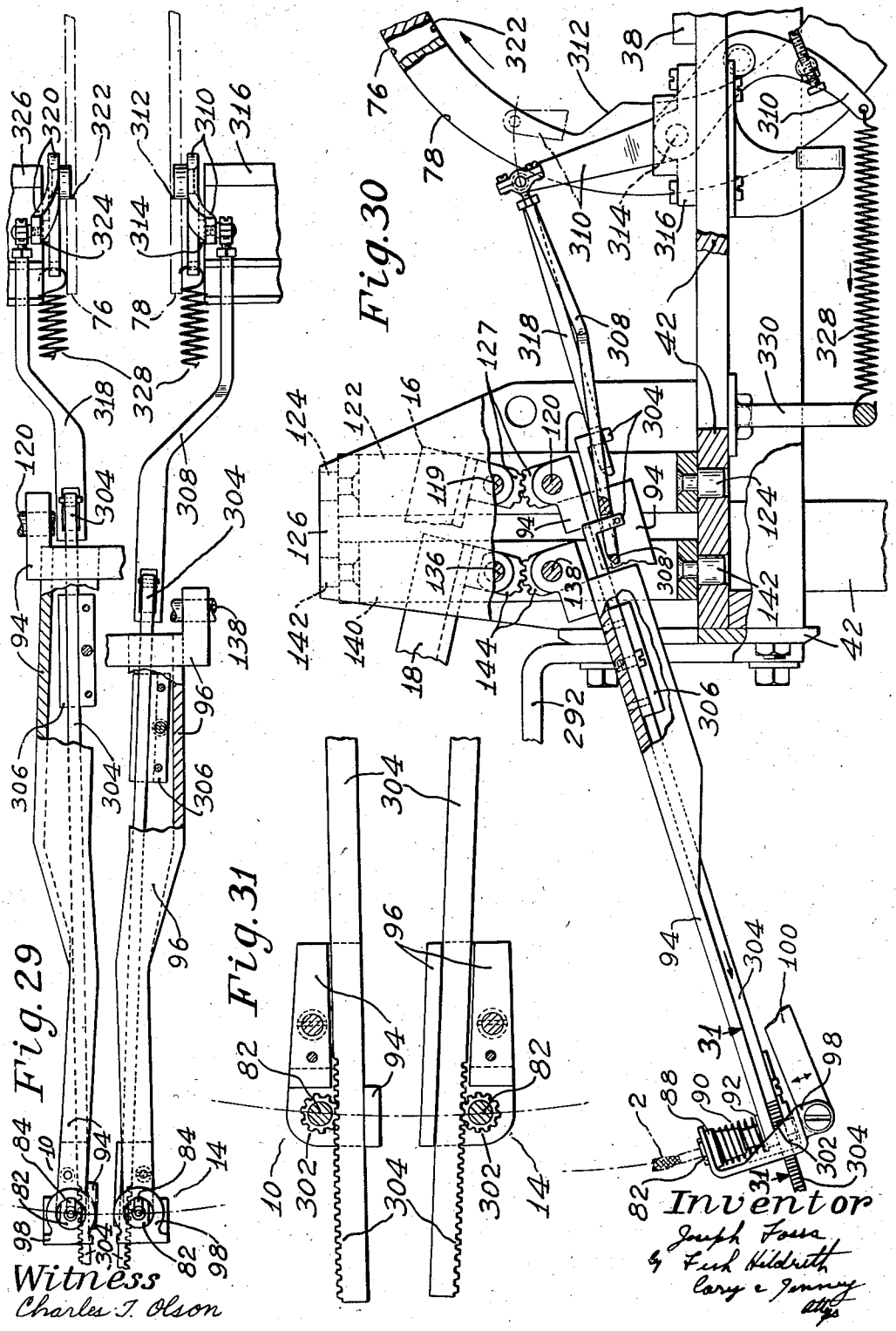
Witness
Charles T. Olson

Inventor
Joseph Fossa
by Fish Hildreth
Carey & Jenney
Attys

Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

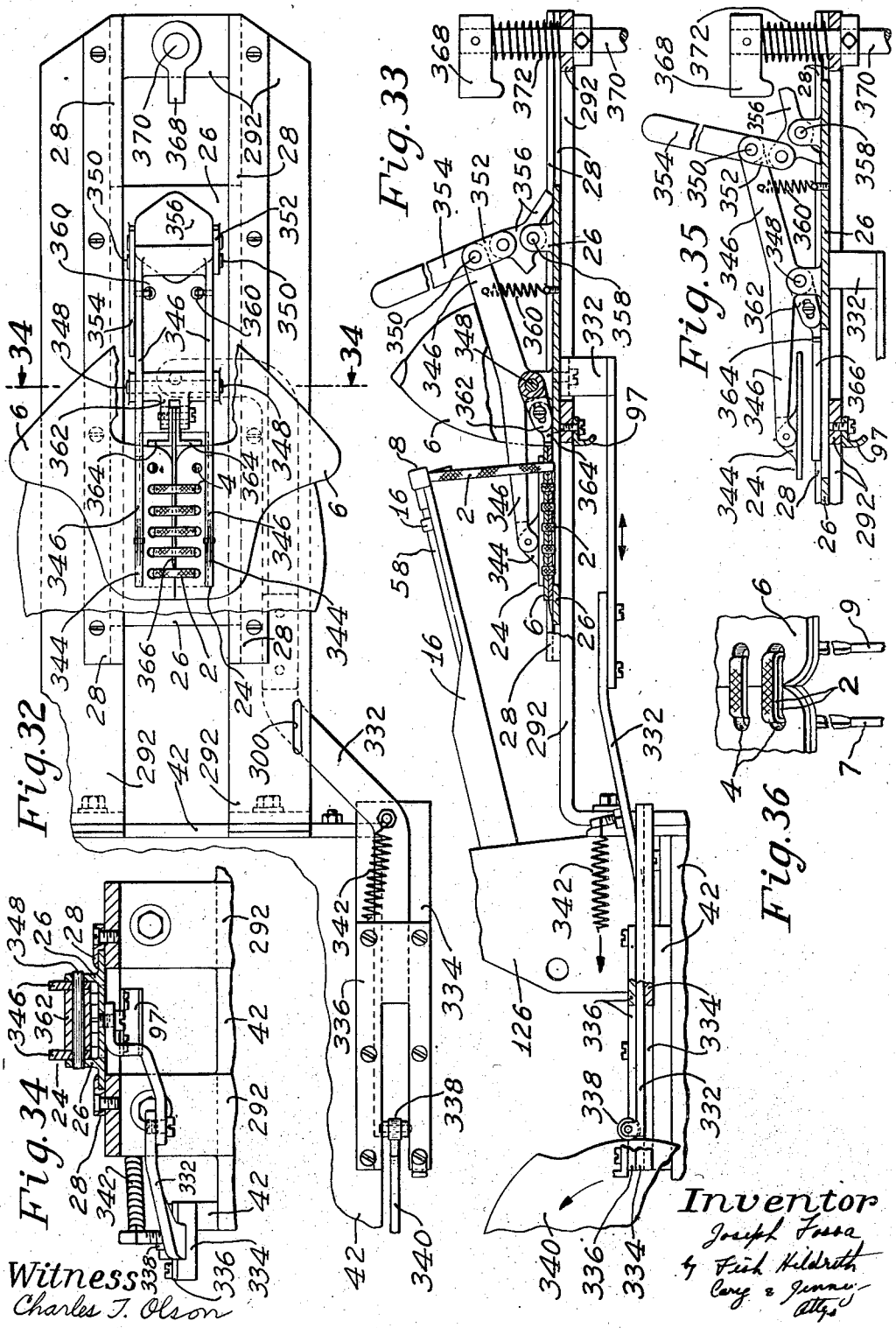
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SHOE UPPER LACING MACHINE

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SHOE UPPER LACING MACHINE

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Fig. 37

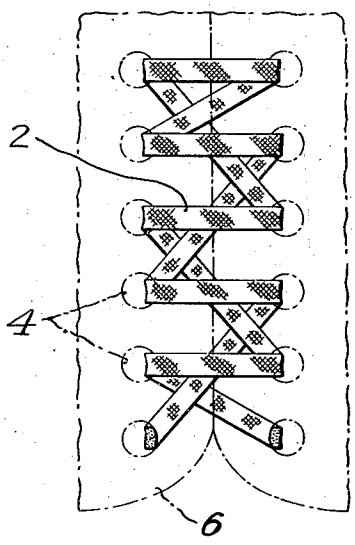


Fig. 38

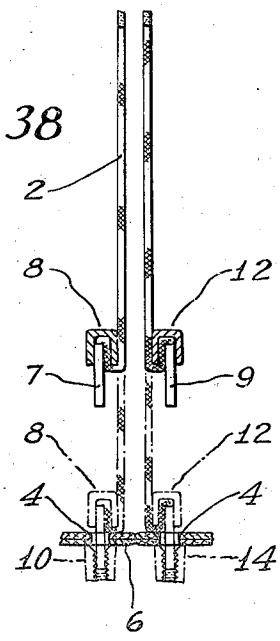
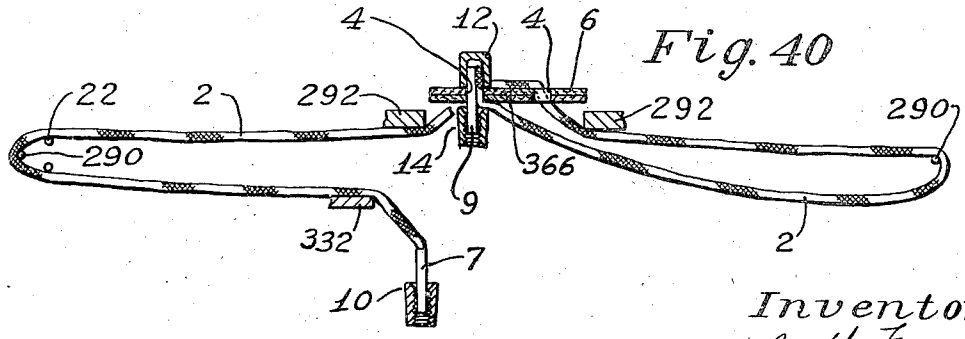


Fig. 39

Fig. 40



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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

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Fig. 41

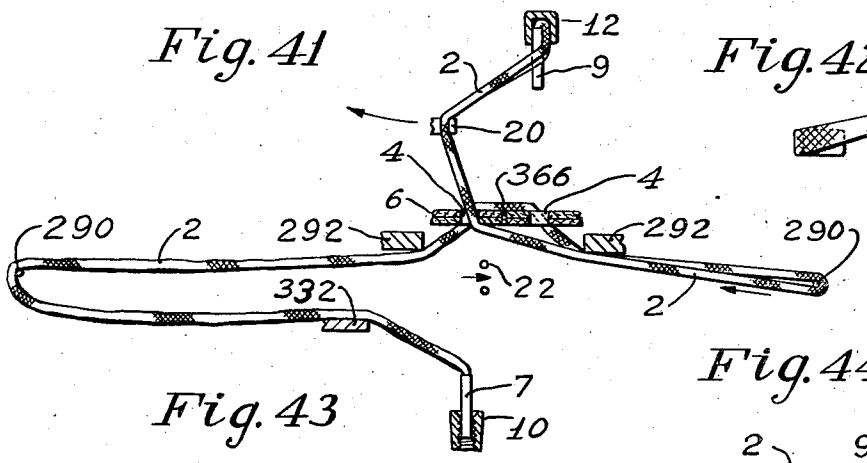


Fig. 42

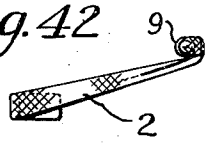


Fig. 44

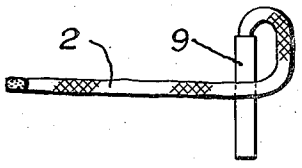


Fig. 43

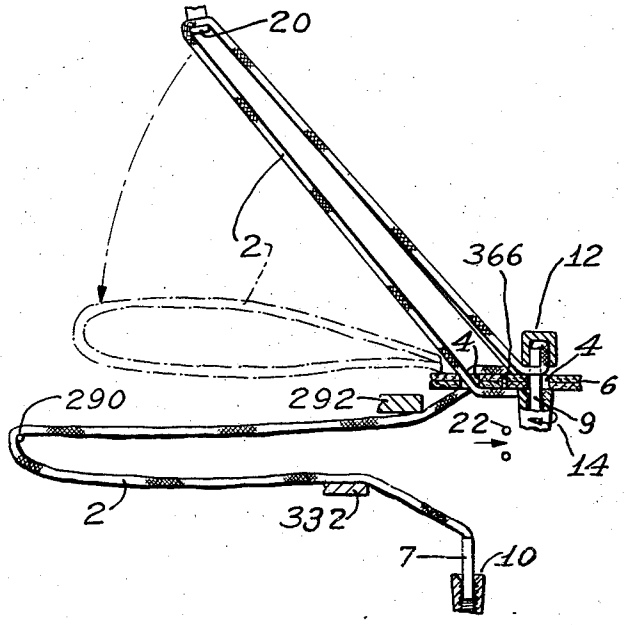


Fig. 45

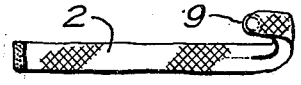


Fig. 46



Fig. 47

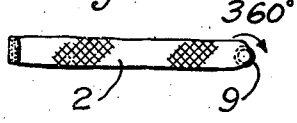
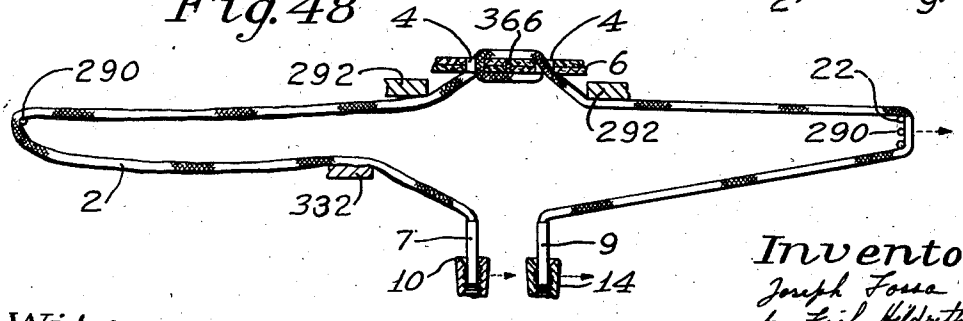


Fig. 48



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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

Filed July 23, 1941 15 Sheets-Sheet 14

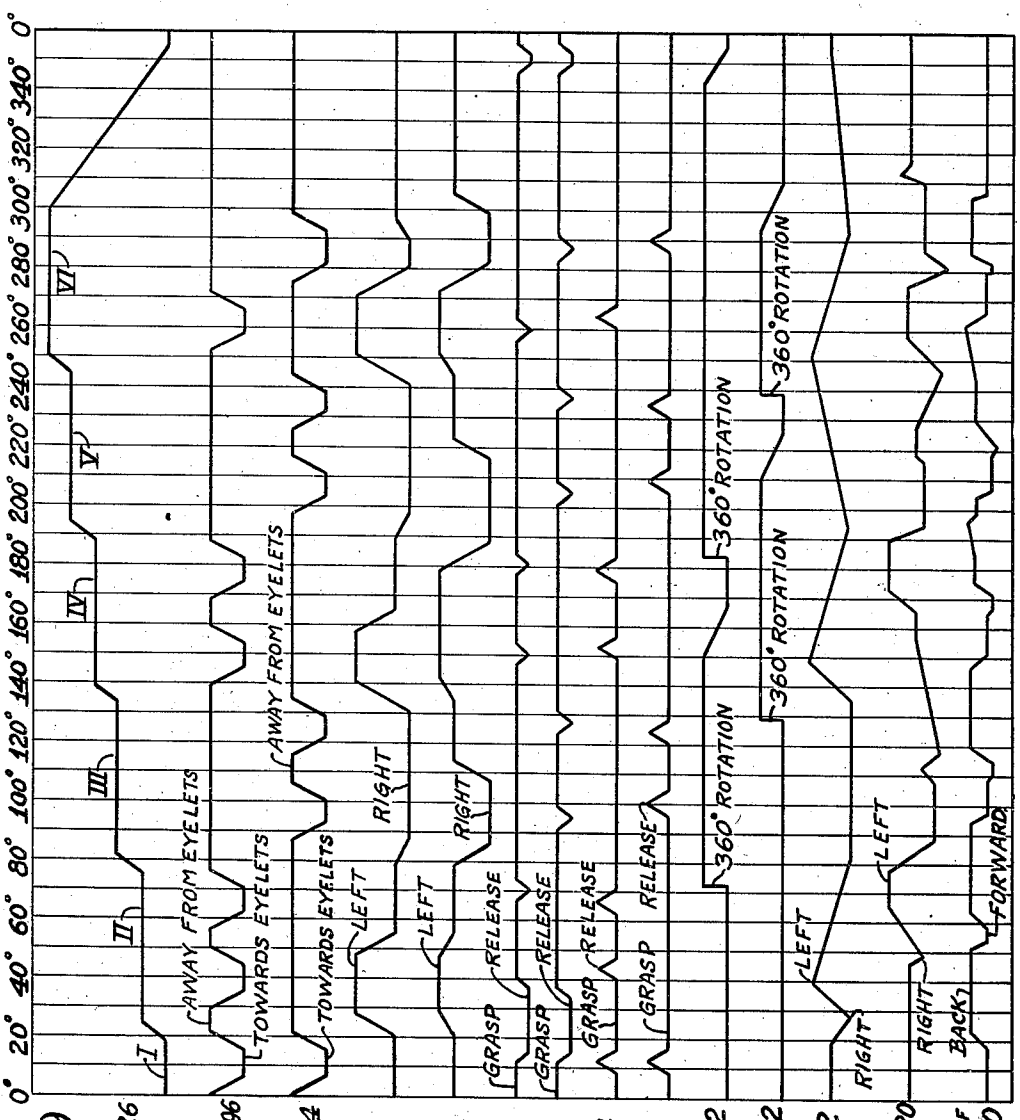


Fig. 49

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Aug. 28, 1945. J. FOSSA 2,383,538

SHOE UPPER LACING MACHINE

Filed July 23, 1941 15 Sheets-Sheet 15

Fig. 50

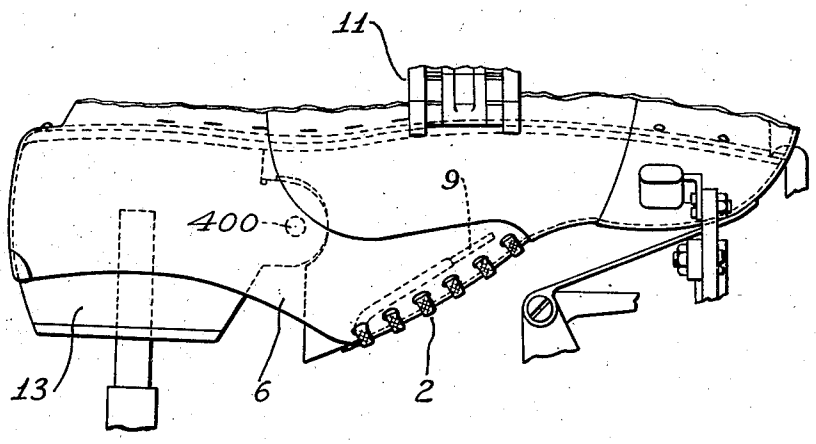
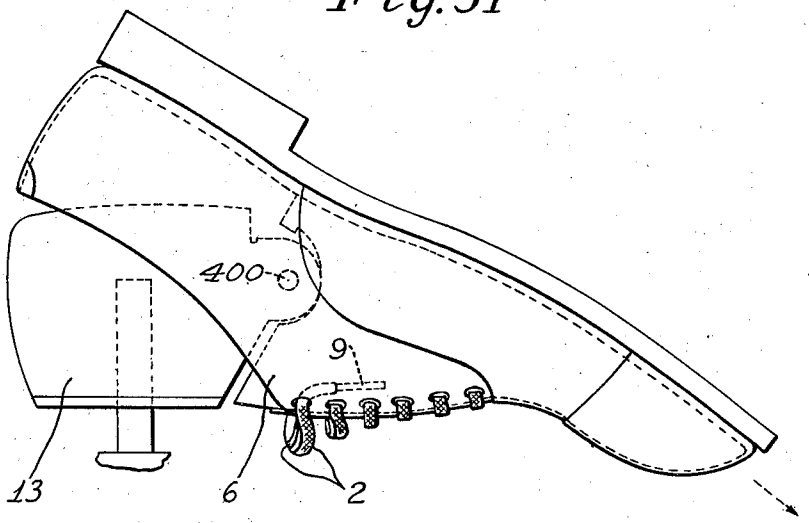


Fig. 51



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Patented Aug. 28, 1945 2,383,538

UNITED STATES PATENT OFFICE

2,383,538

SHOE UPPER LACING MACHINE

Joseph Fossa, Lynn, Mass., assignor to United Shoe Machinery Corporation, Flemington, N. J., a corporation of New Jersey

Application July 23, 1941, Serial No. 403,675

43 Claims. (Cl. 12—69.5)

The present invention relates to shoe upper lacing machines, and the particular machine embodying the invention includes mechanisms for inserting in an eyeletted shoe upper a shoe lace of such a character and in such a manner that it can be utilized as a lasting lacing during the lasting and other shoe making operations and can be allowed to remain permanently in place as a dress lacing for use in the actual wear of the shoe.

Heretofore, lasting lacings composed of inexpensive loose twisted cord have been applied usually by inserting loops of cord in registering eyelets of a folded shoe upper, which loops were interlocked with each other, the ends of cord being tied or left unsecured except by drawing them through the final loops of the completed lacings. Lasting lacings of this nature are generally applied to an upper by machine, such as disclosed in U. S. Letters Patent of the present inventor No. 2,327,345 of August 24, 1943, the lacings inserted by this machine being removed before the shoe is completely manufactured and before the last is removed from the shoe so that there is no necessity for taking special precautions to insure a good appearance or durability in the lacings. The usual practice before placing a finished shoe on sale, is to insert a dress type of lace of the customary form in one of the eyelets of the upper or merely to place a pair of dress laces in the retail container with the shoes, relying upon the retail sales merchant to insert the laces in the eyelets when the shoes are being fitted to the customer.

Dress laces for shoes customarily consist of lengths of flat or round woven textile material, the free ends of which lengths are tipped permanently with ferrules giving them sufficient rigidity and tenuity to facilitate hand insertion in the eyelets of an upper without the use of a needle or other eyelet entering device. Other forms of dress laces have tips of plastic material solidified after being compressed, or laces may be employed, the tips of which are rigid due to the nature of the material from which the laces are composed. The tips of dress laces may thus be grasped and inserted or withdrawn from eyelets conveniently.

An important object of the present invention is to provide a machine for lacing shoe uppers with the customary form of dress shoe lace so that this type of lace may be inserted during manufacture of a shoe by production methods. If a dress lace is inserted before lasting operations are started, the necessity of inserting or removing a special temporary lasting lacing is avoided and effective use may be made of the same lace throughout the various steps of manufacture and sale of the shoe.

Another object of the invention is to provide a lace inserting machine which will operate without the use of needles, or other eyelet engaging members, to carry the end of a lace through the eyelets of a shoe upper in regular lacing order. A still further object of the invention is to provide a machine for lacing shoe uppers arranged to insert a lace having a form especially effective for successful lasting operations and which, at the same time, presents an attractive appearance, free of twists or kinks, corresponding to a dress type of lace which is carefully inserted by hand.

With these and other objects in view, the present invention contemplates the provision of a shoe upper lacing machine having a support, preferably in the form of a clamp, for a shoe upper and lace inserting members acting to carry end first the permanent tip of a single length of lace successively through eyelets in the upper without the use of a needle. In the present machine, the tip engaging means comprises members acting at opposite sides of the upper to thread the end of the tip through the eyelets by transferring the tip alternately from one member to another. Thus, the tip end is inserted into an eyelet from one side of the upper and withdrawn from the other side. As hereinafter described, mechanisms are provided for actuating the tip engaging members, which are in the form of grippers designed to transfer a tip withdrawn from an eyelet to another eyelet without releasing the tip from the gripper in which it is held so that there will be no opportunity for the lace to twist or kink. As the lacing operation in the illustrated machine progresses and the withdrawn tip is transferred to a new eyelet, the lace connected with the tip is bent back on the tip and the tip, together with the bent back lace, is introduced into the new eyelet, thus avoiding the necessity of reversing the tip or changing the position of the tip in the gripper in any way.

As each tip withdrawing movement of the grippers is terminated, the tip being drawn a short distance from the eyelet, the lace stands in a straight line between the gripper and the eyelet. At the other side of the upper, the lace has a slack section which must be taken out in order to make the completed lacing set properly in the upper. Accordingly, another feature of the invention resides in the provision of take-up devices for taking out the slack in a lace between successively laced eyelets after each tip is withdrawn so that a suf-

ficient length is always available for insertion of the tip in other eyelets.

In the preferred form of the machine, each tip engaging gripper is constructed and arranged to grasp the end of a tip leaving a substantial length of tip exposed so that after the exposed length of tip is projected into an eyelet, another gripper may grasp and withdraw the exposed length of tip from the other side of the upper.

To produce a completed lace which corresponds in appearance to a hand inserted dress lace and which is effective for preventing lengthwise shift of the eyeletted upper edges relatively to each other during lasting operations, the gripper actuating mechanism is arranged to insert the tips of the lace through one eyelet at a time, the portions of the lacing outside the upper crossing at right angles to the eyeletted edges and in parallel relation to each other. This feature of the invention is embodied in mechanism for shifting the upper clamping means and tip grippers relatively to each other as the lacing operation progresses and in the present form of this feature, the portions of lace at the inside of the upper cross each other in opposite directions between the eyeletted edges of the upper.

When a shoe lace is transferred across the lacing slit between spaced non-registering eyelets in an upper, unless the tip is reversed end for end while being transferred, the lacing will become twisted between the eyelets. If the slack in a flat lace is taken out of the section between the eyelets with the twist remaining, the completed lacing will produce irregular enlargements or kinks inside the upper causing undesirable bulges in the upper when lasting and a neat appearance in the lacing outside the upper will not be obtained. If a round lace is employed, the strength and durability of the completed lacing will be impaired and the appearance marred. In order to prevent formation of twist or kinks in a completed lacing inserted by transferring the tip from one eyelet to another, mechanism is provided in the machine hereinafter described for rotating one of the grippers in which the tip is grasped equally in amount and oppositely in direction to that of the twist introduced in the lace by reason of the transfer between eyelets. Where the lace is bent back on the tip after being transferred from one eyelet and inserted in another, as outlined above, it is necessary to rotate the gripper receiving the tip only when the tip is inserted in the second eyelet of a pair, the bend in the lace absorbing the twist produced while the tip is being inserted in the other eyelet of the pair. Thus, in the illustrated embodiment of this feature, the twist introduced in the lace, as a result of being transferred from one to another in a series of successive eyelets, is taken out only after being inserted in every second eyelet of the series, since it is possible to bend the lace back on the tip only when inserted in every other eyelet.

In order to hold the slack in the lace taken out after each tip is withdrawn by a gripper in this feature of the invention, a retarding member is provided acting with each take-up device to prevent displacement of the lace after being drawn through the eyelet and until the lace is inserted and withdrawn from the next succeeding eyelet. The slack may then be withdrawn by the take-up at the opposite side of the upper smoothly and uniformly without any possibility of a twist appearing in the completed lace.

While the features of the invention are particularly applicable to a lacing machine having lacing tip grippers arranged to insert and withdraw the tips of a lace in and from the eyelets of an upper without themselves entering the eyelets, certain features of the invention are useful in machines in which lace inserting members do enter the eyelets or in which the laces are inserted by means other than tip engaging grippers. Certain other features relate to a lacing machine in which lacings of any suitable form are inserted in a shoe upper while secured by a clamp in opened out position with the eyelets in separated relation. These and other features of the invention relating to certain details of constructions, combinations and arrangements of parts in the machine, are hereinafter described in the following specification and more particularly pointed out in the appended claims.

In the drawings, Fig. 1 is a perspective view, looking from the right front, of a machine embodying the features of the present invention; Fig. 2 is a similar view of the machine illustrated in Fig. 1, looking from the left of the front; Fig. 3 is a view in right side elevation of a portion of the machine including the main operating cam shaft and the driving clutch, partly broken away, to illustrate the construction; Fig. 4 is a sectional plan view of the parts illustrated in Fig. 3; Fig. 5 is a sectional detail view, on a somewhat enlarged scale, of the main driving clutch and actuating mechanism taken on line **5—5** of Fig. 4; Fig. 6 is a sectional detail view showing the driving clutch in stopping position; Fig. 7 is a perspective view of certain portions of the lacing tip grippers showing their manner of operation, in cooperation with the slack take-ups of the machine while lacking an upper; Fig. 8 is a view in side elevation, and in section, on an enlarged scale, taken along the line **8—8** of Fig. 9, of the lower take-up and one of a pair of cooperating lace retarding members; Fig. 9 is a plan view of the lower take-up, together with the lace retarding members, indicating the extreme positions taken during lacing operations; Fig. 10 is a view in side elevation of the higher take-up, together with its actuating mechanism; Fig. 11 is an enlarged sectional view of a portion of the higher take-up mechanism; Fig. 12 is a plan view of the mechanism illustrated in Fig. 10; Fig. 13 is a view in front elevation of that portion of the take-up mechanism illustrated in Fig. 11; Fig. 14 is a view in right side elevation of the under tip engaging grippers and their actuating mechanisms, partly in section; Fig. 15 is a detail sectional view on an enlarged scale of one of the under grippers illustrated in Fig. 14; Fig. 16 is a detail plan view, on an enlarged scale, of a gripper releasing frame; Fig. 17 is a view in front elevation, and partly in section, of the gripper releasing frame and its mounting; Fig. 18 is a view in side elevation, partly in section, of a portion of the gripper supporting arms and carrier, together with the mechanism for actuating the arms towards and from a shoe upper; Fig. 19 is a view in rear elevation of the cam levers for actuating the gripper arms towards and from the shoe upper; Fig. 20 is a sectional view taken along the line **20—20** of Fig. 18; Fig. 21 is a view in rear elevation and in section of one of the gripper carriers taken along the line **21—21** of Fig. 18; Fig. 22 is a plan view of a portion of the mechanism for actuating the gripper carriers to transfer the tips of the laces from one eyelet to another; Fig. 23 is a sectional view in elevation of portions of the same mechanism; Fig. 24 is a

right side view of portions of the same mechanism; Fig. 25 is a plan view of the over grippers with the mechanisms for causing them to grasp and release the lacing tips; Fig. 26 is a right side view of the same grippers and mechanisms, parts being broken away and shown in section; Fig. 27 is an enlarged detail plan view of the lacing tip engaging portions of the right-hand over gripper; Fig. 28 is a sectional view taken along the line 28—28 of Fig. 27; Fig. 29 is a plan view of the under grippers with the mechanisms for rotating them to take out the twist in a lace; Fig. 30 is a right side view of the same grippers and mechanisms, parts being broken away and shown in section; Fig. 31 is a detail plan view, on an enlarged scale, of the gripper rotating parts; Fig. 32 is a plan view of the shoe upper supporting feed slide of the machine with an upper mounted thereon, together with the actuating mechanism for the slide; Fig. 33 is a detail view in left side elevation, and partly in section, of the feed slide and actuating mechanism; Fig. 34 is a sectional view taken along the line 34—34 of Fig. 32; Fig. 35 is a left side view, partly in section, of the shoe upper clamp shown in Fig. 33, with the clamp in upper releasing position; Fig. 36 is a perspective view of a portion of an upper after being laced in the machine, illustrating one manner of fastening the lacing in the upper; Fig. 37 is an enlarged view of a lacing inserted by the machine indicating the shoe upper in dot-dash lines; Fig. 38 is a detail view in front elevation, as seen from the front of the machine, of the tips of a shoe lace while being inserted in the first pair of eyelets in a shoe upper; Fig. 39 is a detail view of the shoe lace illustrating the position assumed after the tips of the lace have been inserted into and withdrawn from the first pair of oppositely disposed eyelets in the shoe upper; Fig. 40 is a similar view, illustrating the position of the lace after one of the tips has been transferred from the first pair of eyelets and is being inserted in an eyelet of the second pair in an upper; Fig. 41 is a similar view of the lace after the same tip has been withdrawn from the second eyelet; Fig. 42 is a plan view of the withdrawn tip and lace end shown in Fig. 41; Fig. 43 is a view similar to Fig. 41 illustrating the same tip and lace end after being transferred and inserted in the opposite eyelet of the second pair to be laced; Fig. 44 is a detail view in elevation on an enlarged scale of the inserted tip shown in Fig. 43 after the lace has been released from the higher take-up; Fig. 45 is a plan view of the same tip and lace end shown in Fig. 44; Fig. 46 is a plan view of the same lace end after the tip has been rotated 180°; Fig. 47 is a plan view of the same lace end after the tip has been rotated 360°; Fig. 48 is a similar view of the lacing after the inserted tip of Fig. 43 is withdrawn from the second eyelet in the second pair; Fig. 49 is a time chart showing the relation of the movements imparted by the different actuating mechanisms of the machine; Fig. 50 is a detail front view of an upper after being laced by the machine of the present invention, illustrating the step of tensioning the upper over a last; and Fig. 51 is a similar view of a shoe including the upper being removed from the last in a completed condition, except for minor finishing operations.

The illustrated machine is a shoe upper lacing machine constructed and arranged to insert the customary form of dress shoe lace, indicated at 2, in the eyelets 4 of a shoe upper 6 secured in a suitable clamp to be described more fully hereinafter. The lace consists of a flattened length of flexible woven textile strip material having permanent self-sustaining tips 7 and 9 formed by wrapping the end portions of the lace with a hardened plastic sheath. Each tip thus formed has a single free end, being connected integrally with the flexible portion of the lace at the other end. The lace is inserted with the upper opened out ready for application to a last, the portions of the lacing outside the upper being arranged in parallel relationship crossing the lacing slit at right angles to the eyeletted edges of the upper from an eyelet in one side to the opposite eyelet in the other side. The portions of lacing inside the upper extending between the eyelets cross each other at an angle approaching 90°, depending upon the spacings of the eyelets, and extend between the eyelets of every third pair, across the edges of the upper at an acute angle. Each pair of opposite eyelets are thus connected, as indicated in Figs. 32 and 37, by parallel portions of lacing extending along the outer surfaces of the upper and opposite eyelets of every third pair are connected with criss-cross portions of lacing extending along the inner surfaces of the upper. The parallel portions of the lacing take up the direct pull which tends to separate the eyeletted edges of the upper when the upper is tensioned over a last.

The tensioning and lasting operation is illustrated in Fig. 50 which shows a lasting gripper and stapling unit 11 of a machine similar to that disclosed in U. S. Letters Patent to Lawson No. 1,999,298 of April 30, 1935, operating to cause the upper to conform with the surfaces of the two-part jointed last 13 on which it is mounted. The inner criss-cross portions of lacing assist materially in reducing the tendency of the eyeletted edges along the lacing slit to shift lengthwise of each other during the upper tensioning and lasting operations. As a result, the lacing acts in a manner effective to hold the eyeletted edges in proper relationship with a slit of predetermined width while the upper is being applied to a last for the lasting operation with little likelihood of the upper being distorted from proper shape before completion of the shoe. The end portions of the lacing may be fastened together in any suitable manner, as by tying a knot or by passing the tips a second time through opposite eyelets and carrying the ends inside the upper (Fig. 36), so that they will be held between the tensioned upper and the last during lasting operations. One advantage of this form of fastening is that the spacings between eyelets may be adjusted easily when the upper is applied to the last to allow the lasting operator to regulate the separation of the eyeletted edges and the width of lacing slit according to the conditions met during lasting.

Not only is the lacing effective for holding the eyeletted edges of the upper with a predetermining separation during lasting operations, but as illustrated, it corresponds to a common form of hand inserted lacing employed while a completed shoe is being worn. When the completed shoe is ready to be placed on sale, there is provided a usable shoe lace at least of sufficient durability to serve while fitting the shoe to the foot of a prospective wearer.

In order to insert laces in and withdraw them from the eyelets of a shoe upper with reliability, the terminal tips of which have sufficient rigidity and tenuity to permit projection of the ends of the tips without separate support through the

eyelets, the machine embodying the invention has two pairs of grippers 8, 10 and 12, 14 of special construction and mode of operation, as will be more fully described hereinafter, for engaging the tips and threading them lengthwise through a series of eyelets without requiring the grippers themselves to enter the eyelets, certain of the grippers acting to cause a portion of each lace adjacent to a tip to be bent over against the tip and inserted in an eyelet ahead of the tip. Each pair of grippers 8, 10 and 12, 14 is actuable to grasp and release the tip of a lace, to move towards and from the shoe upper 6 while inserting and withdrawing the tip, to move along the surface of the upper while transferring the tip successively from one eyelet to another, and the grippers 10 and 14 under the upper are rotatable to take out the twist in the lace produced during the transferring operations so that the resulting lacing will lie flat both inside and outside the upper.

Referring more particularly to Figs. 1 and 2 of the drawings, the shoe upper 6 is illustrated during operation of the machine to insert the tips successively in oppositely disposed eyelets of the opened-up sides of the upper. The tip engaging grippers 8 and 12 over the upper are secured to outwardly extending arms of gripper supporting levers 16 and 18, respectively, each fulcrumed about a horizontal axis on a carrier frame which in turn is rotatable about a vertical axis to swing the grippers at the ends of the levers during the operation of transferring the tips from one eyelet to another.

To draw out the slack after each tip has been withdrawn from an eyelet, there is provided a pair of take-ups 20 and 22, the higher one acting above and the lower under the position of the upper in the machine. In order to avoid twisting or tangling opposite ends of a lace, each take-up is actuated in one direction away from the lacing slit to draw that portion of lace remaining slack throughout eyelets along one eyeletted edge of an upper and in the other direction away from the lacing slit to draw the slack portion of lace through eyelets in the other edge of the upper, thus keeping the two ends of the lace separate and eliminating the necessity of careful timing of the motions in the parts. To secure the upper in the machine, an upper clamp 24 (see Figs. 32, 33 and 34), is secured to an upper support or slide 26 mounted in guideways 28 running forwardly and rearwardly of the machine and arranged to move the upper in a direction parallel to the eyeletted edges of the upper when secured by the clamp. Movement of the grippers parallel to the surface of the upper causes the tips grasped thereby to be transferred from alignment with eyelets in one side of the upper across the lacing slit and into alignment with eyelets in the other side and movement of the slide 26 in the guideway causes the tips to be transferred along the eyeletted edges, according to the planned design of the finished lacing.

To actuate the grippers, take-ups and slide through their various movements, suitable mechanisms, to be hereinafter described more fully, are provided operated by a main cam shaft 30 having a large peripheral sprocket wheel 31 (see Figs. 1 to 6), surrounded by a driving chain 32 engaging a smaller sprocket wheel 34 mounted on a drive shaft 36. The main cam shaft 30 is supported in bearings 38 and 40 on the frame 42 of the machine and the drive shaft 36 rotates in bearings 44 and 46 also mounted on the frame 42. The drive shaft 36 is rotated from a suitable source of power through a chain 48 surrounding a sprocket 49 and sprocket teeth on a sleeve 50 rotatable on a stub shaft 52 secured in a plate 54 made fast to the frame of the machine. The sleeve 50 is rotated through a suitable driving and stopping mechanism constructed and arranged to cause the cam shaft 30 to be started under the control of an operator and to continue through a complete 360° rotation.

The construction of the tip engaging grippers 8 and 12 acting over the upper is best shown in Figs. 25, 26, 27 and 28 and the operation is such that the lace tip together with a bent over adjacent portion of the lace may be grasped securely without danger of injury to the tip or lace or possibility of slipping from the grasp of the gripper. The over grippers are formed at the ends of gripper supporting levers 16 and 18, respectively, and may be actuated to grasp or release the tips and bent over portions of a lace in any position of their supporting levers. The ends of the levers 16 and 18 have hooked terminal portions, the inner surfaces of which are V-shaped to form a tip receiving stationary jaw. The right side of the left-hand gripper 8 has a side opening 55 through which the flexible portion of the lace in the gripper may pass when reversed on the tip of the lace and presented to the gripper with its free end in position to be inserted within an eyelet. The right-hand gripper 12 is formed in a similar manner except for being bent in the opposite direction to provide an opening 56 for the flexible part of the lace on the left side.

To grasp the tips of the lace in the over grippers 8 and 12, the gripper supporting levers 16 and 18 have movable gripper bars 58 and 60, respectively, slidingly mounted at their forward ends in perforated lugs formed on the respective levers and at their rearward ends within U-shaped plates 62 secured to the levers. The forward ends of the bars 58 and 60 are enlarged in a vertical direction, forming serrated jaws to insure a firm grip on the tips engaged thereby. To prevent projection of a tip either when the lacing is originally inserted in the machine beyond the point where it cannot again be grasped at the opposite side of an upper by another gripper, the grippers 8, 12 have ledges 64 overlying the upper ends of the tips secured in the grippers and acting as abutments for the tips.

For actuating the over grippers 8 and 12 to grasp and release the tips and bent over portions on a lace in timed relation to the operations of the other devices in the machine, the rearward ends of the sliding gripper bars 58 and 60 are upturned and are connected with springs 66 stretched between the upturned ends and pins on the respective gripper supporting levers. Loosely surrounding the upturned ends of the bars 58 and 60 are the perforated forward ends of links 68 and 70 of the respective gripper actuating mechanisms, which links are in turn connected with cam levers 72 and 74 having curved lower ends engaging suitably shaped cams 76 and 78 respectively. The cams 76 and 78 are so shaped that just before the machine is brought to rest, the over grippers 8 and 12 will be held open ready to release the lace tips and the bent over flexible portions of the lace. At stopped position of the machine, the cams 76 and 78 are provided with recesses 80 for receiving the lower cam engaging ends of the cam levers so that the springs 66 may actuate the grippers to closed positions. When inserting the tips of a lace, the upwardly

projecting handle portions on the levers are actuated manually to open the over grippers, the grippers again being closed as soon as the levers are released by the operator. After inserting the tips of a lacing in the over grippers, the machine is started and all of the operations required in lacing the upper are completed without further attention on the part of the operator.

The first movements of the over grippers 8, 12 after the tips of a lace are inserted are downwardly towards the shoe upper, the position of the upper and the spacings of the grippers being such that the tips are inserted simultaneously in the pair of oppositely disposed eyelets at the toe end of the eyeletted upper edges. During the downward movements of the over grippers 8 and 10 towards the upper, the under grippers are being moved upwardly to receive the tips inserted by the over grippers.

The construction of the tip engaging grippers 10 and 14 under the upper is best illustrated in Figs. 14 and 15. These under grippers are in the form of chucks each consisting of a centrally bored flat-sided spindle 82, the inner surface of which is grooved as by internal threading and one side of which is slotted to receive a tip clamping jaw 84 loosely supported on a pin 86 passing diametrically through a loose passage in the spindle and a pin 87 at right angles to the pin 86 extending into slots in the side of the spindle. The pin 86 acts not only to hold the jaw in place, but serves as a stop to prevent projection of a lace tip beyond a point where it cannot readily be grasped at the opposite side of the upper by an over gripper. The tip clamping jaw 84 has an inclined edge projecting beyond the outer surface of the spindle and is beveled at its upper end so as to facilitate entry of a lacing tip into the gripper. To close the jaw against the tip, the upper tapered end of the spindle is surrounded by a conical sleeve 88 pressed upwardly by a spring 90 coiled around the spindle and acting at its upper end against a shoulder on the sleeve and at its lower end against a washer 92. The spindles 82 of the under grippers are rotatably mounted in the forward ends of gripper supporting levers 94 and 96, respectively, the washers 92 being urged by the spring 90 against the upper surfaces of the levers. When the sleeves 88 are pressed upwardly, they force the clamping jaws 84 against the lacing tips in their respective grippers. The upper end of each sleeve is engaged by the perforated right angle portion of a downwardly extending plate 98, the lower end of which is pivotally connected with a chuck releasing arm 100 pivoted to a flange portion of one of the corresponding levers 94 or 96.

To hold the perforated portion of the plate 98 away from the tip clamping jaw 84 in each chuck when the chuck is open, an angular clip 97 is secured beneath the guideway 28 in the path of both plates. When the chucks are in tip releasing positions, the plates are pressed away from the jaws 84 by engaging the clip. The arrangement of the under grippers is such that the stationary jaws formed by the spindle are each located at the same side of a tip while the tip is being inserted in an eyelet as the stationary jaw of the opposite gripper in the pair, thus rendering certain the alignment of the tip with the grippers.

For actuating the chuck releasing arms 100 to release the lace tips when the under gripper supporting levers 94 and 96 move upwardly towards the upper, there is fulcrumed on each arm 100 a cam lever 102 (see Fig. 14) arranged with its upper end to act on the under surface of the corresponding gripper supporting lever 94 or 96 and at its lower end to engage the cross bar portion of a U-shaped releasing frame 104 secured to a horizontal shaft 106 rotatable in a bracket 108 on the machine frame. The left end of the shaft 106, as illustrated in Fig. 2, has clamped to it a slotted arm 109 in the slot of which is adjustably secured a pivot screw 110 connecting a link 112 with the arm 109. The link 112 also is connected to a follower arm 114 rotatable on a stud 116 in proper relation to the cam shaft 30 to cause a roll on the arm to engage a cam 117 mounted thereon and cut in the proper configuration to cause the frame 104 to be rocked at suitable times, the cam levers forcing the chuck releasing arms 100 downwardly relatively to the gripper supporting lever to release the lacing tip held by the under grippers. To hold a roll on the follower arm 114 against the cam 117, a spring 118 is stretched between the pivot screw 110 and the machine frame. The lower ends of the levers 102 project rearwardly, as indicated in the drawings, and may be engaged by the crossbar portion of the frame 104 only when the arms 100 are raised so that the under grippers may be actuated to grasp and release the tips of a lace only when moved into a position as close as possible to the upper.

The grippers of each pair are actuated simultaneously towards and from the upper being laced. The gripper levers for the left pair 16, 94 are mounted on separate horizontal shafts 119 and 120, respectively, the ends of which are secured in a rectangular carrier 122 rotatable about vertical pivot studs 124 secured in horizontal sides of the carrier (see Figs. 18 to 21 inclusive). The pivot studs 124 project loosely into the frame 42 below the carrier and into a rectangular brace 126 above the carrier (see Figs. 18 and 20). The hubs of the levers 16 and 94 are elongated sufficiently to fill the space between vertical sides of the carrier and are provided with gear segments 127 meshing with each other to cause the levers to move together. Connected with the gripper lever 16 is an actuating link 128 having spherical sockets engaging ball ended studs 130 on the gripper lever and on a cam lever 132 fulcrumed on a shaft 134 fixed in the brace 126. The gripper levers of the right pair 18, 96 are mounted in a manner similar to the left pair on separate horizontal shafts 136 and 138. The shafts 136 and 138 have their ends secured in a rectangular carrier 140 which, in turn, is rotatable about vertical pivot studs 142 secured in horizontal sides of the carrier and loosely mounted in the frame 42 and brace 126. The elongated hubs of the gripper levers 18, 96 are provided with meshing gear segments 144 to cause the levers to move together towards and away from the upper. The lever 18 is connected by an actuating link 146 to a cam lever 148 in a manner similar to the connection of the actuating link for the lever 16. The cam levers 132 and 148 are provided with rolls 150 engaging cams 152 and 154 on the shaft 30 (see Fig. 2), the rolls being drawn against the cams by springs 156 and 158 stretched between pins extending from the respective levers and the frame of the machine.

By this mechanism and manner of mounting the gripper levers, the pairs of grippers are separately movable towards and from the upper in any position of the respective carriers, while permitting swinging movement parallel to the

surfaces of the upper being laced. The links 128 and 146 are relatively short and the locations of the cooperating studs 130 are such that one or the other of the joints formed by the studs 130 is substantially in alignment with the studs 124 or 142 for the respective carriers at all times. The swinging movements of the carriers, therefore, have little or no effect on the movements of the grippers towards and from the upper.

The carriers 122 and 140 are swung from side to side about their pivot studs to cause the grippers to move alternately from alignment with eyelets in one side of the upper into alignment with eyelets in the other side of the upper while transferring the tips from one eyelet to another. The mechanism for swinging the carrier frame 122 includes a link 160 best shown in Figs. 22, 23 and 24, having a socket surrounding a spherical headed stud 162 secured in an angle member 164 mounted on the carrier 122. The other end of the link 160 has a socket surrounding a similar stud 166 secured to an arm 168 mounted on a rock shaft 170. The rock shaft 170 rotates in suitable bearings on the frame 42 and carries an arm 172 having a cam roll 174 engaging a cam 176 on the shaft 30, the roll being drawn into contact with the cam by a spring 178 stretched between the link 160 and the machine frame.

The mechanism for swinging the carrier frame 140 about its pivot studs is similar and consists of a link 180 connected to an angle member 182 at one end and to an arm 184 at the other end by similar sockets and spherical headed studs 186 and 188. The arm 184 is secured to a rock shaft 190 rotatable in suitable bearings and actuated by an arm 192 having a cam roll 194 engaging a cam 196 on the shaft 30. The roll 194 is pressed against the cam 196 by a spring 198 connected between one end of the link 180 and the machine frame.

The construction and arrangement of the higher slack take-up 20 is best shown in Figs. 1, 2 and 10 to 13 inclusive. The take-up consists of a downwardly and rearwardly bent bar having reversed prongs forming a double hook to receive a lace being inserted at either side of the bar. The take-up is secured at its upper end to a block 200 pivotally mounted on a pin 202 passing through spaced lugs on a yoke 204. The axis of the pin 202 extends forwardly and rearwardly so that the hooked end of the take-up may move relatively to the yoke and to maintain the take-up yieldingly in a central position on the yoke, the sides of the block 200 are engaged by flat headed ends of a pair of bolts 206 passing loosely through downwardly bent terminals of the yoke and having a pair of springs 208 coiled about their respective shanks between the headed ends and yokes. For actuating the take-up forwardly and rearwardly towards and from engagement with a lace being inserted, the yoke 204 is pivoted on a bolt 210 secured at right angles to the pin 202 in the T-shaped end of a shaft 212 and the yoke has a ball-shaped upper end fitting and arcuate recess of a reciprocating guideway 214. The guideway 214 is formed integrally with a rod 216 slidingly mounted in a pair of blocks 218 secured to a tubular support 220 within which the shaft 212 rotates. The support 220 is connected with an angle bracket 222 mounted on the top surface of the brace 126. When the rod 216 is moved rearwardly, the hooked end of the take-up moves forwardly into engagement with a lace and thereafter, the shaft 212 is rocked in the proper direction to draw the lace to one side (see Figs. 1 and 2) removing the slack from between successive eyelets previously laced. After the tip of the lace has been inserted in the next eyelet, the hooked end of the take-up is moved rearwardly to release the lace so that the slack may be drawn through that eyelet by the lower take-up 22.

The actuating mechanism for the higher take-up 20 consists of a link 226 connected between the rod 216 and an arm 228 secured to a shaft 230 mounted in a suitable fixed bearing 232. The shaft 230 also has secured to it a cam arm 234 having a roll engaging a cam 236 on the shaft 30. The shaft 212 has, at its rearward end, a bevel gear 238 meshing with a gear segment 240 secured to one end of a shaft 242 rotatable in a bearing at the upper end of an upstanding bracket 244. The shaft 242 also passes through bearings in a pair of side plates 246 secured to opposite sides of a rectangular enlargement at the rearward end of the tubular support 220, the gear segment 240 being located between the side plates. To rotate the shaft 242, the shaft has a cam arm 248 provided with a roll engaging a cam 250 on the shaft 30. Suitable springs 251 and 252 are provided for keeping the cam rolls of the arms 228 and 248 in engagement with their respective cams.

The lower take-up 22 is in the form of a relatively heavy wire member bent into a right angle to provide a vertical shank at one end rotatable in bearings in outwardly bent ears of a plate 254 bolted to the frame 42 (see Figs. 7, 8 and 9). At the forward end of the lower take-up are a pair of laterally extending fingers arranged to fend off the lace as the take-up passes across its path and prevent the lace from moving rearwardly towards the shank of the take-up. In operation, the take-up swings to the right to take out the slack from above the surface of the upper and draw it to the right when the lace passes through an eyelet in the right-hand side of the upper and to the left when the lace passes through an eyelet in the left-hand side of the upper.

The mechanism for actuating the lower take-up consists of an arm 256 having an elongated hub clamped to the shank of the take-up between the ears of the plate 254 and a rod 258 pivotally connected at one end to the arm 256 and passing through a tubular support 260 mounted to rotate between set screws 262 received within threaded perforations in the hollow rectangular end of an arm 264 through which the tubular support passes. A yielding connection is provided between rod 258 and the support 260 in the form of a pair of springs 266 surrounding the rod 258 between a pair of collars 268 on the rod and the ends of the tubular support 260, there being a pair of pins 270 (Fig. 9) passing through the rod and slots in the support 260 to take up the pressures of one of the springs 266 when the other is compressed. The arm 264 has its hub clamped to a vertical shaft 272 rotatable in upstanding arms of a U-shaped frame member 274. The shaft 272 has fastened thereto a collar 276 provided with a laterally projecting spherically headed pin 278. The head of the pin 278 is received in a socket at one end of a link 280, the other end of which has a similar socket surrounding the spherical head of a pin 282 fixed to one arm of a cam lever 284. The cam lever is fulcrumed on the stud 116 mounted on the machine frame and has a cam roll held by a spring 286 against a cam 288 on the shaft 30.

As the lower take-up 22 swings to the right or left, as the case may be, it engages one of a

pair of slack retarding members 290 formed of angularly bent lengths of wire rotatably mounted in a pair of angle bars 292 bolted to the front portion of the machine frame and arranged with suitable cross braces to form the supporting members for the upper clamp guideway 28. During operation of the lower take-up between its central position illustrated in Fig. 9 and either extreme right or left positions indicated by the dot-dash lines, a bight is formed in the lace by the take-up and by a downwardly and forwardly bent finger 294 (Figs 7 and 8) forming a fork on the take-up. Each retarding member is engaged between the take-up and the finger 294, the retarding members being mounted at points spaced from the rotary support for the take-up. Either retarding member engaged by the take-up therefore is caused to slide between the take-up and finger 294 and to enter the bight in the lace formed by the take-up as the take-up swings to right or left (dot-dash positions of Fig. 9). The retarding members thus prevent slack in the lace from working its way back after being drawn through an eyelet and avoid displacement of the lace after the take-up releases it.

Each retarding member 290 is constructed with a laterally projecting portion to prevent the bight of the lace being carried rearwardly and after the take-up returns to its central position, the bight of the lace is held by the retarding member alone. To keep the retarding members in the positions to which they are moved by the take-up, the mounting for each retarding member includes a collar 295 clamped to the angularly bent shank of the retarding member between the respective bar 292 and a spring plate 296 bolted to the bar so that the slotted end of the plate will engage frictionally with the collar. When a tip of the lace is being drawn upwardly through an eyelet, the retarding member 290, about which the bight in the lace passes, is drawn by the lace back into its original solid line position ready for a new operation, the bight slipping off the end of the retarding member as the retarding member reaches its original position. To prevent the lower take-up from drawing an excessive amount of lace before the lace is inserted in the second pair of eyelets, the swinging motion of the take-up is limited in either direction by engagement with the downwardly projecting ends of a pair of bolts 298 having thumb nuts for holding them in suitably adjusted positions within slots 300 formed in the guideway supporting bars 292.

As has been stated, mechanism is provided for rotating the grippers in which the lacing tip is grasped in a direction to take out the twist inserted in the lace as a result of transferring the tip from one eyelet to another without releasing the grasp on the tip. For this purpose, as illustrated in Figs. 15, 29, 30 and 31, each spindle 82 of the grippers under the upper has gear teeth 302 cut in its lower end, with which teeth mesh corresponding teeth of a rack bar 304 slidably mounted in bearings including a guide 306 secured to the respective gripper supporting lever. The rack bar 304 for the right-hand under gripper 14 is arranged at the left of the spindle 82 for that gripper and the rack bar for the left-hand under gripper 10 is located at the right side of the corresponding spindle so as to produce rotation of the under grippers in opposite directions. Rotation in opposite directions to take out the twist in the lace is essential, due to the manner in which the tip of the lace is handled and transferred from eyelet to eyelet by the grippers over the upper.

To actuate the under gripper rack bars 304, their rearward ends are connected by similar cam actuated mechanisms, the right-hand rack bar having its rearward end bent downwardly and received in an elongated slot formed in a link 308 pivotally connected to a cam lever 310 having a roll engaging an internal cam 312 on the main shaft 30. The lever 310 has secured to it a pivot stud 314 fitting a bearing 316 bolted to the machine frame. The left-hand rack bar has its rearward end bent downwardly through an elongated slot in a link 318 pivotally connected to a cam lever 320 engaging an internal cam 322 on the main shaft, the lever 320 having a fulcrumed stud 324 (see Fig. 29) rotatable within a bearing 326 on the machine frame. The shapes of the cams 312 and 322 are such that when the spindles 82 are to be rotated, sudden drops are reached on the surfaces of the cams, causing the tips engaged by the grippers to be rotated within as short a time as possible thereafter. To cause each under gripper to be rotated when the sudden drop on the gripper rotating cam is reached, the gripper rotating levers 310 and 320 are connected to springs 328 having their ends secured to a V-shaped standard 330 beneath the machine frame. The slots in links 308 and 318 are of the proper length to prevent rotation of the spindles on the corresponding grippers when the gripper levers on which the links are mounted are actuated towards and from the shoe upper.

The mechanism for actuating the shoe upper supporting slide 26 in the guideways 28 is illustrated in Figs. 32 to 34 inclusive and comprises an irregularly shaped link 332 connected at its forward end to the slide 26 and slidingly arranged in a grooved block 334 mounted on the machine frame with a cover plate 336 to hold the link within the groove of the block. The rearward end of the link 332 is bent upwardly and has a roll 338 actuated by a cam 340 on the main shaft 30, a spring 342 being stretched between a pin on the link 332 and machine frame to hold the roll against the cam.

To clamp the shoe upper in operative position on the slide 26, the upper is engaged outside the rows of eyelets by two clamping bars 344 pivotally mounted between their ends on parallel arms joined together at their forward ends by a central hub to form a double lever 346 fulcrumed on a pin 348. The pin 348 is secured at its ends in upstanding lugs on the upper slide 26 so that movement of the hub at the forward end of the lever 346 will swing the clamping bars against or from the upper. To actuate the bars against the upper, the hub at the forward end of the lever 346 has a bearing for supporting a shaft 350 to one end of which is secured a link 352 and to the other end of which is secured a clamping lever 354. The link 352 and the lower arm of the clamping lever act, together with an elongated link 356, to form a toggle which may be moved towards and from aligned position by actuating the clamping lever 354. The link 356 is pivotally connected between the lower ends of lever 354 and link 352 and a shaft 358 mounted in lugs on the shoe upper slide 26. The link 356 also has forwardly and rearwardly extending projections for limiting the movement of the toggle towards and from aligned position. When the toggle is brought into aligned position, as indicated in Fig. 33, the upper is clamped to the slide and when the clamping lever is actuated forwardly and the toggle

broken, a pair of springs 360 connecting the lever 346 and the upper slide cause the clamping bars 344 to be raised from engagement with the upper.

For locating the upper in a central position with relation to the clamping bars 344 and with the eyelets in the upper in alignment with the grippers for the tips of the lace before clamping the upper, there is rotatably supported on the shaft 348 the hub of a slotted arm 362, within the slot of which is clamped a pair of oppositely extending angular gages 364 and a centralizing plate 366. When an unlaced upper is placed on the upper slide 26, the eyeletted edges of the upper are brought against opposite sides of the centralizing plate 366 and the ends of the upper at the ankle opening are held against the gages 364, as illustrated in Fig. 32. With the centralizing plate and gages properly set, the eyelets of the upper, after being secured by the clamp, will be located to receive the tips of the laces inserted by the grippers when the eyelets are located in a standard relationship along the edges of the upper, the edges being separated by the thickness of the centralizing plate.

At the end of the lacing operation, the upper slide 26 is moved forwardly to its starting or loading position, as in Fig. 35. To facilitate clamping the upper while holding the sides of the upper against the centralizing plate and gages, the upper clamp may be actuated by a foot treadle. For this purpose, a rearwardly extending projection from the link 356 is brought into the path of downward movement of a block 368 at the upper end of a treadle connected rod 370 passing loosely through an opening in the guideway 28. The rod 370 has coiled about it between the block and guideway 28 a spring 372 for holding the rod and block 368 in raised position. Since there is no need to actuate the upper clamp at other times, the block will not engage the link 356 except after the lacing operation is completed. Thus, there is no danger of disturbing the movements of the upper slide during lacing operations.

The operation of the machine is indicated in Figs. 38 to 49 inclusive. In the chart of Fig. 49, the abscissae represent degrees of rotation of the cam shaft 30 and the ordinates indicate the nature of the movements imparted by the cams on the cam shaft to the various operating devices throughout a complete machine cycle. The cams for actuating the tip engaging grippers are shaped to produce the proper tip grasping and releasing operations as the tips are inserted and withdrawn from the eyelets, these operations of the grippers being readily understood from an inspection of the chart. It will be noted that after both tips have been inserted simultaneously into the first pair of eyelets, one pair of grippers is actuated twice to insert and withdraw a tip from an eyelet before the other pair of grippers is actuated, and the pairs of grippers are given alternate double operations to insure that the slack in each end of the lace will be stored out of the way beneath the upper before the other tip is inserted in the succeeding pair of eyelets. The upper supporting slide actuating cam is shaped to produce feeding movements of the eyelets successively into line with the tip engaging grippers, as indicated by the numerals I to VI inclusive, which correspond to the pairs of eyelets operated upon beginning from the toe end of the upper. The movements imparted by the other cams will be readily apparent from the descriptive wording associated with the corresponding curves.

Before starting the machine in operation, the tips of a lace having a length suitable to provide the desired width of lacing slit between the eyeletted edges of an upper are inserted manually in the grippers 8 and 12, the upwardly projecting handle portions of the cam levers 72 and 74 being actuated to open the grippers. The tips of the lace are inserted and grasped in the grippers with the portions of lace adjacent the tips bent back along the tips, as illustrated in Fig. 38. As the cam shaft of the machine reaches approximately 12° of rotation from starting or 0° position, as indicated in the chart of Fig. 49, the levers on which both over grippers 8 and 12 are mounted move downwardly towards the upper inserting the projecting ends of the tips simultaneously into the first pair of oppositely disposed eyelets at the toe end of the upper. As soon as the tips have entered sufficiently within the eyelets, they are grasped by the grippers 10 and 14 under the upper (dot-dash lines of Figs. 38 and 28° position of the chart). To hold the portion of the lace between the tips out of the way, a light lace supporting wire 374 fastened to a stationary part of the machine frame with its free end extending over the upper is employed, as indicated in Figs. 1 and 39. As the tips are inserted in the eyelets, the supporting wire yields to give up the lace and as soon as the tips are withdrawn from the first pair of eyelets by the under grippers 10 and 14 and the lower take-up 22, the lace drops off the supporting wire 374, no further use being made of the wire until a new operation is started.

The lace is drawn through the right-hand eyelet of the first pair by the lower take-up 22 into the position of the lace indicated in Fig. 39 and the upper supporting slide 26 is moved to bring the second pair of eyelets from the toe end of the upper into line with the grippers. At the same time, the carrier 140 for the right-hand pair of grippers causes the tip of the lace to be transferred from alignment with the right-hand eyelet of the first pair into alignment with the left-hand eyelet of the second pair. In the position of the lace indicated in Fig. 40, which corresponds to approximately 44° of shaft rotation, the lower take-up has moved to the extreme left-hand position and has started back, leaving the right-hand retarding member 290 in control of the right-hand side of the lace and the left-hand retarding member in control of the left-hand side of the lace. At the same time, the right-hand pair of grippers move towards the upper to insert the right-hand tip with the portion of lace adjacent the tip bent back along the tip within the left-hand eyelet of the second pair, the bent over portion entering the eyelet ahead of the tip. During the operation of transferring in inserting the tip of the lace, a twist is imparted to the lace but is absorbed by the reversely bent portion of lace. The amount of twist in the reversely bent portion corresponds to 180° of rotation in the tip. The bent back portion of lace and tip are then withdrawn from the upper side of the eyelet by the gripper 18 and the carrier 140 for the right-hand pair of grippers is returned to a position where the right-hand grippers are in line with the right-hand eyelet of the second pair, as indicated in Fig. 41, which represents approximately 57° of rotation in the shaft 30. This movement of the carrier transfers the right-hand tip of the lace accordingly and introduces into the lace an additional 180° of twist. At the time of this transfer, the higher take-up 20 has engaged the lace and has started to draw the slack from the under

side of the upper. The position assumed by the tip of the lace at this time is illustrated in plan in Fig. 42. Shortly after this position of the lace is reached, the higher take-up draws the slack completely from the under side of the upper, as indicated in Fig. 43, and the right-hand grippers again move towards the work inserting the tip in the right-hand eyelet of the second pair. When the higher take-up **20** releases the face, it falls towards the dot-dash position and the right-hand spindle of the gripper **14** is rotated 360° while grasping the tip of the lace to take out all of the twist inserted during the previous two tip transferring operations.

The right-hand tip of the lace, after being released by the right-hand over gripper **12**, assumes a position similar to that indicated in Figs. 44 and 45. During the first 180° rotation in the under gripper **14**, the lace assumes the position of Fig. 46, and it is not until the end of the second 180° or the full 360° of spindle rotation that the lace is entirely straightened and lies flat throughout its length above the upper (Fig. 47). This 360° rotation of the spindle occurs before the right-hand pair of grippers has separated substantially from the upper so that the tip **9** of the lace remains within the right-hand eyelet of the second pair. Thus, all of the twist in the lace is taken out before being drawn through the eyelet so that it will lie flat on the surface of the upper, as in Fig. 48, when the lower take-up **22** moves to the right. The operations of the tip engaging grippers and take-ups continue in the same manner, as illustrated in Fig. 49, until the lacing of Fig. 37 is completed, the spindles of the under grippers being rotated to take out the twist in the lace as a result of straightening the reversely bent portions of lace after transferring and inserting a tip into every second eyelet.

To complete the lacing and fasten it in place, the ends may be tied manually in any suitable manner or the tips may be inserted a second time in the last pair of eyelets laced (see Fig. 36). With the tips inserted a second time and drawn tightly through the pair of eyelets last laced, the double thicknesses of lace are crowded in the eyelets and the ends of the lace extend inside the upper so that when mounted upon a last, the ends and tips will be secured between the upper and the last. When tension is applied to the lacing fastened in this way, the double thicknesses tend to move in opposite directions so that a firm grip is obtained resisting separation of the eyeletted edges.

For inserting the tips of the lace a second time in the last pair of eyelets operated upon, the shapes of the cams on the shaft **30** are changed somewhat from those indicated in Fig. 49 to provide the additional movements required in the operating devices. In order to simplify the completion of the lacing, the cams for actuating the gripper levers and gripper lever carriers are cut to cause one tip of the lace to be inserted and withdrawn from both eyelets of the last pair before the other tip is inserted in the first eyelet. For the upper supporting slide cam, the slide is retained for a longer time with the final pair of eyelets in line with the tip engaging grippers than indicated in the chart. Additional motions also are imparted to the gripper levers for moving them towards and from the upper, to the carriers **122** and **140** to swing the gripper levers right or left, to the gripper jaws to grasp and release the tips of the lace and to the take-ups for corresponding operations. However, it is unnecessary to rotate the spindles **82** when inserting the tip of the lace a second time in the last laced eyelets.

With the lacing fastened in place in this way, the spacings between the eyelets in the upper as secured in the upper clamp are retained when the upper is applied to a last. It is therefore evident that the upper being laced in opened out position is presented to the machine with the eyeletted edges in the same relation as when lasted. This arrangement is an advantage because the upper is visible before starting the machine and may be adjusted to suit the lasting conditions without the use of special devices in the machine for measuring the length of lace between eyelets. The effective length of lacing thus is inserted automatically with the proper maximum spacings between eyelets for lasting operations.

Referring to Figs. 3 to 6 inclusive, the driving and stopping mechanism comprises a cylindrical block **375** keyed to the sprocket sleeve **50** on the shaft **52**, a cup-shaped pulley **376** also rotatable on the shaft **52** partially surrounding the block **375**. A clutch bar **378** is mounted to slide axially in the block **375** and arranged with a transverse pin **380** (see Fig. 6) acted upon by a spring **382** received in a passage in the block **375** to press the bar into the path of a series of headed studs **384** within the hollow portion of the pulley **376**. When the clutch bar is moved into the path of the studs **384**, the block **375** is rotated with the pulley **376**.

To bring the machine to rest, the clutch bar **378** has secured to one end a cam plate **385** engaged by the upper end of a locking bolt **386** slidingly mounted in a bracket **388** on the plate **54**. The locking bolt **386** is surrounded by a coil spring **390** compressed between the bracket **388** and the perforated end of an L-shaped releasing bar **392** secured to the locking bolt, the spring **390** acting to raise the locking bolt into the path of the cam plate **385**. As the block **375** rotates, the cam plate **385** engages the locking bolt **386** and causes the clutch bar **378** to be disengaged from the studs **384** on the pulley **376**, as indicated by the full line position of Fig. 6. Engagement of the cam plate **385** with the locking bolt **386** not only withdraws the clutch bar from the studs **384**, but stops rotation of the block **375** on the shaft **52**, the plate being provided with an abutment for this purpose. To prevent rebound and reverse rotation of the block after the cam plate engages the locking bolt, there is a spring-pressed plunger **394** mounted in the block **375** serving as a latch for the locking bolt to be depressed by the locking bolt as it engages the cam plate.

To start the machine in operation, the locking bolt is depressed against the action of the spring **390** by a treadle connected rod **396** having its upper right angle end inserted in an opening in the L-shaped bar **392**, releasing the clutch bar towards the dot-dash position of Fig. 6. As soon as the machine starts in operation as a result of contact between the clutch bar and studs **384**, a notch in a disk **398** secured to the cam shaft **30** moves out of line with the upper end of the L-shaped bar **392** and prevents the locking bolt from again being raised by the spring **390** until the lacing is completed. The operator then may release the treadle actuated rod **396** and the machine will continue in operation for a full 360° rotation of the cam shaft. At the end of the cam shaft rotation, the notch in the disk **390**

comes into alignment with the upper end of the L-shaped bar **392**, allowing the locking bolt to be raised and the machine brought to rest.

After the lasting operation is completed, the last **13** is removed from the shoe by hand or by a last pulling machine of the type disclosed in U. S. Letters Patent to Whelton et al. No. 1,820,952 of September 1, 1931, a hinge **400** in the last being broken to facilitate removal, as indicated in Fig. 51. When the hinge is broken and the last drawn slightly towards the heel end of the shoe, as illustrated in this figure, the lacing may be loosened as much as necessary to remove the last fully from the completed shoe. In this condition, the shoe presents a salable appearance and is ready for use, the lacing being loosened further when necessary or tightened somewhat for display purposes without any additional handling operations being required.

By the practice of the method herein disclosed, not only is an entire lacing operation eliminated from the manufacturing steps heretofore employed, but since it has been found possible to remove the last without cutting the lacing, as ordinarily required where a tight knot is tied between the ends of a lasting lacing composed of several strands of relatively fine cord, the difficulty ordinarily attendant in removing the loose ends of severed lacing also is avoided. A further advantage in using the dress type lace **2** for lasting purposes is that this type of lace, composed of woven material, is larger and stronger than the ordinary cord lacing heretofore employed, and as a result, will withstand the strains produced during lasting operations better without tendency to mark the upper or slip through the eyelets. By employing a dress type of lace for lasting operations, the expense of the higher grade material is avoided, further use being made of the lace after the shoe is completed.

Certain features of the invention herein disclosed, relating to a method of making shoes and a shoe upper employing a lacing inserted by the machine of the present claims, form the subject matter of a divisional application, Serial No. 558,771, filed October 14, 1944.

The nature and scope of the invention having been indicated and a particular embodiment thereof having been specifically described, what is claimed is:

1. In a shoe upper lacing machine employing a flexible lace provided with permanent, relatively rigid terminal tips for projection through the eyelets in an upper to connect the edges of the upper along its lacing slit, the combination with upper supporting means, of tip engaging members on opposite sides of the supported upper, and means for actuating said members alternately to insert end first the tip of a lace into an eyelet from one side of the upper and to withdraw the tip from the other side of the upper.

2. In a shoe upper lacing machine employing flexible laces provided with permanent, relatively rigid terminal tips for projection without separate support through the eyelets in an upper to secure together the edges of the upper along its lacing slit, the combination with an upper clamp, of tip engaging members at opposite sides of an upper in the clamp, and mechanisms for actuating the tip engaging members comprising levers and gear segments for connecting the levers for simultaneous movement towards and from the upper to carry the lace from one eyelet to another.

3. In a shoe upper lacing machine employing flexible laces provided with permanent terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of tip engaging members at opposite sides of an upper in the clamp, and mechanisms for actuating the members to insert both tips of a lace simultaneously in separate eyelets in the upper and to withdraw the tips from the eyelets.

4. In a shoe upper lacing machine for inserting a flexible lace provided with permanent, relatively rigid terminal tips for projection through the eyelets in an upper, the combination with an upper clamp, of tip engaging grippers, and mechanisms for actuating one of the grippers at one side of an upper in the clamp to insert the free end of a tip into a first eyelet, and for actuating another of the grippers at the other side of the upper to withdraw the tip from the first eyelet, and thereafter to bend the lace back on the tip and insert the bent-back portion ahead of the tip into a second eyelet.

5. In a shoe upper lacing machine for inserting a flexible lace provided with a pair of permanent terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of tip engaging grippers constructed and arranged to grasp the end of each tip leaving a substantial length of the tip exposed, and mechanisms for actuating one of the grippers to project the exposed length of each tip through an eyelet from one side of an upper secured in the clamp and for actuating another gripper to grasp and withdraw the exposed length of tip from the other side of the upper successively through a plurality of operations while maintaining the grasp on the tip obtained in transferring the tip from one gripper to another.

6. In a shoe upper lacing machine for inserting a flexible lace provided with a pair of permanent terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of tip engaging grippers constructed and arranged to grasp the end of each tip leaving a substantial length of the tip exposed, mechanisms for actuating one of the grippers to project the exposed length of each tip through an eyelet from one side of an upper secured in the clamp, for actuating another gripper to grasp and withdraw the exposed length of the projected tip from the other side of the upper and thereafter for reversing the operation while maintaining the grasp on the tip obtained in transferring the tip from one gripper to another, and stop means on at least one of the grippers for preventing projection of each tip within the grippers beyond a point where the tip cannot again be grasped at the opposite side of the upper by another gripper.

7. In a shoe upper lacing machine for inserting a flexible lace provided with a pair of permanent terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp arranged to secure the sides of an upper in opened-out position, of tip engaging grippers, mechanism for actuating the grippers to project the tips through a plurality of eyelets at a time while maintaining the grasp on the tips obtained in transferring the tips from one set of eyelets to another with portions of the lace outside the upper crossing at right angles to the eyeletted edges and in parallel relation to each other, and mechanism for shifting the clamp and

grippers relatively to each other to cause the lace portions at the inside of the upper to cross each other and the eyeletted edges.

8. In a shoe upper lacing machine for inserting a flexible lace provided with a pair of permanent terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a main operating shaft, an upper clamp, tip engaging grippers at opposite sides of an upper secured in the clamp, mechanisms driven from the operating shaft for actuating the grippers towards and from alignment with the eyelets while the upper and clamp remain fixed in position, and other mechanism driven from the shaft to cause each gripper at one side of the upper to grasp a tip carried by a gripper at the other side of the upper and to transfer the tip to another gripper, maintaining the grasp on the tip obtained in transferring the tip from one gripper to another.

9. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of tip engaging grippers and mechanism for actuating the grippers to transfer the tip of a lace from one eyelet to another in an upper secured in the clamp and to thread the tip through the eyelets, and mechanism for rotating one of the grippers to take out the twist produced in the lace as a result of transferring the tip from one eyelet to another.

10. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of a first tip engaging gripper at one side of the upper secured in the clamp and a second tip engaging gripper at the other side of the upper, mechanism for actuating the first gripper to insert the tip of lace into an eyelet in the upper and for actuating the second gripper to withdraw the tip from the eyelet and to insert that end of the tip which is connected to the lace together with a reversely bent portion of the lace connecting the tip into another eyelet, and for actuating the first gripper to withdraw the bent lace and tip from said last-mentioned eyelet, and mechanism for rotating one of the grippers to take out the twist produced in the lace as a result of straightening the bent portion of the lace.

11. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp arranged to secure the sides of an upper in opened-out position, of a slide on which the clamp is mounted, tip engaging grippers, a carrier on which the grippers are mounted for movement transverse to the movement of the upper clamp slide, and mechanisms for actuating the slide and carrier relatively to each other to transfer the tip of a lace from alignment with one eyelet in an upper secured in the clamp into alignment with other eyelets in a predetermined order.

12. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp arranged to secure the sides of an upper in opened-out position, of tip engaging grippers at opposite sides of an upper secured in the clamp, gripper supporting levers, separate shafts on which the gripper levers are mounted for movement towards and from the upper, and connections between the grippers for actuating them simultaneously to positions in which the tip of a lace is transferred from one gripper to another.

13. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp arranged to secure the sides of an upper in opened-out position, of tip engaging grippers at opposite sides of an upper secured in the clamp, separate shafts on which the grippers are mounted for movement towards and from the upper, a carrier pivoted at right angles to said shafts for supporting the shafts, and connections in the carrier between the grippers to cause the grippers to move towards and from the upper together in any position of the carrier.

14. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp arranged to secure the sides of an upper in opened-out position, of two pairs of tip engaging grippers, each pair having individual grippers disposed at opposite sides of an upper secured in the clamp, separate carriers for supporting each pair of grippers, shafts in the carriers on which the grippers are mounted for movement towards and from the upper, and connections in each carrier between the grippers to cause the grippers of each pair to move together towards or from the upper in any position of the respective carrier.

15. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp arranged to secure the sides of an upper in opened-out position, of tip engaging grippers at opposite sides of an upper secured in the clamp, separate shafts on which the grippers are mounted for movement towards and from the upper, a carrier for supporting the shafts, a pivot about which the carrier is rotatable about an axis at an angle to said shafts, mechanism for actuating the grippers towards and from an upper secured in the clamp, and connections between said mechanism and grippers including joints substantially in alignment with the pivot for the carrier.

16. In a shoe upper lacing machine, the combination with an upper clamp arranged to secure the side portions of a shoe upper adjacent the eyeletted edges in an opened-out position with eyelets disposed in opposite sides of the upper spaced apart, of lacing devices, and mechanism for actuating said devices to insert a lace passing through eyelets on opposite sides of an upper secured in said clamp and across the lacing slit.

17. In a shoe upper lacing machine, the combination with an upper clamp arranged to secure the side portions of a shoe upper adjacent the eyeletted edges in an opened-out position with eyelets disposed in opposite sides of the upper spaced apart, of lace inserting members, and a centralizing plate against which the eyeletted edges of the upper are brought to locate the upper on the upper clamp in operating relationship with the inserting members before the upper is clamped.

18. In a shoe upper lacing machine, the combination with an upper clamp arranged to secure the side portions of a shoe upper adjacent the eyeletted edges in an opened-out position with

eyelets disposed in opposite sides of the upper spaced apart, of lace inserting members, and a centralizing plate and gages against which the eyeletted edges of the upper and the ends of the eyeletted edges at the angle opening of the upper are brought to locate the upper in operating relationship with the lace inserting members before the upper is clamped.

19. In a shoe upper lacing machine, the combination with an upper clamp arranged to secure the side portions of a shoe upper adjacent the eyeletted edges in an opened-out position with eyelets disposed in opposite sides of the upper spaced apart, of lacing devices, mechanism for actuating said devices to insert a lace passing through eyelets on opposite sides of an upper secured in said clamp and across the lacing slit, and means for imparting a step-by-step movement to the clamp in a direction lengthwise of the lacing slit to locate the eyelets successively in alignment with the lacing devices.

20. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp, of a pair of tip engaging grippers, one of which is disposed at one side of an upper secured in the frame, and the other of which is disposed at the other side of the upper to transfer the tip of a lace through an eyelet in the upper from one gripper to the other of the pair, and mechanism for rotating one of the grippers of the pair relatively to the other through substantially a complete 360° rotation.

21. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp, of a pair of tip engaging grippers, one of which is disposed at one side of an upper secured in the clamp, and the other of which is disposed at the other side of the upper to transfer the tip of a lace through an eyelet in the upper from one gripper to the other of the pair, a reciprocating rack and gear teeth on one of the grippers for rotating the gripper to impart a twist in the tip of a lace held thereby.

22. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp, of a pair of tip engaging grippers, one of which is disposed at one side of an upper secured in the clamp, and the other of which is disposed at the other side of the upper to transfer the tip of a lace through an eyelet in the upper from one gripper to the other of the pair, and mechanism acting while a lace tip remains within an eyelet to rotate the gripper in which the tip is held.

23. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp, of a pair of tip engaging grippers, one of which is disposed at one side of an upper secured in the clamp, and the other of which is disposed at the other side of the upper to transfer the tip of a lace through an eyelet in the upper from one gripper to the other of the pair, mechanism for actuating the grippers simultaneously towards and from the upper, mechanism for actuating one gripper of the pair to grasp and release a lace tip in any relative position of the grippers, and mechanism for actuating the other gripper of the pair to grasp and release the tip only when moved into a position close to the upper.

24. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp, of a pair of tip engaging grippers, one of which is disposed at one side of an upper secured in the clamp, and the other of which is disposed at the other side of the upper to transfer the tip of a lace through an eyelet in the upper from one gripper to the other of the pair, means for rotating one of the grippers, and movable and stationary jaws on each gripper for grasping and releasing the tips of the lace, the stationary ones of which are located at the same side of the tip while transferring the tip from one gripper to another to insure alignment of the tip with the jaws.

25. In a shoe upper lacing machine for inserting a flexible lace provided with terminal tips to permit projection through the eyelets in an upper, the combination with an upper clamp, of tip engaging grippers, mechanisms for actuating one of the grippers at one side of an upper secured in the clamp to insert a tip into one of the eyelets at a time and for actuating another of the grippers at the other side of the upper to withdraw the tip from the eyelet, a take-up, and mechanism for actuating the take-up alternately in opposite directions to draw through each eyelet that portion of the lace remaining slack after the tip has been withdrawn.

26. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of tip engaging grippers and mechanism for actuating the grippers to thread the tip of a lace successively through a series of eyelets in an upper secured in the clamp by transferring the tip through one eyelet at a time, first from one side of the upper and then by withdrawing it from the other side and then inserting a bent over portion of the lace ahead of said tip into a second eyelet in the opposite direction, and take-ups at opposite sides of the upper for drawing the slack in the lace through each separate eyelet in either of two directions between the upper and the tip after the tip is withdrawn from the eyelet.

27. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets along the edges of the lacing slit in an upper, the combination with an upper clamp, of tip engaging grippers and mechanism for actuating the grippers to thread the tip of a lace successively through eyelets in an upper secured in the clamp by projecting the tip through one eyet at a time, first from one side of the upper and by withdrawing it from the other side and then projecting a bent over portion of the lace ahead of said tip through a second eyelet in the opposite direction, and take-ups actuated in planes parallel to the sides of the upper away from the lacing slit in one direction between the upper and the tip after being withdrawn to take out slack in the lace at the first-mentioned side of the upper and to draw the slack through the first-mentioned eyelet and away from the lacing slit in the other direction to draw the slack

through the second-mentioned eyelet after the tip is withdrawn therefrom.

28. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets along the edges of the lacing slit in an upper, the combination with an upper clamp, of a tip engaging gripper at one side of an upper secured in the clamp, mechanism for actuating the gripper to insert the tip into one only of a series of eyelets from one side of the upper, a tip engaging gripper at the other side of the upper, mechanism for actuating the second-mentioned gripper to withdraw the tip from said one eyelet, a take-up acting within a plane parallel to a side of the upper away from the lacing slit to draw that portion of lace remaining slack through said eyelet after the tip has been withdrawn, and means movable in the same plane to prevent the slack from working its way back through the eyelet after the take-up has acted.

29. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets along the edges of the lacing slit in an upper, the combination with an upper clamp, of a tip engaging gripper at one side of an upper secured in the clamp, mechanism for actuating the gripper acting to insert the tip into one only of a series of eyelets from one side of the upper, a tip engaging gripper at the other side of the upper, mechanism for actuating the second-mentioned gripper to withdraw the tip from said one eyelet and to insert a bent over portion of the lace ahead of the tip into another eyelet, a take-up acting within a plane parallel to the side of the upper away from the lacing slit to draw that portion of lace remaining slack through certain eyelets after the tip has been withdrawn, and a retarding member acting in the same plane to prevent displacement of the lace after being drawn through an eyelet by the take-up.

30. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp for securing an upper, of two pairs of tip engaging grippers, each pair having individual grippers disposed at opposite sides of an upper secured in the clamp, mechanisms for actuating the grippers to transfer both tips of a lace through separate eyelets in the upper, and a take-up at each side of the upper acting to draw that portion of lace remaining slack through one eyelet in one direction and from another eyelet in another direction between the upper and each tip after being withdrawn from said eyelet.

31. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with a clamp, of two pairs of tip engaging grippers, each pair having individual grippers disposed at opposite sides of an upper secured in the clamp for transferring both tips of a lace through the eyelets of the upper from one gripper to another of the pair, a take-up at each side of the upper, and mechanisms for actuating each take-up in one direction to draw that portion of lace remaining slack through an eyelet along one edge of the upper and in the other direction to draw the slack portion of lace through an eyelet along the other edge of the upper.

32. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of a tip engaging gripper at one side of an upper secured in the clamp, mechanism for actuating the gripper to insert the tip into one only of a series of eyelets from one side of the upper, a tip engaging gripper at the other side of the upper, mechanism for actuating the second-mentioned gripper to withdraw the tip from said one eyelet, a take-up acting on the portion of lace at that side of the upper from which the tip is withdrawn to form a loop in the lace and to draw that portion of lace remaining slack at the other side of the upper through said eyelet, and a retarding member actuated in one direction by engagement with the take-up while drawing the slack out of the lace and held frictionally against movement with the take-up in the other direction to hold the loop formed by the take-up against displacement while being drawn through the next eyelet of the series.

33. In a shoe upper lacing machine employing flexible laces provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of a tip engaging gripper at one side of an upper secured in the clamp, mechanism for actuating the gripper acting to insert the tip into one of a series of eyelets from one side of the upper, a tip engaging gripper at the other side of the upper, mechanism for actuating the second-mentioned gripper to withdraw the tip from said one eyelet, a take-up acting on the portion of lace at that side of the upper from which the tip has been withdrawn to form a loop in the lace and to draw that portion of lace remaining slack through said eyelet after the tip has been withdrawn, and a pair of retarding members actuated one in one direction and the other in the other direction by the take-up while drawing the slack through an eyelet and held frictionally against return movement with the take-up to hold the loop formed by the take-up against displacement after being drawn through said eyelet.

34. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of a tip engaging gripper at one side of an upper secured in the clamp, mechanism for actuating the gripper to insert a tip into one of a series of eyelets from one side of the upper, a tip engaging gripper at the other side of the upper, mechanism for actuating the second-mentioned gripper to withdraw the tip from said one eyelet, a take-up acting to draw that portion of lace remaining slack through said eyelet after the tip has been withdrawn, and a frictionally restrained retarding member arranged to enter a bight in the lace formed by the take-up as the lace is being drawn by the take-up through the eyelet.

35. In a shoe upper lacing machine employing a flexible lace provided with terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp, of a tip engaging gripper at one side of an upper secured in the clamp, mechanism for actuating the gripper to insert a tip into one of a series of eyelets from one side of the upper, a tip engaging gripper at the other side of the upper, mechanism for actuating the second-mentioned gripper to withdraw the tip from said one eyelet, a forked take-up acting to draw that portion of lace remaining slack through an eyelet

after the tip has been withdrawn, and a retarding member entering between the fork portions of the take-up to prevent displacement of the lace after being drawn through the eyelet.

36. In a shoe upper lacing machine, the combination with means for supporting an eyeletted shoe upper in opened-out position with its edges along the lacing slit spaced apart, of means for inserting alternately both ends of a single length of lace through the eyelets comprising means for passing one end of the lace successively through a plurality of the eyelets and across the lacing slit, and means for pulling through an eyelet the slack in the lace before passing the end of the lace through another eyelet.

37. In a shoe upper lacing machine, the combination with means for supporting an eyeletted shoe upper in opened-out position with its edges along the lacing slit spaced apart, of means for inserting alternately both ends of a single length of lace through the eyelets comprising means for passing each end of the lace successively through a plurality of the eyelets and across the lacing slit, and means acting between successive passages to pull the slack in the lace through the last laced eyelet.

38. In a shoe upper lacing machine, the combination with means for supporting an eyeletted shoe upper in opened-out position with its edges along the lacing slit spaced apart, of means for passing one end of a single length of lace successively through a plurality of the eyelets and across the lacing slit to form a lacing, said means comprising lace engaging members on opposite sides of the supporting means movable towards and away from the upper, and means for actuating each member to engage the end portion of a lace passed through an eyelet by the other member and to bend over the end portion against the lace before passing said end portion through another eyelet.

39. In a shoe upper lacing machine employing a flexible lace provided with permanent terminal tips, the combination with means for supporting an eyeletted shoe upper, of two grippers for engaging the same tip of a lace successively, each gripper having relatively movable jaws, means for actuating said jaws to grip and release the said tip, and means for actuating the grippers to transfer the tip from one gripper to the other and to carry it through an eyelet.

40. In a shoe upper lacing machine for inserting a flexible lace provided with permanently connected terminal tips to permit projection without separate support through the eyelets in an upper, the combination with an upper clamp arranged to secure the sides of an upper in opened-out position, of tip engaging grippers, and mechanism for actuating the grippers to project a tip through one eyelet at a time, with portions of the lace outside the upper crossing the eyeletted edges.

41. In a shoe upper lacing machine, the combination with means for supporting an eyeletted shoe upper in opened-out position, of means for inserting a single predetermined length of lace through the eyelets, comprising means for gripping both ends of the lace and for passing them through a plurality of eyelets, and means for actuating the grippers to insert within an eyelet a bent over portion of the lace adjacent to one end of the lace ahead of the extreme end of the tip.

42. In a machine for inserting flexible laces into the eyelets along the lacing slit of a shoe upper, each lacing being provided at its ends with permanent, relatively rigid terminal tips, the combination with an upper clamp for securing the upper in lacing position, of two pairs of grippers for grasping both tips of a lace, and mechanisms for actuating each pair of grippers twice to insert and withdraw a tip from the upper before the other pair is actuated and thereafter for actuating the other pair of grippers twice.

43. In a machine for inserting flexible laces into the eyelets along the lacing slit of a shoe upper, each lacing being provided at its ends with permanent, relatively rigid terminal tips, the combination with an upper clamp for securing the upper in lacing position, of two pairs of grippers for grasping both tips of a lace, mechanisms for actuating each pair of grippers twice to insert and withdraw a tip from the upper before the other pair is actuated and thereafter for actuating the other pair of grippers twice, and take-up means for storing the slack in each end of the lace at one side of the upper while the tip connected to the other end is being inserted and withdrawn from the upper.

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