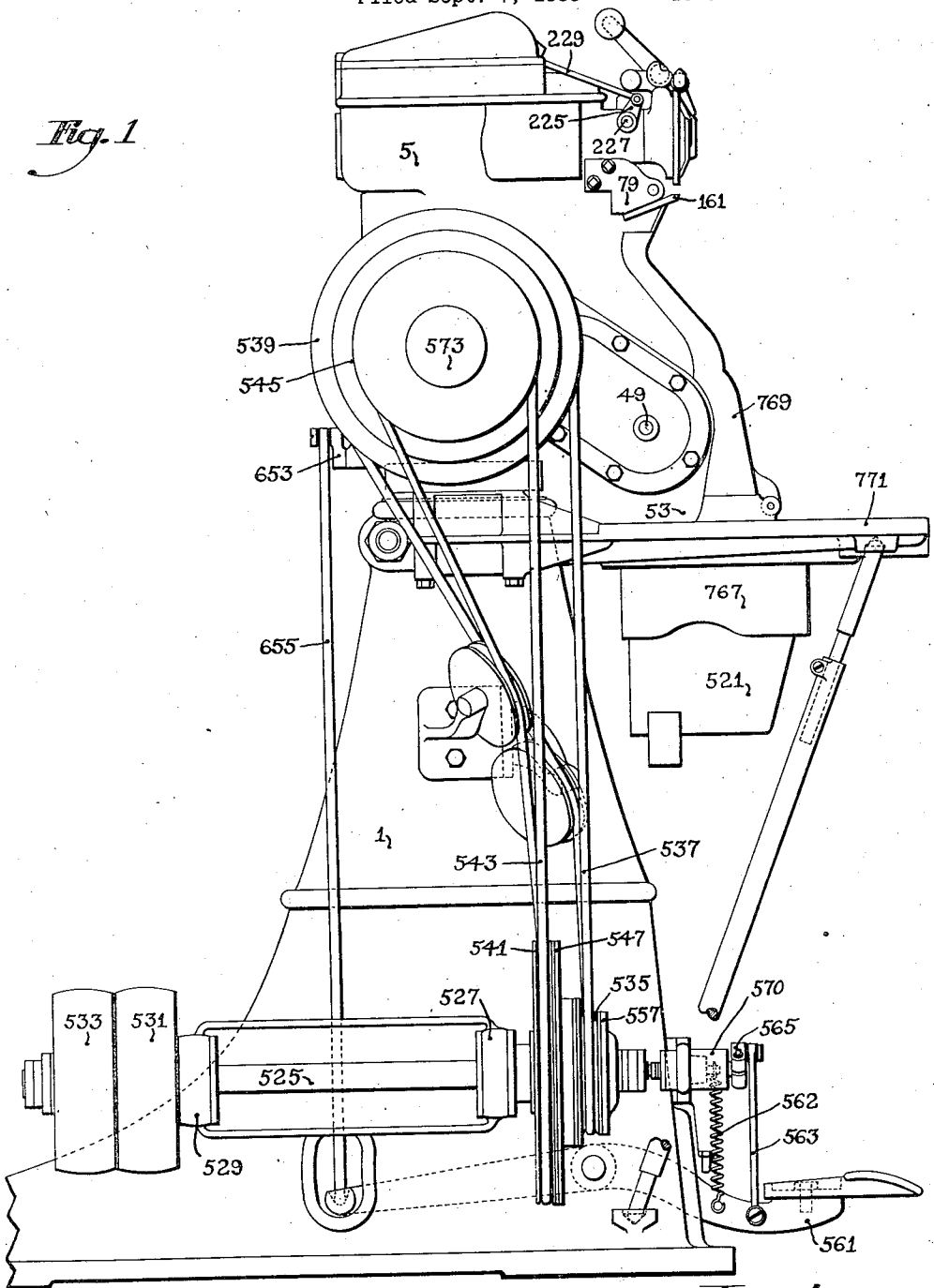
Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 1



Witness
H. E. Van Diner

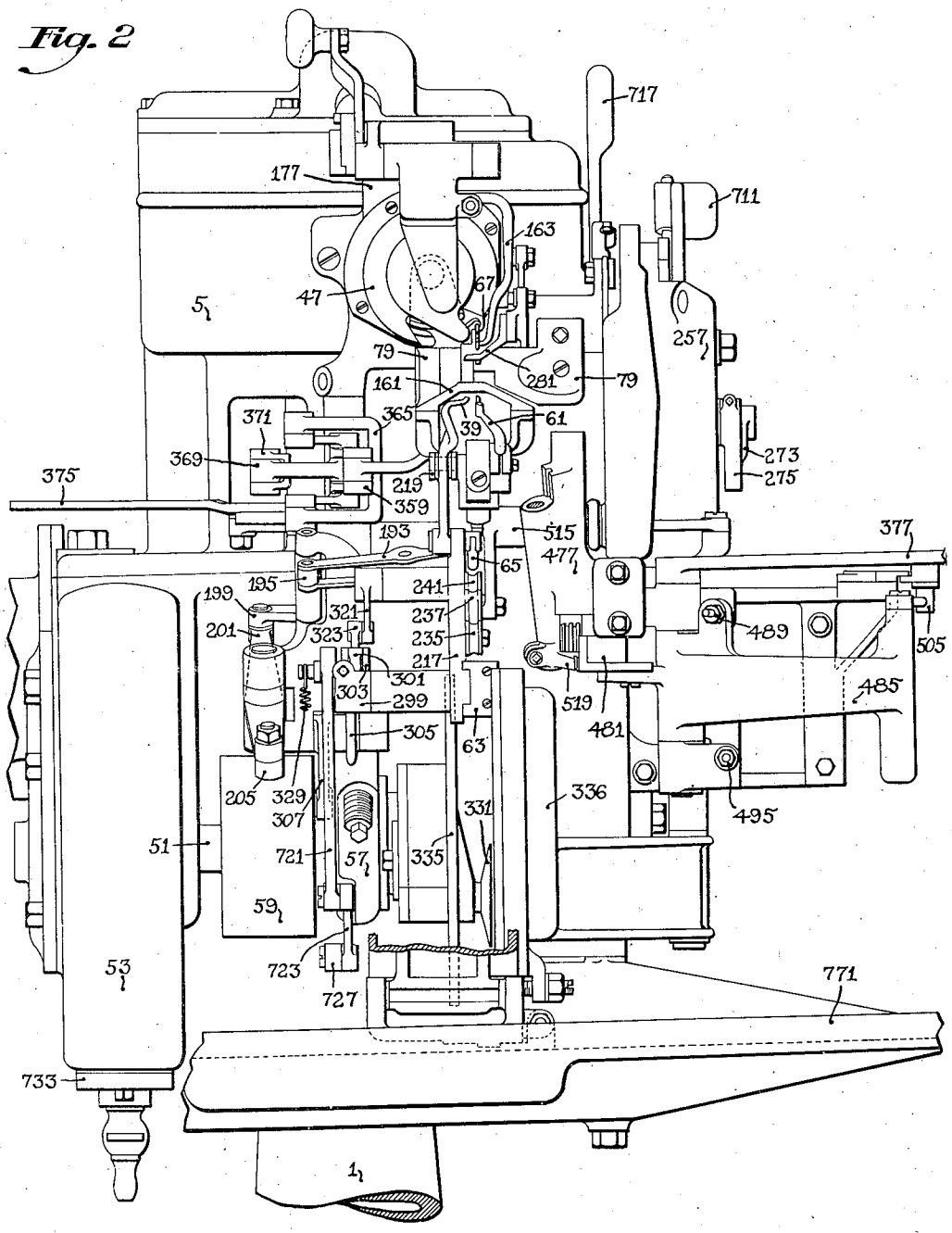
Inventors
Joseph Gouldbourn
Thomas A. Restall
Frank B. Reall
by Fish Hildreth Leary & Jenney, Attys

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 2



Witness
H. VanDine

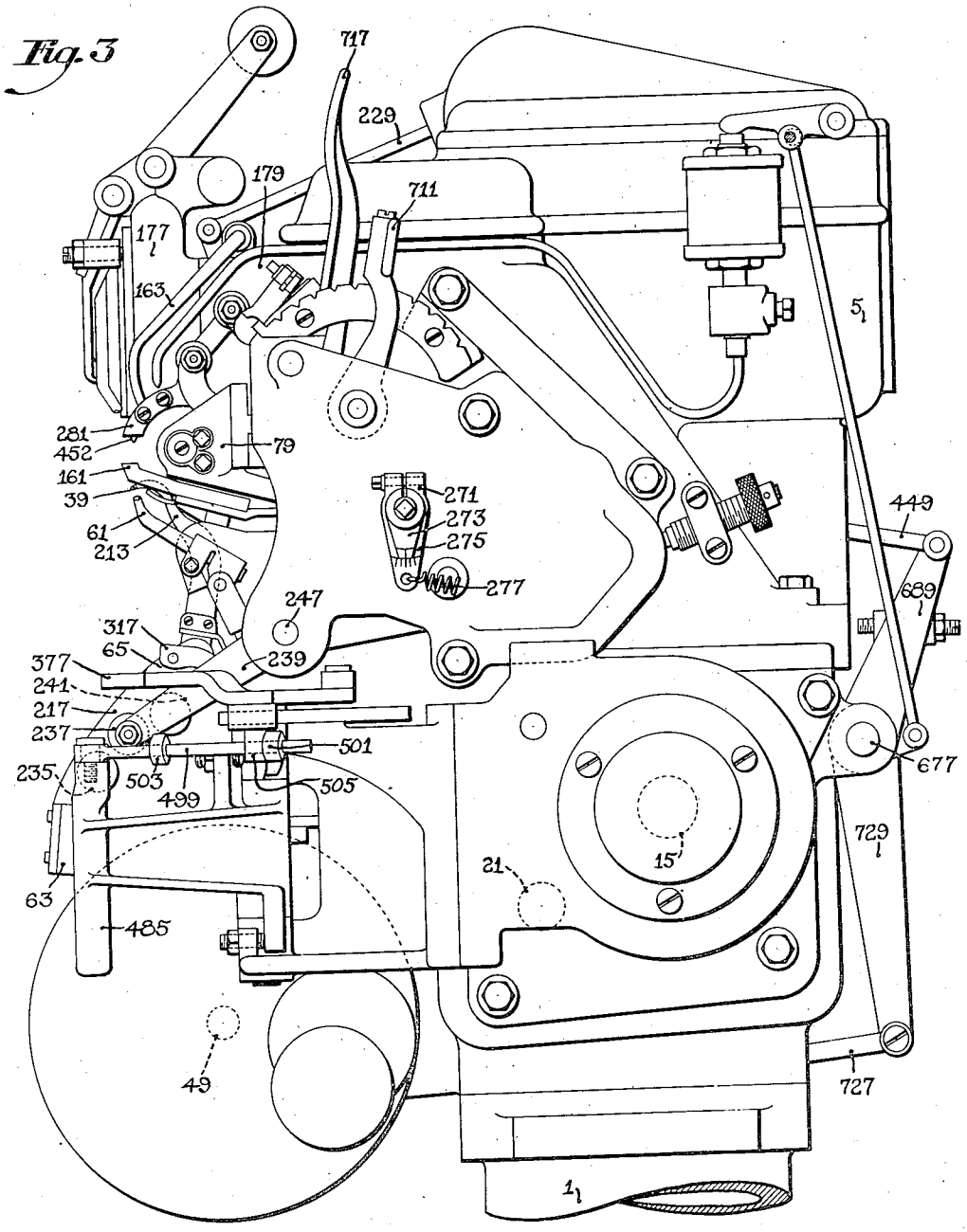
Inventors
Joseph Gouldbourn
Thomas A. Restell
Frank B. Keall
by Fish Hildreth
Casy & Jenney Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 3



Witness
H.E. Van Dine

Inventors
Joseph Gouldbourn
Thomas A. Kirtell
Frank B. Keall
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Cary & Jenney, Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

Filed Sept. 7, 1933 19 Sheets-Sheet 4

Fig. 4

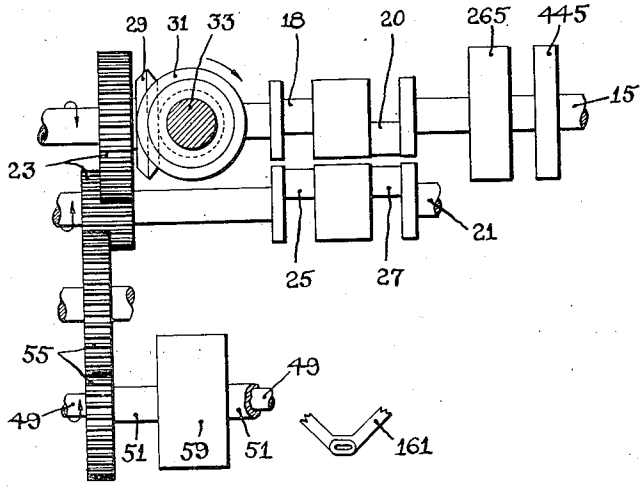
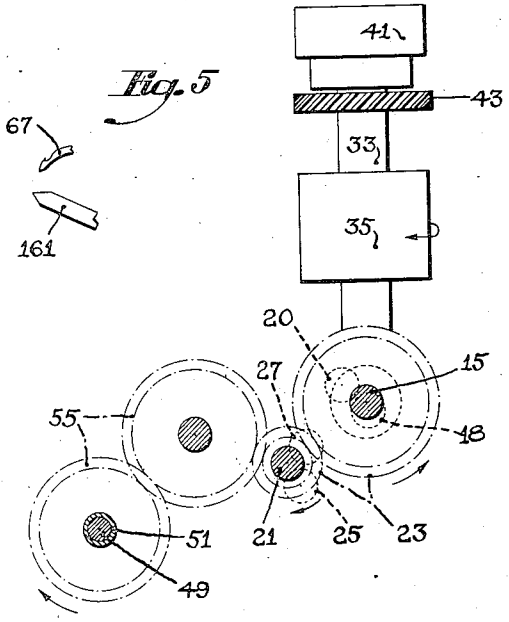


Fig. 5



Witness
H. E. Van Dine

Inventors
Joseph Gouldbourn
Thomas A. Keslell
Frank B. Keall
by Crisp Hildreth
Cary & Feaney Attys

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 7

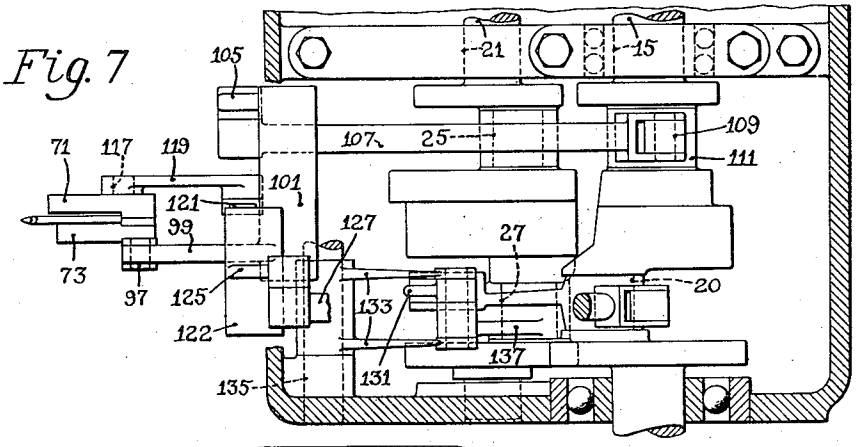
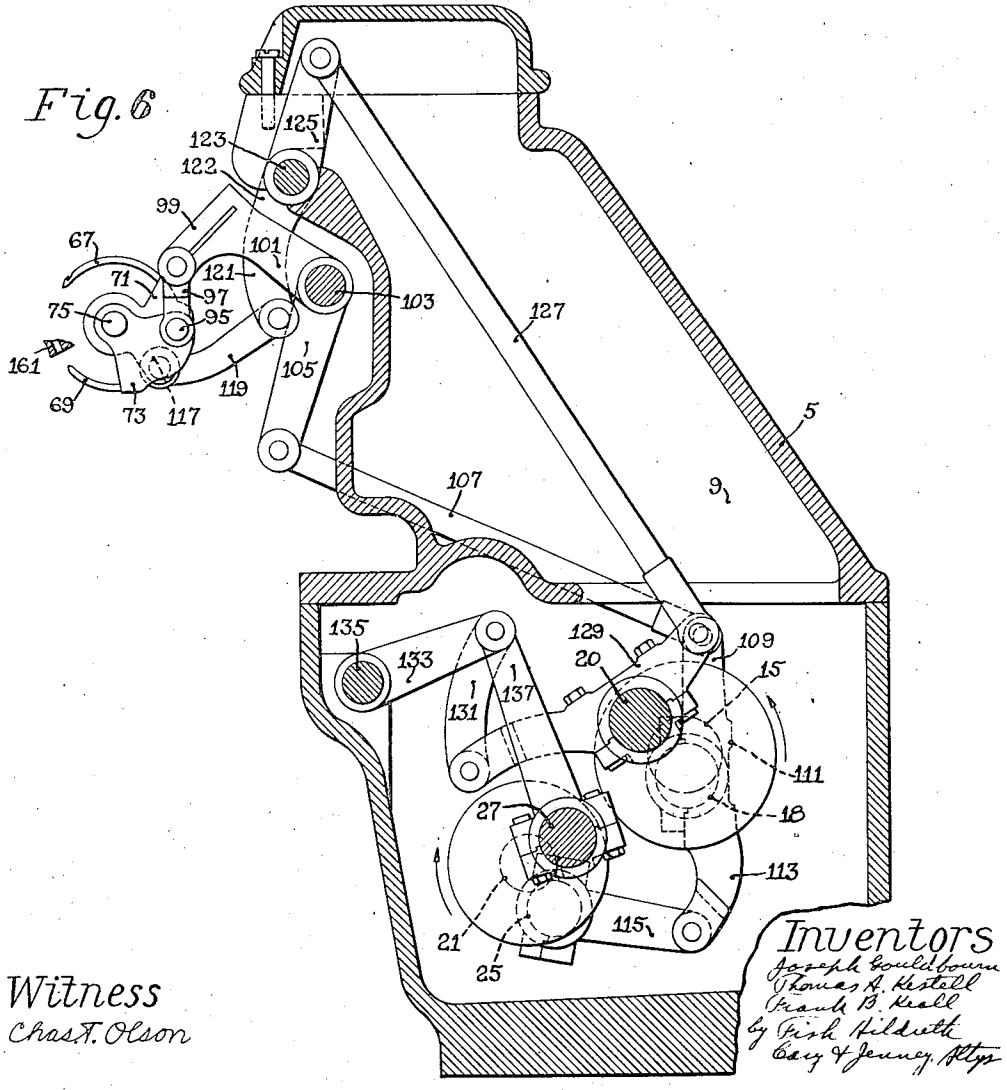


Fig. 6



Witness
Chas. T. Olson

Inventors
Joseph Gouldbourn
Thomas A. Hestell
Frank B. Keall
by Fish Hildreth
Esq & Jenney, Attys

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 9

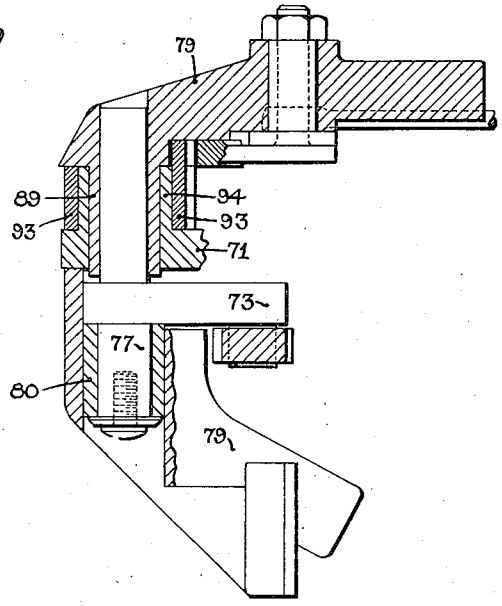


Fig. 10

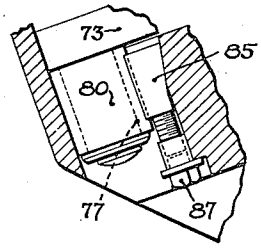


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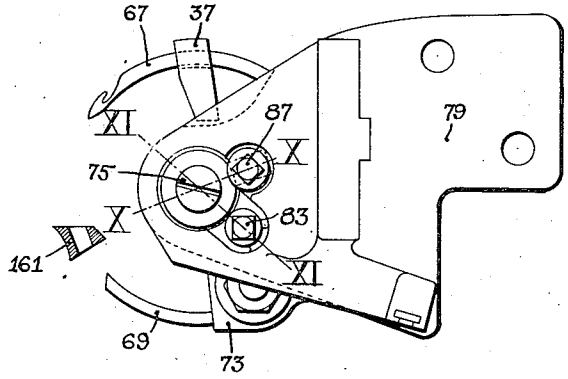


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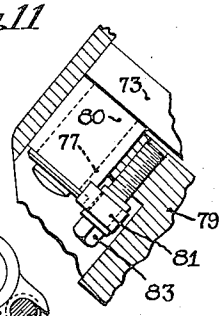
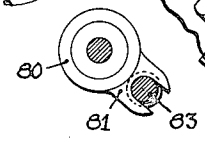


Fig. 12



Witness
H. C. Van Dine.

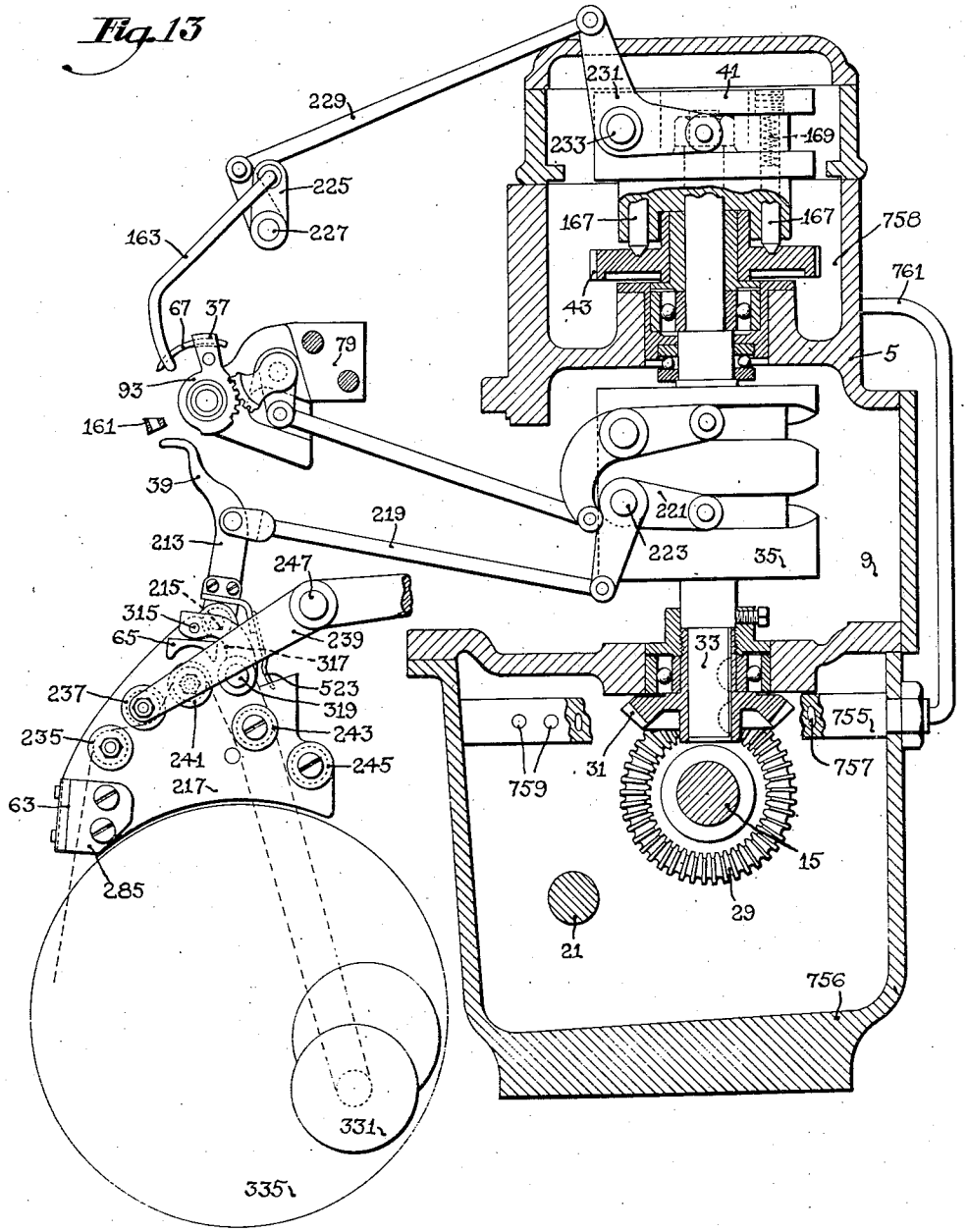
Inventors
Joseph Gouldbourn
Thomas A. Kestell
Frank B. Keall
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Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 13



Witness
H. E. Van Dine.

Inventors
Joseph Gouldbourn
Thomas A. Kestell
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Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 14

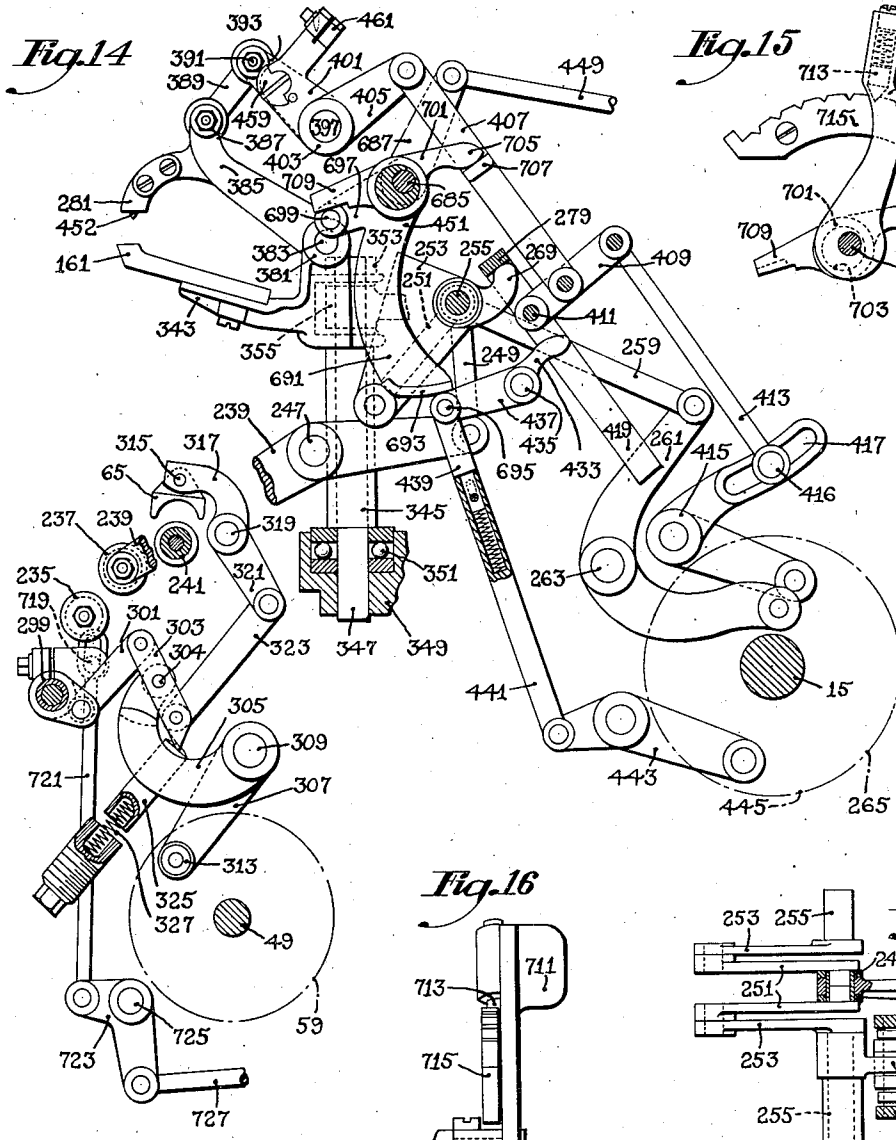
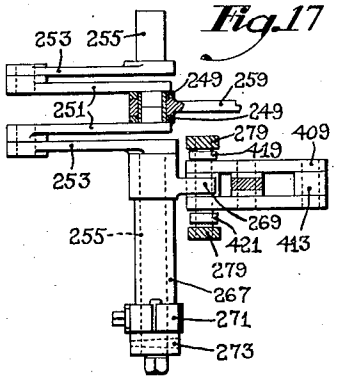


Fig. 15

Fig. 16

Fig. 17



Witness
H. E. Van Dine

Inventors
Joseph Gouldbourn
Thomas A. Kestell
Frank B. Keall
by Fish Hildreth
Esq & Jenney Attys

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 19

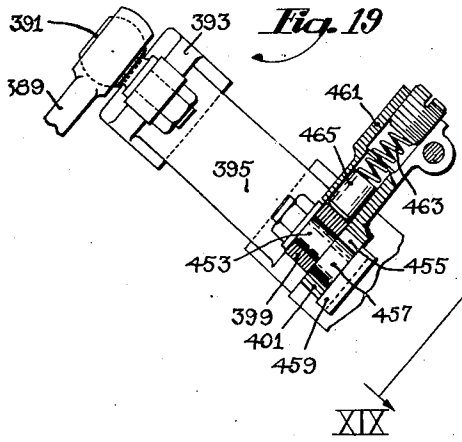


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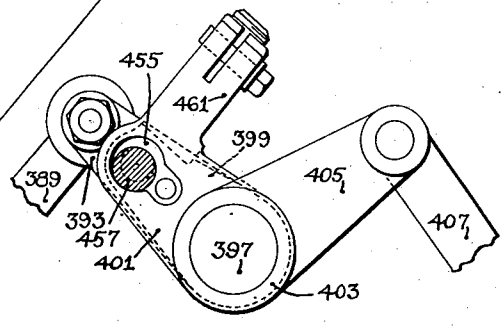


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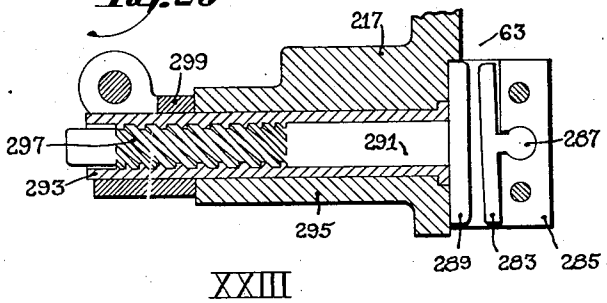


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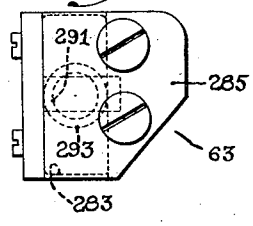


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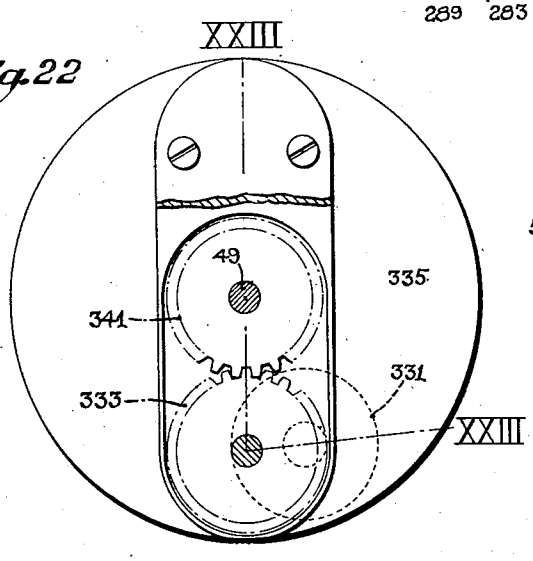
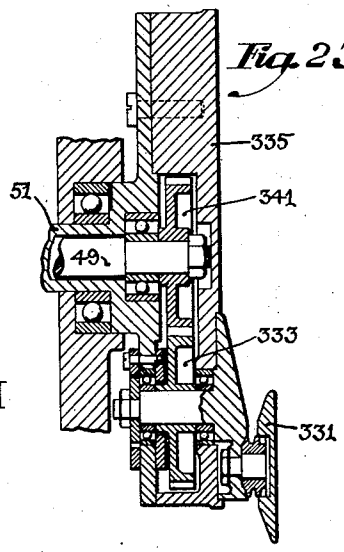


Fig. 23



Witness
H. E. Van Dine.

Inventors
Joseph Gouldbourn
Thomas A. Heathcote
Frank B. Keall
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Carey & Jenney, Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

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Fig. 25

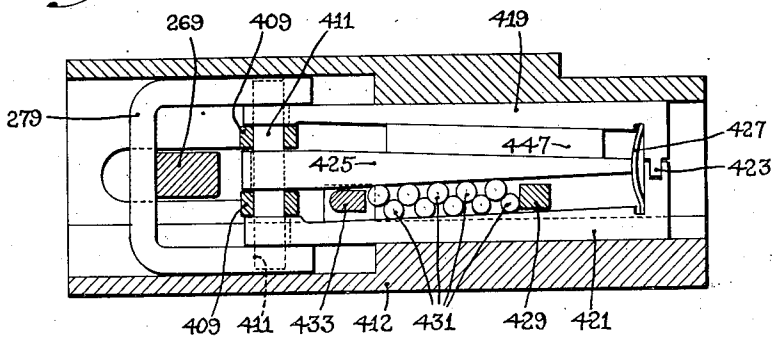
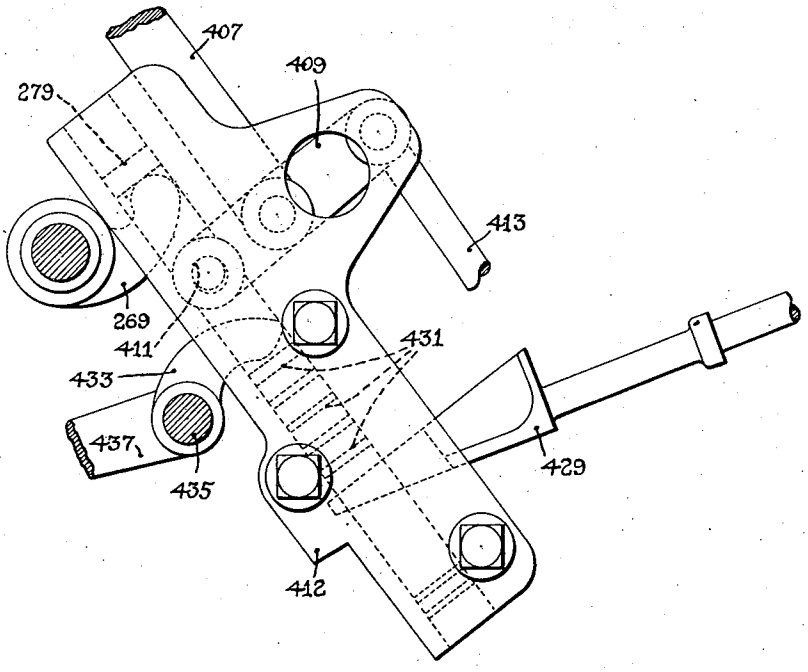


Fig. 24



Witness
H. E. Van Dine

Inventors
Joseph Gouldbourn
Thomas A. Kestell
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Cary & Jenney, Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

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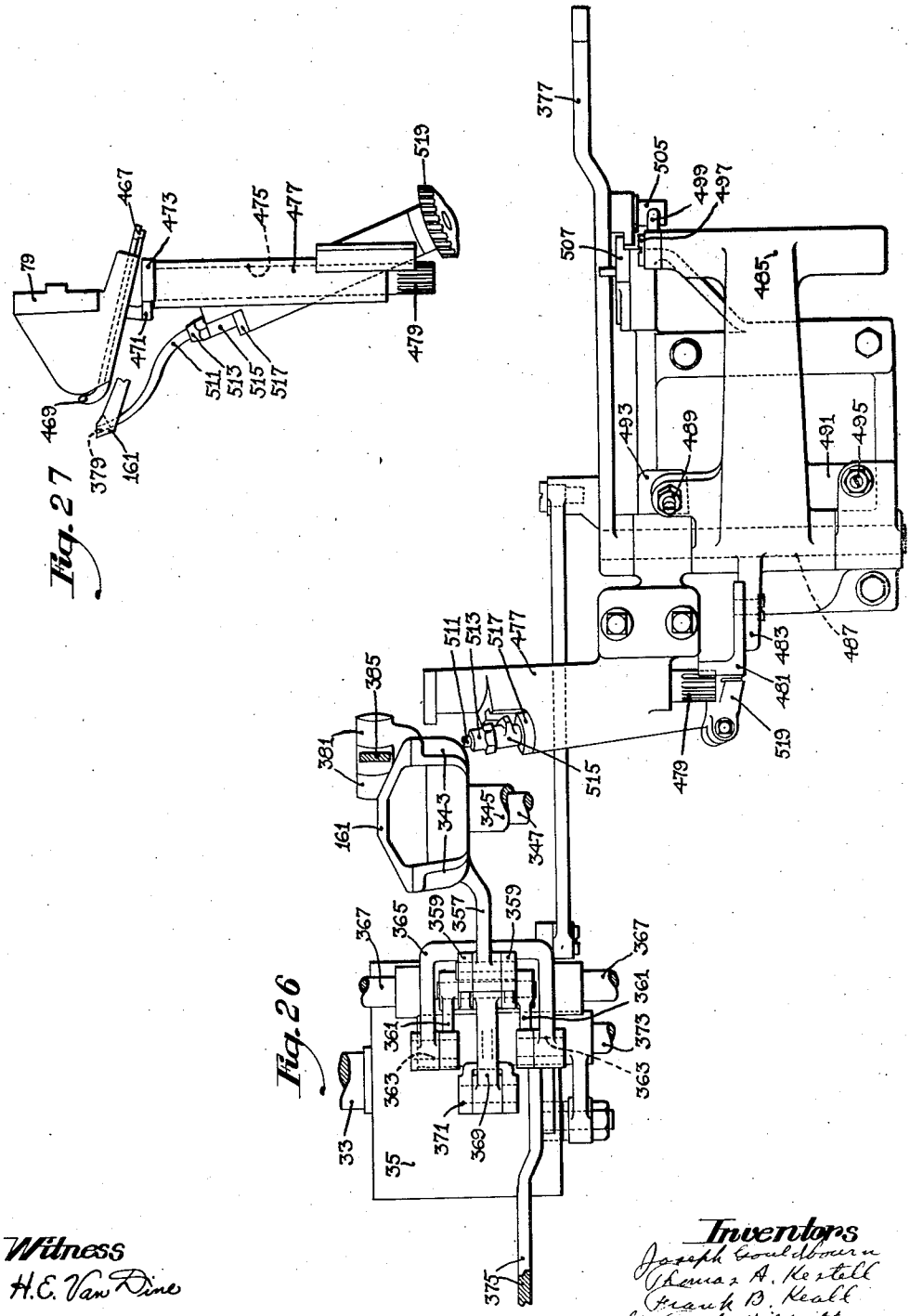


Fig. 27

Fig. 26

Witness
H. E. Van Dine

Inventors
Joseph Gouldbourn
Thomas A. Kestell
Frank B. Keall
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Cary & Jenney, Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

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Fig. 28

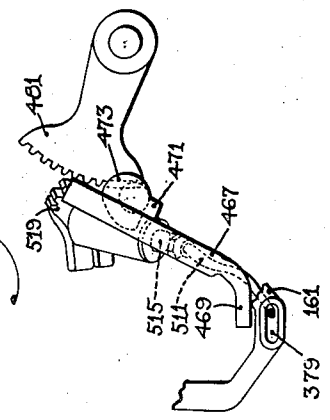


Fig. 29

Witness
H. E. Van Dine

Inventors
Joseph Gouldbourn
Thomas H. Kestell
Frank B. Keall
by Fish Gildersleeve
Cary & Jenney, Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

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Fig. 30

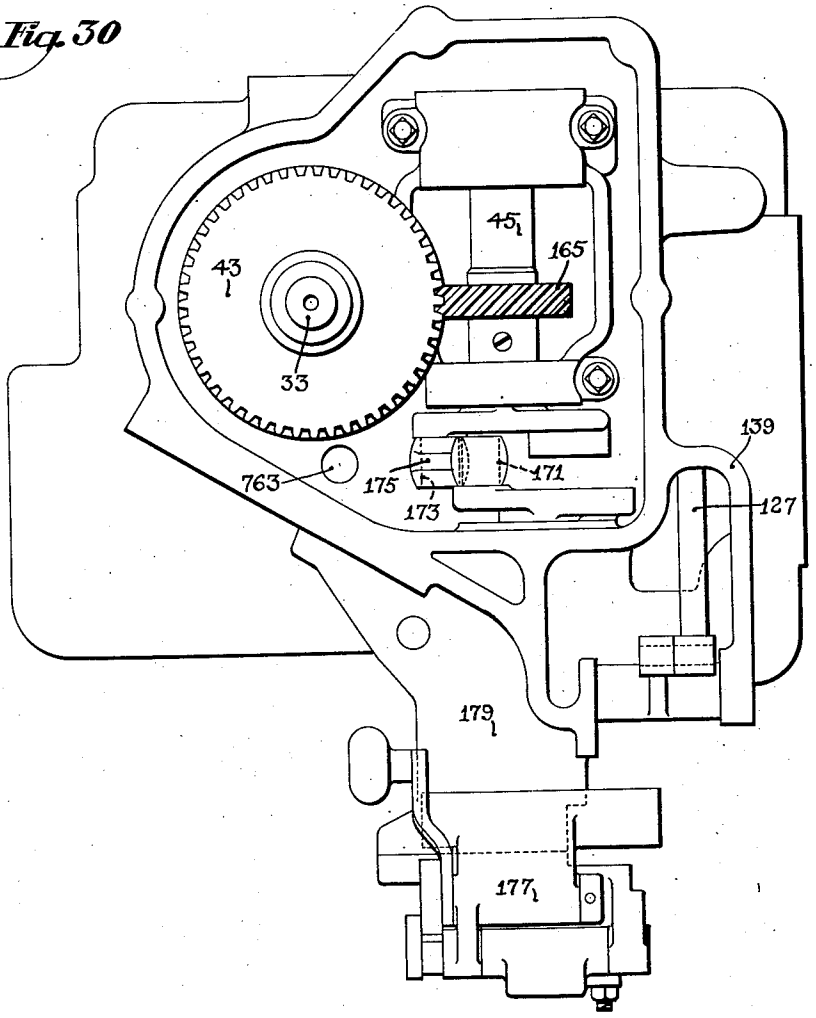
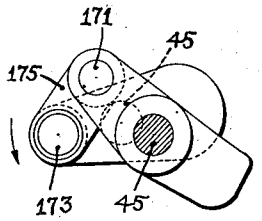


Fig. 31



Witness
H. E. Van Dine.

Inventors
Joseph Gouldbourn
Thomas A. Kestell
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Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 34

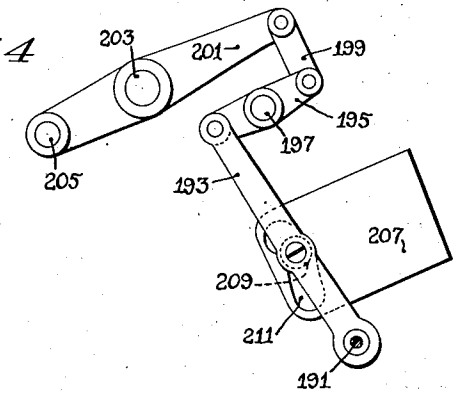


Fig. 35

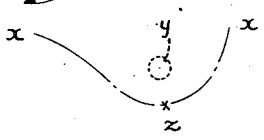


Fig. 33

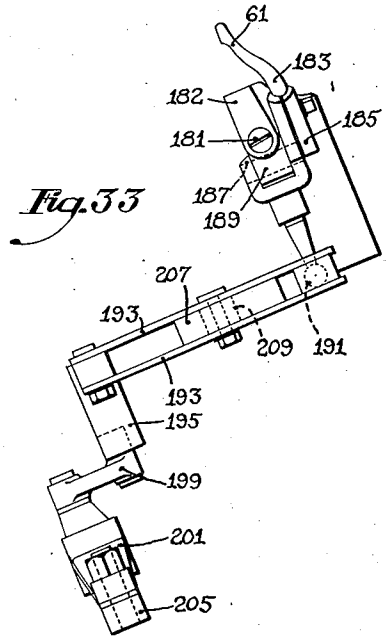
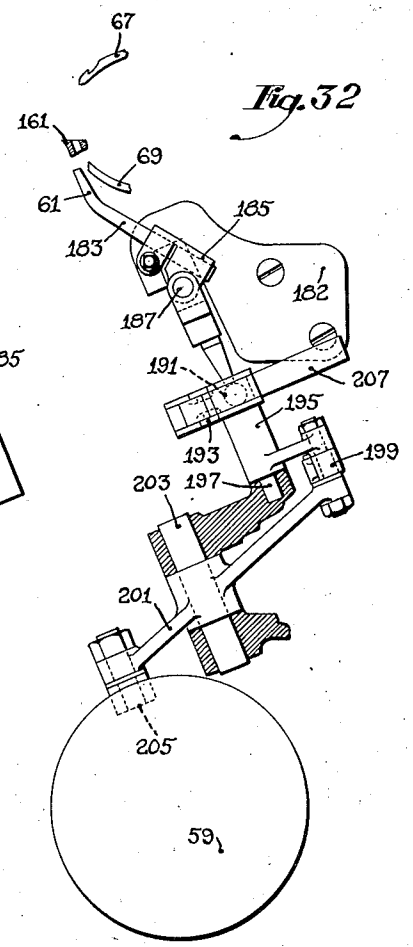


Fig. 32



Witness
H. E. Van Pine.

Inventors.
Joseph Gouldbourn
Thomas A. Kestell
Frank B. Keall
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Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

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Fig. 36

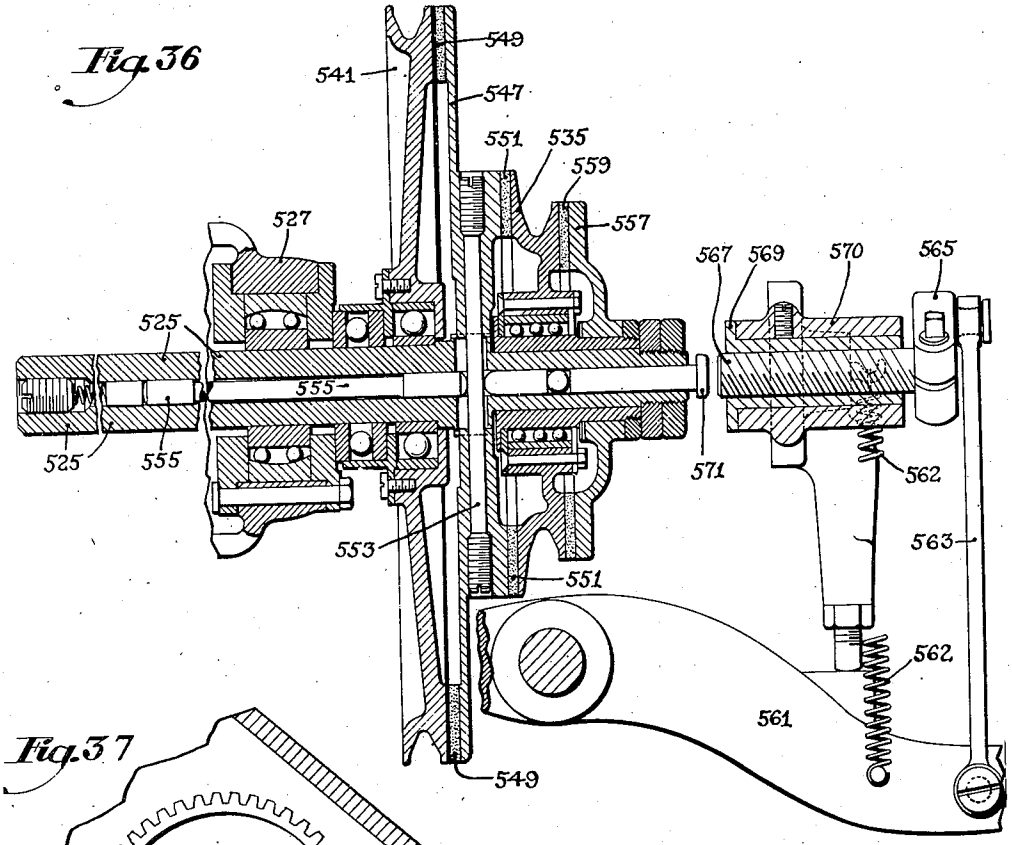
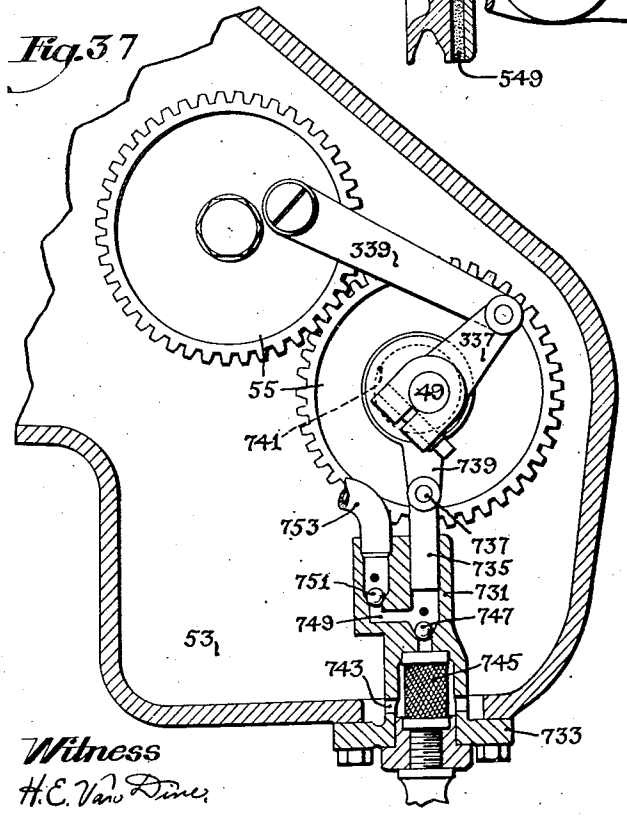
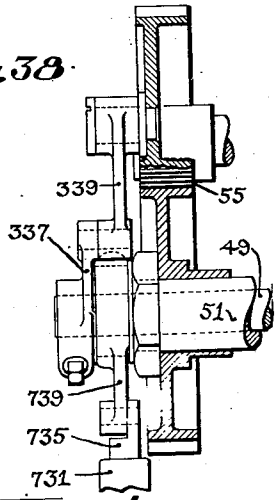


Fig. 37



Witness
H. E. Van Dine

Fig. 38



Inventors
Joseph Gouldbourn
Thomas A. Restell
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Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 39

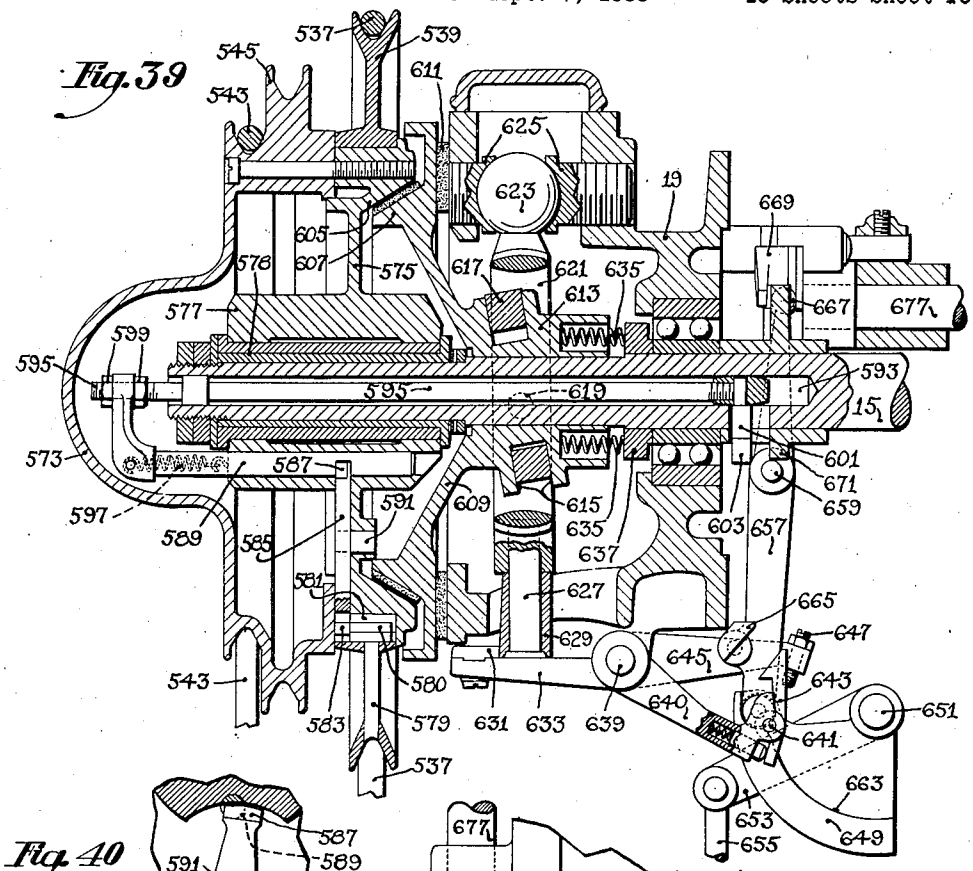


Fig. 40

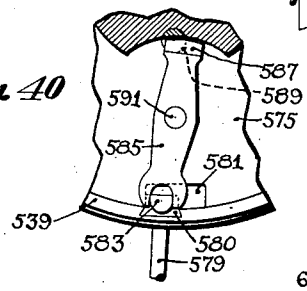


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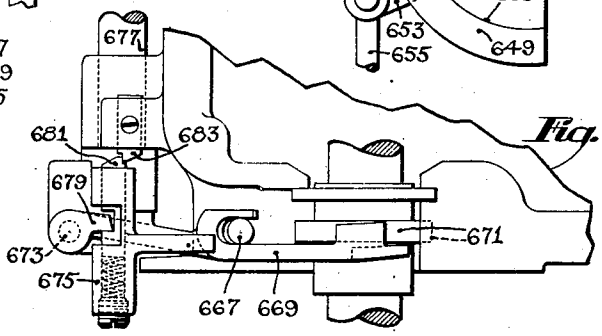


Fig. 43

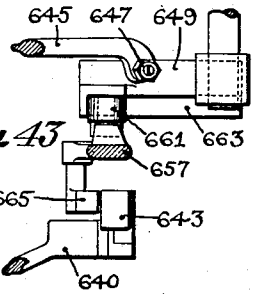
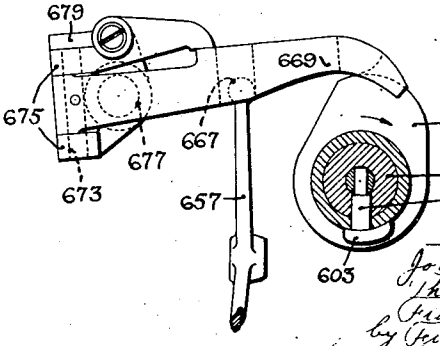


Fig. 42



Witness
H. E. Van Dine

Inventors
Joseph Gouldbourn
Thomas A. Kestell
Frank B. Keall
by Fish Gilderth
Barry & Penney Attys

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

Filed Sept. 7, 1933 19 Sheets-Sheet 17

Fig. 44

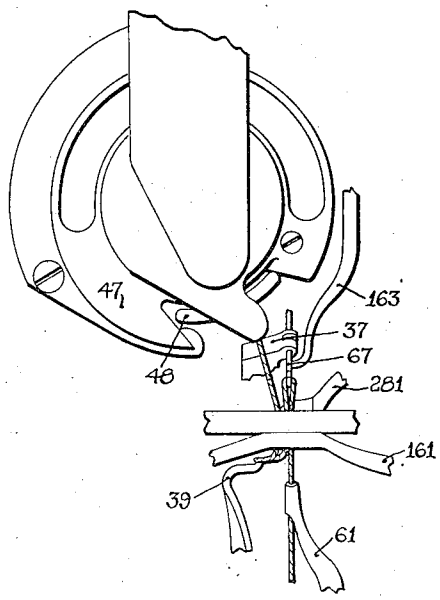


Fig. 45

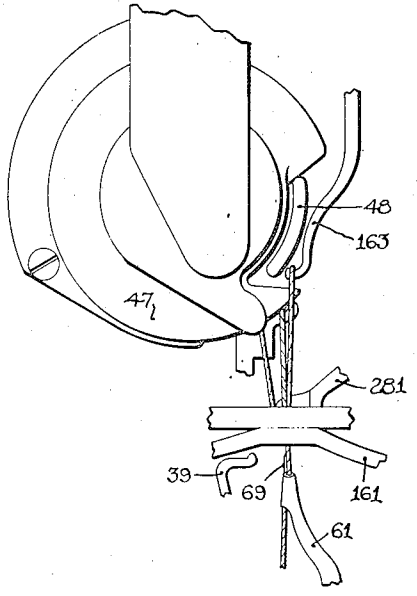
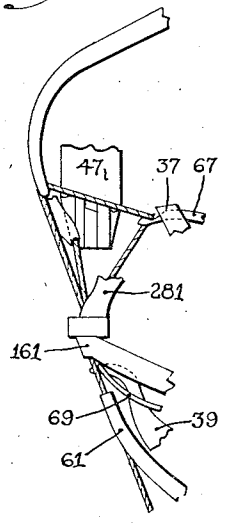


Fig. 46



Witness
H. E. Van Dine.

Inventors
Joseph Gouldbourn
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Frank B. Keall
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Cary & Penney, Attys.

Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Fig. 47

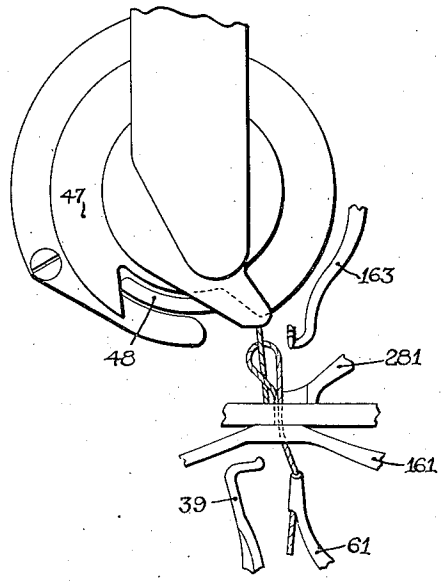


Fig. 48

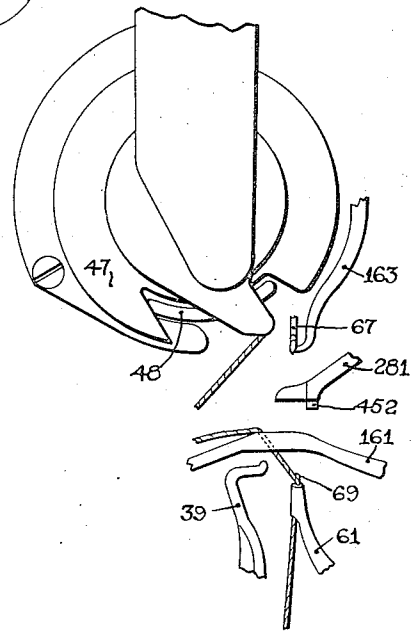
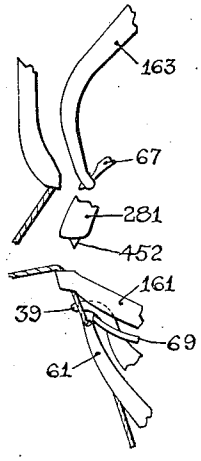


Fig. 49



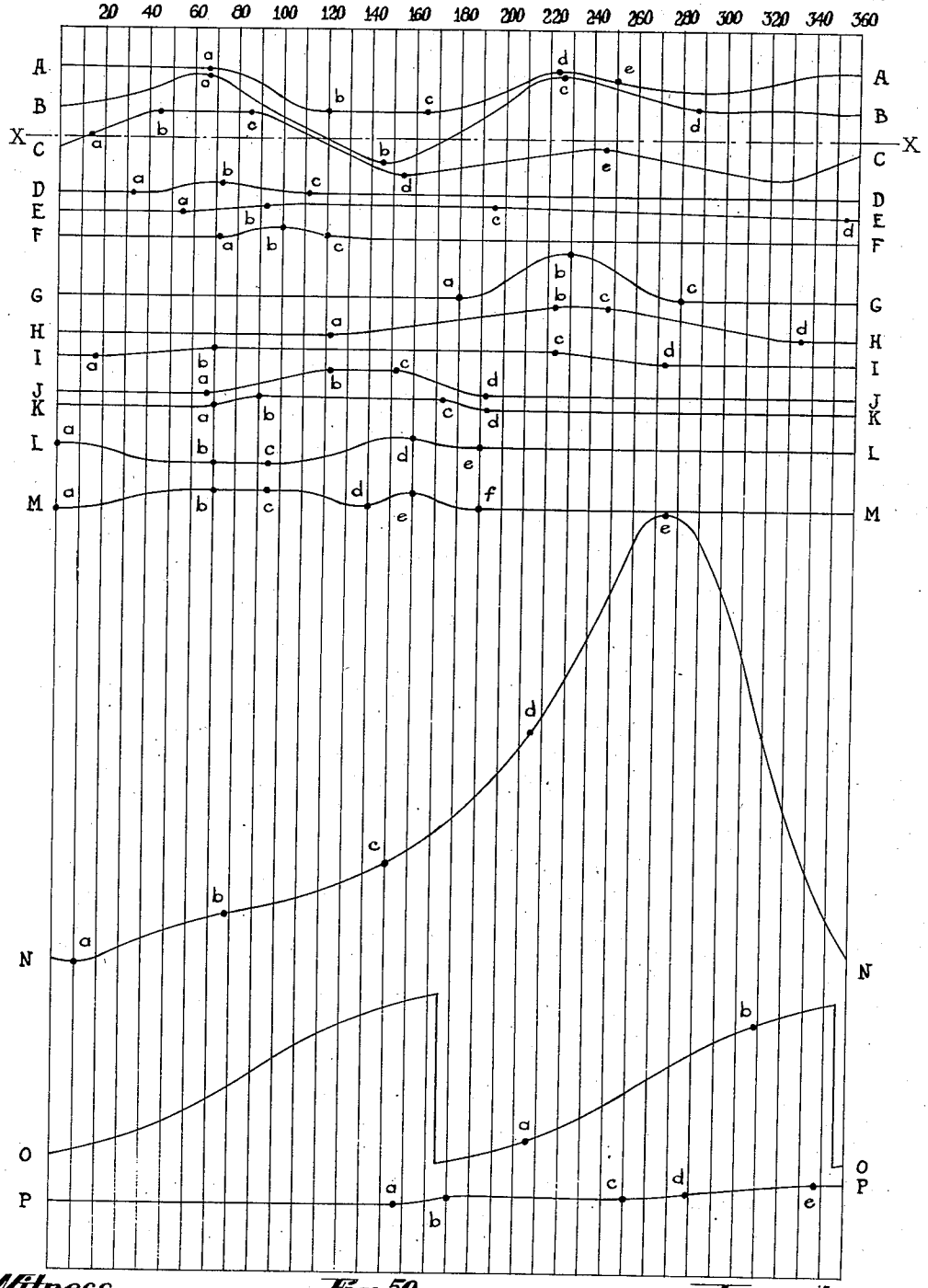
Witness
H. E. Van Dine.

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Frank B. Real
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Oct. 6, 1936. J. GOULDBOURN ET AL 2,056,670

SEWING MACHINE

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Witness
H. E. Van Dine

Fig. 50

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Patented Oct. 6, 1936 2,056,670

UNITED STATES PATENT OFFICE

2,056,670

SEWING MACHINE

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This invention is concerned with improvements in or relating to sewing machines including starting and stopping mechanisms particularly applicable thereto and is particularly but by no means exclusively concerned with sewing machines (and stop motions therefor) for operating on thick stubborn materials such as leather.

In the boot and shoe industry, for example, machines are used for sewing the outsoles of welted shoes (which term is used herein as including also boots) to their welts by a lockstitch seam and such machines make use of a curved hooked needle, a rotary shuttle, a looper, thread lock and thread lifter to cooperate in handling thread to form the stitches in a manner well known.

An illustrative machine of this kind is disclosed in United States Patent No. 1,169,909 granted to Fred Ashworth, February 1, 1916.

Usual machines of this kind employ mechanism for actuating the sewing instrumentalities which, while satisfactory for enabling the machine to sew efficiently, up to a speed of say five hundred stitches per minute or thereabouts, is not suited for enabling the machine to run at a relatively high speed for example to sew a thousand stitches per minute. For instance, the actuating mechanism for the sewing instrumentalities in machines of the type aforementioned comprises two relatively long and horizontal cam shafts arranged (one above and behind the other) transversely across the head of the machine near its top and carrying relatively heavy cams which actuate the various sewing instrumentalities through jointed and relatively heavy mechanisms some of which extend across the machine for considerable distances. The arrangement of the cam-shafts in the said position and the use of somewhat heavy mechanisms for actuating the sewing instrumentalities results in the setting up of vibration in the machine which becomes excessive if it is attempted to run the machine at high speeds and makes the smooth continuity of the sewing operation difficult if not impossible to secure and also tends to render the formation of the individual stitches less accurate.

One of the several objects of the present invention is to provide a novel form of sewing machine of the kind referred to in which actuating mechanism for the sewing instrumentalities is so arranged in the machine that the tendency for vibration to be set up in the machine when it is running at a high speed will at least be markedly less acute than were any such speed to be attempted with such known mechanism as just referred to.

In an illustrative embodiment of the present invention hereinafter described the various sewing instrumentalities are actuated by a number of cams and cranks which, instead of being secured to horizontal shafts which extend across near the top of the machine, are arranged on a number of shafts extending in a plurality of directions and which consequently can be and are grouped closely adjacent the point in the machine at which the sewing takes place. This arrangement assists the actuating mechanism as a whole to run at high speeds without excessive vibration and also, since the shafts are grouped relatively close to the sewing point, enables the connections between the various cams and the sewing instrumentalities to be relatively short and light, thus also tending to minimize the vibration. Moreover the particular heightwise disposition (hereinafter disclosed) in the said illustrative embodiment of the said shafts relatively to the point at which the sewing takes place is such that the shafts are disposed mainly below the sewing point thus not only producing a machine which has a low centre of gravity (and therefore runs more steadily) but also enabling the progress of the sewing operation to be more easily watched by permitting an abundance of light to come from different directions to the sewing point.

In arranging a sewing machine to run at a high speed it is important that both the individual speeds of movement of the sewing instrumentalities in relation to the machine cycle and their relative timing be settled with a high order of accuracy so that the absolute time taken by the various instrumentalities in carrying out their individual functions may be made as small as is consistent with smoothness of operation and in order that they may cooperate one with another in complete harmony. It is particularly important that in sewing machines of the kind previously referred to the needle and awl should be actuated in a manner which, while allowing them to remain inoperative during certain periods of the machine cycle, will nevertheless cause them to move smoothly and with rapidity at other times and this imposes special conditions as indicated when a machine of this kind is to be run at very high speeds.

Accordingly it is another object of the present invention to provide novel mechanism, in a machine of the kind hereinafter referred to, for actuating a needle and awl in this manner. In the illustrative embodiment of the invention

hereinafter described, mechanism for actuating the needle and awl comprises a pair of shafts each having two cranks formed on it, one of the cranks on one shaft cooperating with one of the cranks on the other shaft to actuate the needle and the other of said cranks cooperating with the other crank on the other shaft to actuate the awl. The said shafts are rotated at different speeds and in opposite directions and the respective pairs of cranks are coupled by linkage mechanism respectively to needle and awl carriers in such a manner that the needle and awl are operated in the desired manner.

Prior machines of the type referred to rely, for the feeding of the work through the machine, on an awl which rises from below the work to pierce the latter at a point to the right of the needle, looking at the machine from the front, and which while it is still in the work moves towards the left to carry the work towards the needle. When the awl has come into line with the needle it is withdrawn downwardly from the work (the needle being thereafter lowered to pass through the hole punched for it in the work by the awl) and while in its retracted position moves across to the right to be once more ready to rise again to pierce the work and to feed it a further step towards the needle. When the needle has passed downwardly through the said hole, the looper and thread hook cooperate to lay the thread in the needle barb and the latter then rises through the work, taking a loop of thread with it. As the needle rises the loop of thread which it carries is engaged and held open by the thread lifter ready to be engaged by the beak of the shuttle and carried over the shuttle and over the thread extending between the same and the stitch last set. When the thread has passed over the highest part of the shuttle a thread take-up device operates below the work to draw the thread down from over the shuttle on to the work and to set the stitch lock within the work. Since the shuttle over which the thread has to pass has to be of relatively large size in order to be able to accommodate a sufficiently large spool of thread within it, it follows that the amount of thread drawn up through the work by the thread lifting function of the shuttle is considerable and consequently a similar amount of thread must be pulled down through the needle hole by the take-up device for the setting of the stitch.

If now the awl were to be allowed in such a machine to pierce the work at such time as to be in the work during the time that the thread is being pulled down by the take-up device through a needle hole previously formed in the work there would arise a danger that the action of the awl in penetrating the work would have caused or cause the material of the work to be crowded around the needle hole and so to grip the moving thread and thus cause reeving and chafing of the thread and weakening the latter and also marring the appearance of the stitch formed. This danger would be the more acute by reason of the fact that the portion of the thread passing up from the underside of the work which is actually used in the formation of a stitch will, during the formation of previous stitches, already have been drawn up through the work by the needle and pulled down on to the work by the takeup device several times, thus increasing the harmful effect on the thread.

If however (as occurs in prior machines of the type referred to) the awl after its return from a feed stroke is maintained out of engagement with the work until after the thread used for a previous stitch has been drawn down on to the work and the setting of the stitch has been substantially completed, the portion of the machine cycle during which the awl can be moved first to pierce the work and then to feed the latter through the machine is relatively small since the portion of the machine cycle required for the looping of the needle and the formation of a stitch including the drawing down of the thread on to the work for the setting of the stitch is considerable.

In a machine in which as indicated the portion of the machine cycle during which the awl can pierce the work and feed it towards the needle is small, difficulties will arise if the machine is speeded up beyond its accustomed speeds since the work feeding movements of the awl will become very jerky and unreliable and excessive wear rapidly develop in the machine parts due to the rapidity with which the awl actuating mechanism will move.

Further when a machine of the type above referred to is operating on heavy work it may arise that the awl does not come accurately into line with the needle at the end of its feeding stroke (doubtless owing to inertia of the work imposing bending strain on the awl) and in such event the needle as it descends either becomes deflected into the awl hole by the work or makes a passage for itself in the work. In either case the appearance of the work becomes marred. This is a condition of affairs which would be accentuated at increased machine speeds.

Another of the several objects of the present invention is to provide, in a machine of the kind referred to, novel work feeding means which will enable the machine to run at a high speed without detracting from the efficiency of the sewing operation.

Yet another of the several objects of the present invention is to provide in a machine of the kind described, a novel feed arrangement in which a needle and awl lie always in the same plane enabling the alignment of these parts to be easily verified and if need be easily adjusted and, since they do not partake in feeding, enabling a thin needle and a thin awl to be used so that but a small hole is made in the work, the arrangement being such in the preferred embodiment of the invention which is hereinafter described in detail that the work feed is performed solely by the presser-foot and work table which return while the awl (which is shorter and therefore stiffer than the needle) is in the work and holding it against return movement.

In the illustrative embodiment of the invention hereinafter described a curved hooked needle and a curved awl are carried by members which rock about a common axis to cause the awl and needle successively to enter the work and the needle and awl are retained always in one and the same vertical plane. The machine constituting the illustrative embodiment comprises an arrangement for feeding the work through it which includes a work supporting table and a presser-foot (both movable along the line of feed) which latter presses the work against the table and moves with the latter to assist in feeding the work towards the left through the machine a distance equal to the length of stitch to be made. When the work has been fed the requisite distance the awl rises to pierce the work to form a needle hole while the work is held stationary and supported against the action of the awl by the presser-foot. While the work is held station-

ary by the awl the presser-foot is lifted out of engagement with the work and is returned towards the right to its original position, the work supporting table moving with it and sliding along the underside of the work in contact with it in order to be ready to effect another work feeding movement which commences as soon as the thread lifter engages the loop of thread drawn up by the needle above the work through the needle hole last referred to.

Other objects of the invention are to provide novel looper mechanism well suited to operation at high speed, novel forms of thread control devices cooperating with a take-up in providing the correct amount of thread for each stitch and securing effective setting of the latter (including in particular simple means rendering the customary auxiliary take-up unnecessary, a thread-measuring and pull-off mechanism operating with exceptional accuracy and an arrangement of alternately acting thread locks effectively guarding against loss of control of the thread by both locks), starting and stopping means particularly well adapted for stopping without shock and invariably at the same point in its cycle such a high speed machine as is contemplated, and a curved hooked needle sewing machine having timings in the machine cycle of its various thread handling and work feeding instrumentalities which lend themselves particularly well to performing the sewing operation at very high speed without radical departure from the general principles of the conventional and well tried stitch forming cycle represented by that of the machine disclosed in the specification aforesaid.

In order that the nature of the present invention may be more clearly understood the illustrative embodiment aforementioned will now be described and the above and other objects of the invention and its several features will become apparent to those skilled in the art from said description.

In the drawings:

Figure 1 is a view from the left hand side showing the general form of the illustrative machine; Figure 2 is a front view showing the head of the machine in greater detail; Figure 3 is a view from the right hand side of the machine showing certain parts of the head of the machine; Figures 4 and 5 are diagrammatic views in plan and right hand side elevation respectively illustrating the relative dispositions in the machine head of shafts for actuating various instrumentalities of the machine; Figure 6 is a sectional view from the right hand side of the machine showing mechanism for actuating the needle and awl; Figure 7 is a plan view of certain parts seen in Figure 6; Figure 8 is a side elevation on an enlarged scale showing details of the mounting for the needle and awl; Figure 9 is a sectional plan view showing details of the needle and awl mounting; Figure 10 is a section on the line X—X of Figure 8 showing means for aligning the needle and awl; Figure 11 is a section on the line XI—XI of Figure 8 also showing the needle and awl aligning means; Figure 12 is an end view showing certain details seen in Figure 11; Figure 13 is a view from the right hand side of the machine showing mechanism for operating a thread lifter, a needle guide and a thread hook of the machine and also showing certain parts of thread measuring and thread locking means; Figure 14 is a view from the right hand side of the machine showing chiefly mechanism for raising and lowering the presser foot of the machine, for locking the presser foot against the work, for actuating a thread measuring lever and for actuating dual thread locks of the machine; Figures 15 and 16 are detail views on an enlarged scale from the right hand side and front respectively showing an adjusting lever for varying the extent to which the presser-foot is lifted at the conclusion of a sewing operation;

Figure 17 is a detail sectional plan view of parts associated with the presser-foot controlling and thread measuring mechanism; Figure 18 is a view from the right hand side of the machine showing connections between a presser-foot operating link and a bell crank lever for actuating the same; Figure 19 is a view looking in the direction of the arrows XIX—XIX in Figure 18 of the parts seen in that figure; Figure 20 is a sectional view from the front of the machine showing certain details of thread locking means of the machine; Figure 21 is a view from the right hand side of the machine showing certain details of the parts seen in Figure 20; Figure 22 is a view from the left hand side of the machine and partly broken away showing certain parts of a rotary take-up device also seen in Figure 13; Figure 23 is a section on the lines XXIII—XXIII in Figure 22; Figure 24 is a right hand side elevation showing certain details of the presser locking means; Figure 25 is a view showing partly in section certain other details of the presser foot locking means; Figure 26 is a view from the front of the machine showing chiefly mechanism for imparting to the work table of the machine and the presser foot swinging movements for feeding the work through the machine; Figure 27 is a view from the right hand side showing certain mechanism for adjusting an edge gauge and a fudge knife of the machine; Figure 28 is a plan view showing certain parts seen in Figure 27; Figure 29 is a plan view of parts seen in Figure 26; Figure 30 is a plan view illustrating the manner in which a rotating shuttle of the machine is driven; Figure 31 is an end view showing certain details of the shuttle driving mechanism; Figure 32 is a right hand side view illustrating the means for operating a looper of the machine; Figure 33 is a view from the front of the machine showing certain of the parts seen in Figure 32; Figure 34 is a plan view showing certain parts of the mechanism for actuating the looper; Figure 35 is a diagram illustrating the path of the looper relatively to the needle; Figure 36 is a sectional view illustrating certain clutches on a countershaft of the machine; Figure 37 is an end view from the left of the machine partly broken away showing details associated with the rotary take-up driving mechanism; Figure 38 is a view from the front of the machine showing certain parts seen in Figure 37; Figure 39 is a sectional view showing high speed and low speed driving mechanism on the main shaft of the machine; Figure 40 is a detail view looking from the left of the machine showing certain elements associated with the stopping mechanism of the machine; Figure 41 is a plan view illustrating part of the stopping mechanism of the machine; Figure 42 is an end view from the left hand side of the machine showing certain parts of the stopping mechanism seen in Figure 41; Figure 43 is a plan view showing part of the clutch tripping mechanism shown in Figure 41; Figure 44 shows the relation of certain parts of the machine at one stage in the cycle of the machine; Figures 45 and 46 show the relation of parts at a later stage in the cycle

of the machine; Figure 47 shows the relation of parts at a still later stage in the machine cycle; Figures 48 and 49 show the relation of parts when the machine has come to rest; and Figure 50 is a timing diagram of the machine.

The said illustrative embodiment is a machine designed for sewing the outsoles of welted shoes to their welts and comprises a column 1 and a head casting 5. A main shaft 15 is arranged parallel to the front of the machine (i. e. from left to right) and has mounted on it a high speed and low speed driving clutch arranged to be driven by belts from a countershaft secured to the column 1. The arrangement of the clutch (the construction of which will be described in detail hereinafter) is such that the shaft 15 is caused to run normally at a high speed in a clockwise direction looked at from the left of the machine when the starting treadle is fully depressed but can be caused to run at a low speed in the same direction by causing or allowing the treadle to occupy a position higher than its fully depressed position. Shaft 15 has secured to it (in a manner hereinafter more fully described) two cranks 18 and 20 and various cam members which actuate (also in a manner hereinafter described) needle and awl mechanism of the machine, presser-foot lifting and locking mechanism and thread-measuring means.

A second crank shaft 21 (Figs. 4, 5, 6 and 7) (which constitutes an auxiliary needle and awl actuating shaft) is arranged parallel to shaft 15 somewhat lower than, and in front of the latter. This shaft 21 is coupled by gearing 23 (Figs. 4 and 5) at its left end, to shaft 15 and is arranged to be rotated by the latter at twice the speed of the latter and in the opposite direction. Shaft 21 carries two cranks 25 and 27 which are respectively arranged in front of the two cranks 18 and 20 on shaft 15 and cooperate with the latter cranks to impart the desired movements to the awl and needle in a manner more fully described hereinafter. The left one of each of the pairs of cranks on shafts 15 and 21 cooperates to actuate the awl and the right one of each of the pairs of cranks cooperates to actuate the needle. The angular relation between the two cranks on shaft 15 and the two cranks on shaft 21 is such that in the stopping position of the machine the radial line of the needle-actuating crank 20 on shaft 15 extends upwardly and forwardly at an angle of about thirty degrees to the horizontal while the radial line of the awl-actuating crank 18 on shaft 15 extends downwardly and rearwardly at an angle of some few degrees to the vertical. At the same time the radial line of the needle-actuating crank 27 on shaft 21 extends upwardly and rearwardly at an angle of about thirty degrees to the horizontal while the radial line of the awl-actuating crank 25 on shaft 21 extends rearwardly and downwardly at an angle of about twenty-five degrees to the vertical.

The main shaft 15 has a bevel gear 29 (Figs. 4 and 13) secured to it and this gear meshes with a similar gear 31 secured to the lower end of a short vertical shaft 33 which is secured against endwise movement. Shaft 33 is therefore rotated at the same speed as the main shaft in an anticlockwise direction looked at from above and has secured to it a cam block 35 for actuating a needle guide 37 a thread hook 39 and work feeding mechanism and also has mounted on it near its upper end a thread lifter cam 41 and a spiral gear 43 which rotates a divided shaft 45 which drives the shuttle 47 of the machine. A third horizontal rock shaft 49 housed within a driven sleeve 51 rotatable around it is positioned in front of shaft 21. A hollow arm 53 (Figs. 1 and 2) forms a case in which a train of gears 55 (Figs. 4, 37 and 38) establishing driving connection between shaft 21 and said sleeve 51 is enclosed. This sleeve 51 and the shaft 49 within it cooperate to form a driving arrangement for a rotary thread take-up device hereinafter described and the sleeve 51 has secured to it a cam member 59 by which operative movements are imparted to a looper 61 and a pair of thread locking elements 63 and 65.

The arrangement above described in which the various members for actuating the instrumentalities of the machine are disposed on a number of mainly short shafts grouped closely together in the different parallel side by side and perpendicular relative dispositions indicated enables the machine to be run at high speeds without excessive vibration generally or at any particular speeds and allows relatively short connections from the said members to the instrumentalities to be used with the result that such parts enclosed by any necessary casing or like elements give the head of the machine a somewhat inverted T formation having the sewing point more or less in front of the junction of the elements of the T—a result providing an abundance of illumination at the working station from light reaching there from behind and above the machine from each side of the upwardly extending branch of the generally inverted T-shaped assemblage.

A curved hooked needle 67 with its barb on the forward side and a curved awl 69 are clamped to needle and awl segments 71, 73 which are mounted so that they shall oscillate always in one and the same vertical plane about a horizontal axis 75 extending across the machine when viewed from the front, the awl moving up from below the work to pierce it and the needle moving downwards to enter the hole punched for it in the work by the awl. The awl segment has extending from its left and right sides axially aligned horizontal spindles 77 (Fig. 10) which are rotatably mounted in brackets 79 fixed to the machine head to the left and right of the awl segment, respectively. The right spindle 77 is received within a sleeve 80 and is secured against endwise movement in the sleeve. The sleeve may be adjusted axially to align the awl with the needle and for this purpose has formed on it an ear 81 (Figs. 11 and 12) through which passes an adjusting screw 83 threaded into the corresponding bracket 79. The screw 83 carries collars which abut against opposite sides of the ear 81 to cause axial movement of the sleeve 80 and awl segment when the screw 83 is rotated. A wedge 85 having a threaded stem may be adjusted endwise by rotation of a nut 87 engaging the bracket 79 to clamp the sleeve 80 in adjusted position. The bracket 79 at the left side of the awl segment 73 has projecting from it towards the awl segment a sleeve portion 89 through which the left spindle 77 of the awl segment passes. A sleeve 94 is mounted against endwise movement on said sleeve portion 89 and has formed on its right end the needle segment 71 which is so shaped that the needle lies in the same vertical plane extending forwardly and backwardly as the awl and rotatably mounted on sleeve 94 is a needle guide carrier 93 which carrier is prevented from moving laterally by con-

tact with the left bracket 79 and with the needle segment 71.

In order to impart to awl 69 (Fig. 6) the movements which are desired, awl segment 73 has projecting laterally from it a pin 95 (Figs. 6 and 7) which is offset radially from the supporting spindles 77 and has pivoted on it a link 97 which is also pivotally connected to the upper arm 99 of a bell crank lever 101 which is pivoted on a fixed horizontal pivot 103 on the forward side of the machine head which lies slightly above the axis 75 and somewhat behind the latter and extends transversely. An arm 105 of lever 101 has pivotally connected to it a rod 107 which is also pivotally connected to an arm 109 of a lever 111 which is pivotally mounted about midway of its length on the left one 18 of the two cranks carried by the main shaft aforesaid. The lower arm 113 of the lever 111 has pivotally connected to it a link 115 which is pivoted on the left one 25 of the two cranks on the shaft 21 aforesaid.

In order to impart to needle 67 the movements which are desired, needle segment 71 has projecting laterally from it a horizontal pin 117 which is offset radially from the axis about which it oscillates and has pivoted to it a link 119 which is also pivotally connected to an arm 121 of a lever 122 pivoted at 123 slightly above and somewhat behind the axis about which the needle oscillates. An arm 125 of lever 122 has pivotally connected to it a rod 127 pivotally connected to a rear arm of a lever 129 pivoted on the second crank 20 of the main shaft. A forwardly extending arm of lever 129 is pivoted to a link 131 which is also pivoted to a link 133 pivoted to the machine frame on a pin 135 in front of and above the shaft 21. Pivotally connected to link 133 on the same pivot as link 131 is a link 137 which is connected to the second crank 27.

The result of employing such an awl driving linkage as will be further explained below is that the mechanical advantage of the mechanism is unusually favourable at the time when the awl comes to penetrate the work and even on the stoutest of shoe soles little added resistance to turning of the main shaft is felt as the awl penetrates the work.

The relative timing of the movements of the awl 69 needle 67 and needle guide 37 during a single complete cycle of the machine including, incidentally, the relationship of some of the devices of the machine cooperating therewith at certain times in the cycle of the machine will now be described, the degrees of rotation of the main cam shaft of the machine being stated in each instance, as degrees of rotation from the stopping position of the machine. When the machine is in its stopping position the point of the awl 69 is below a work-supporting table 161. When the machine is started the awl rises and its point enters the work after about 15 degrees rotation of the main shaft and reaches its highest position after having passed through the work after about 45 degrees of rotation. The awl remains practically in this raised position till after about 85 degrees of rotation and then begins to descend. While the awl is in the work, work-feeding devices of the machine make a return or idle movement, the movement of the feed devices in the direction of feed having taken place in the previous cycle of the machine. The point of the awl leaves the work (i. e. it passes below the work table) after about 115 degrees of rotation and reaches its lowest position after about 155 degrees of rotation. The awl then commences to rise again (for a reason hereinafter explained) and reaches a position where its point is about 4.8 mm. below the work after about 245 degrees of rotation. The awl then moves down again and reaches the same lowest position as that which it previously occupied after about 325 degrees of rotation when it again rises and at the end of the machine cycle is part way along its upward movement to pierce the work but still below the work. The upward movement of the awl nearly into engagement with the work which takes place after the awl has penetrated and then retired from the work is merely to provide clearance between the rear ends of the needle and awl segments to allow the needle to be raised to its highest position without obstruction.

The point of the needle when the machine is in its stopping position is above the work and when the machine is started the needle commences to rise reaching its highest position after about 65 degrees of rotation. The needle then commences to move down and enters the work after about 110 degrees of rotation of the main shaft (the precise time at which the needle enters the work depending however upon the thickness of the work) its point passing through the lower face of the work after about 115 degrees of rotation and reaching its lowest position after about 145 degrees of rotation. The needle then commences to rise and its point passes up into the work after about 175 degrees of rotation. During the time that the point of the needle is below the work, that is, from about 115 degrees to about 175 degrees of rotation, the laying of the thread in the barb of the needle by the looper 61 takes place. The needle continues to rise and again reaches its highest position after about 225 degrees of rotation. As the needle rises and after about 195 degrees of rotation the thread lifter 163 engages the loop of thread drawn up by the needle and spreads the loop of thread. The beak of the shuttle 47 enters the needle loop after about 215 degrees of rotation i. e. just before the needle loop reaches its highest position. The needle after it reaches its highest position descends again and after about 245 degrees of rotation has descended about 6.4 mm. from its highest position and just after this time the thread is taken from the needle barb by the rotation of the shuttle, the thread lifter (which has a rising and falling movement along a curved forwardly and rearwardly extending path) at this time having passed its highest position and partly descended again so that it has left the loop of needle thread. The needle continues to descend until after about 285 degrees of rotation it reaches a position about midway between its highest position and the level of the work table although still remaining well above the work in which position it dwells until the end of the cycle. After about 285 degrees of rotation the loop of needle thread has just passed over the top of the shuttle and after about 320 degrees of rotation the shuttle is in such a position that the loop of needle thread can be freely pulled by a thread take-up device away from the shuttle and down to the work. While the needle is above the work and the awl is below the work the feed of the work takes place during the time that the main shaft rotated from about 195 degrees nearly to the end of the cycle.

The needle guide remains stationary in its rearmost position until the needle starts to descend when the needle guide descends partway with it and when the needle passes through the

work the needle guide remains stationary above the work during rotation of the main shaft from about 120 degrees to about 165 degrees. As the needle rises above the work the needle guide is so close to the needle barb as to trap the thread within the latter, a condition prevailing as the needle guide once more rises (in company with the needle) until after the main shaft has rotated through about 250 degrees the needle barb descends sufficiently far below the needle guide to allow the shuttle beak to withdraw the thread loop from the needle.

The shuttle 47 (which makes two complete rotations in each cycle of the machine) is similar both in its construction and in the driving mechanism for rotating it to the shuttle described in the U. S. application for Patent Serial No. 630,044, filed August 23, 1932. The gear 43 (Fig. 30) which rotates the shuttle shaft 45 (by meshing with a spiral gear 165 on said shaft) is rotatable on vertical shaft 33 but is normally coupled to it to rotate with it by means of two pins 167 (Fig. 13) which are housed in diametrically opposite bores in the thread lifter cam 41, the pins 167 being urged downwardly by springs 169 to cause their lower ends to enter countersunk recesses in the upper face of gear 43 thereby coupling the latter yieldingly to the shaft 33, but yet allowing the gear to remain stationary if, for any reason, the shuttle should be prevented from rotating. The shuttle shaft 45 is, as before stated, a divided shaft which comprises, as does that described in the prior application above referred to, two relatively offset horizontal shaft portions coupled together by crank pins 171, 173 (Figs. 30 and 31) and a link, the one portion of the shaft being coupled to the shuttle 47 and the other portion having secured to it the spiral gear 165. The carrier member 177 providing the race for the shuttle is situated at the forward end of a bracket 179.

The thread looper 61 (see particularly Figs. 32, 33 and 34) is supported by a short and fixed pivot pin 181 secured to an extension 182 projecting forwardly from the machine head, and so positioned that its axis lies substantially in the vertical plane in which the movements of the needle and awl take place and the pin lies just rearwardly of the vertical plane containing the axis about which the needle and awl move and considerably below the said axis. The pin is inclined forwardly and downwardly at an angle of about 22 degrees to the horizontal.

The looper comprises a short stem 183 (extending downwardly from its thread passage) which is fast in a short lever 185 which extends below pin 181 and is freely pivoted (between its ends) on a stud 187 which is secured in a block 189 freely pivoted on the pin 181 which thus supports the looper. This arrangement provides a universal joint to enable desired forward and rearward and transverse movements of the upper end of the looper to be obtained in a manner hereinafter described. The looper stem 183 extends from lever 185 upwardly and forwardly so that the thread passage at its upper end lies in front of the barb of the needle (which barb is positioned in the forward side of the needle) when the needle has descended through the work and just before it reaches its lowest position. The length of the stem is such that at this time the upper end of the stem (which has a short bore extending upwardly through it constituting the thread passage) is substantially in the same horizontal plane as the barb of the needle.

The lower end of lever 185 is formed as a ball 191 which is received within a bore or socket in one end of a lever 193 which at its other end is pivotally connected to a lever 195 which is rotatably mounted on a fixed and upwardly extending shaft 197, and connected by a link 199 to a cam lever 201 which is pivoted on a shaft 203. This shaft 203 and the shaft 197 are arranged parallel to each other and extend downwardly and rearwardly at an angle of about twenty degrees to the vertical. The lever 201 has a roll 205 which enters a cam groove in the cam member 59 aforesaid.

The connections to the lever 201 just described operate to impart to the upper end of the looper rocking movement transversely of the machine about the pin 181. For imparting to the upper end of the looper movement forwardly and rearwardly about stud 187 lever 193 comprises two plates arranged one above the other and above and below a stationary plate 207 projecting forwardly from the head casting and a cam roll 209 secured between and bridging the plates passes through a cam slot 211 formed in plate 207. The cam slot has such a shape that when looked at in plan it is curved rearwardly slightly at its left end and curved forwardly slightly at its right end so that as lever 193 is pulled bodily transversely towards the left by the cam member 59 to rock the upper end of the looper about pin 181 towards the right, the cam roll 209 and the cam slot 211 cooperate to rock the upper end of the looper about pin 187 from a position rearward of that which the barb of the needle will occupy when it is in a position to have the thread laid in it, forwardly. Thus as the upper end of the looper moves across towards the right of the machine it passes across in front of the needle in a curved path which at its right hand lies once more behind the needle barb. It will be understood that the mechanism described causes the thread delivery end of the looper to return along the same path as that along which it moved to effect looping, this path being, in view of the shape of the cam slot 211, a somewhat S-shaped path seen from above the right hand, the more pronounced concavity of the S thus seen, being so oriented as to embrace the path of the needle, as seen in Figs. 29 and 35.

The thread hook 39 cooperates with the looper 61 to lay the thread in the needle barb when the latter has almost reached the bottom of its work-piercing stroke. The thread hook is at the upper end of an arm 213 (Fig. 13) which is mounted to swing forwardly and rearwardly being mounted on a pin 215 secured in a plate 217 extending forwardly from the machine head. The upper end of arm 213 is so bent as seen in Fig. 2 that it extends horizontally close to the plane in which the needle moves and just above the level at which the upper end of the looper moves and it has a notch constituting the thread-hook in its rear side to engage the thread passing upwardly from the looper as the thread hook moves rearwardly about its pivot.

The arm 213 is connected by a link 219 to a bell crank lever 221 mounted to rock about a pin 223 and carrying a cam roll which engages in a cam groove in the cam block 35. This mechanism gives to the thread hook its forward and rearward movements to assist the looper in laying the thread in the needle barb in a manner hereinafter more fully described.

The thread lifter 163 (which operates to hold open the loop of thread taken up through the

work by the needle so that the shuttle beak may enter the loop) extends close to the right hand side of the shuttle (Figs. 2, 13 and 47) and at its lower end has a thread engaging hook which extends into the plane in which the needle moves and lies, when it is inactive rearward of the most forward point in the needle path. The thread lifter is secured in a bell crank lever **225** mounted to rock about a pivot **227** and connected by a link **229** to a bell crank lever **231** mounted to rock about a pin **233**. The bell crank lever **231** carries a roll which engages a cam groove formed in the cam member **41** aforesaid. This arrangement causes the thread engaging hook of the thread lifter to move to and fro along a curved path which extends forwardly and upwardly from just behind the most forward point in the needle path at an angle of roughly forty-five degrees to the horizontal.

Means for withdrawing needle thread from a supply beneath the work for the formation of each stitch and for allowing the withdrawn thread to be absorbed in stitch formation at the correct time in the machine cycle will now be described. The thread passes from the supply upwardly through a locking device **63** (Fig. 13) (hereinafter described) mounted on the right side of the plate **217** and thence over a guiding roll **235** secured to the plate, then under a roll **237** projecting from a swinging thread measuring lever **239** and thence over a guiding roll **241** (forming part of a second thread locking device hereinafter more fully described) also secured to the said plate **217**. The thread then passes downwardly around a rotary thread take-up device **331** (hereinafter referred to) and thence between two further stationary rolls **243**, **245** secured to the plate **217**, and up through the thread passage in the upper end of the looper **61**. The lever **239** is pivoted upon a fixed shaft **247** (Figs. 13, 14 and 17) and its rear end is connected by a link **249** to the upper ends of a double link **251**, the members of which are of the same length as the link **249**. The lower ends of this double link are pivoted to a swinging bifurcated bracket **253**, the limbs of which are spaced apart to embrace the double link **251** and are of the same length as the double link. The said bracket has secured at its rear end horizontal spindles **255** which are mounted in fixed bearings carried by the head casting. A rod **259** is secured to the pivotal connection between the links **249** and **251** and is connected to a bell crank lever **261** mounted on a rod **263** and provided with a roll which enters into a cam groove in a cam member **265** secured to the main shaft **15**. The spindle **255** which extends from the right hand side of the bifurcated bracket **253** extends to the right beyond its bearing in the supporting bracket and a sleeve **267** surrounds the spindle within the bearing. This sleeve has formed in its left end, a short rearwardly and upwardly curved finger **269** and a split clamping collar **271** is mounted on the right end. The extreme right end of the spindle **255** has a pointer **273** (Fig. 3) secured to it which may be utilized, when the clamping collar **271** is loosened from clamping engagement on the spindle, to rotate the spindle relatively to the sleeve to adjust the angular position of the bifurcated bracket **253** relatively to the upwardly curved finger **269** on the sleeve. The clamping collar has a short arm **275** depending from it to the lower end of which the front end of a tension spring **277** is secured, which spring extends rearwardly to a fixed pin. The spring therefore tends to rock the spindle **255** and sleeve **267** in a counterclockwise direction looked at from the right hand side of the machine to lift the upwardly curved finger **269** and rock the bifurcated bracket **253** downwardly about its supporting spindles **255**. The short arm **275** has indicating marks formed on it as seen in Fig. 3 over which the pointer **273** lies and which may serve to assist the operator in effecting a desired angular adjustment between the bifurcated bracket **253** and the upwardly curved finger **269**. An adjustment of the angular position of the bifurcated bracket relatively to the finger before commencing to sew a shoe will serve to vary the length of thread pulled from the supply by each thread pulling off movement of the thread measuring lever **239** and thus provides a means for varying the depth to which the thread locks are set within the work and also for varying the length of thread pulled off from the supply in accordance with the length of the stitches to be made. The upwardly curved finger **269** is urged by the spring **277** up against the underside of a stirrup **279** (Figs. 14, 24 and 25) which is connected in a manner hereinafter more fully described to a presser foot actuating lever, the arrangement being such that the extent to which the said finger may lift the stirrup is determined by the thickness of the work which therefore determines the position to which the bifurcated bracket **253** is swung downwardly as the finger moves upwardly, the presser foot being lowered into engagement with the work (as will hereinafter more fully appear) and the bifurcated bracket being swung into its downward position just before thread-measuring movement of the thread measuring lever **239** is effected by its cam **265**. Downward swinging movement of the bifurcated bracket **253** causes the pivotal connection with the double link **251** to move into a lower position and this in turn causes the path through which the pivotal connection between link **249** and the double link **251** is moved by the cam member **265** to assume a direction which has a smaller component of vertical movement and a larger component of horizontal movement. The thinner the work being operated on the less will be the vertical movement imparted to link **249** and the less will be the rocking movement imparted to the thread measuring lever **239**. Thus the extent of the rocking movement of the thread measuring lever and therefore the length of thread pulled off from the supply for each stitch is directly proportional to the thickness of the work. The two guiding rolls **235** and **241** and the roll **237** on the thread measuring lever are spaced so far apart that the gaps between the sides of the roll **237** on the measuring lever and the near sides of the stationary rolls **235** and **241** are both approximately equal to the radius of the rolls when the roll **237** is in its highest position at which time it is still in engagement with the thread and deflects it downwardly somewhat from a straight position. This arrangement of the spacing brings about the result that as the roll **237** descends between the stationary rolls the angle between the sides of the bight of thread passing over the rolls will gradually decrease. Thus, assuming for example the thread roll **237** on the thread measuring lever to have a given maximum throw, the amount of thread drawn off from the supply during the first quarter of this throw will be a certain amount, the amount of thread drawn off during the next quarter will be greater than that drawn off during the first quarter, the amount of thread drawn off during the

movement of the roll through the third quarter of its throw will be greater than either of the amounts drawn off during the movements through the first and second quarters and the amount of thread drawn off by the movement of the roll during the last quarter will be greater than the amounts drawn off by the roll during its movement through any of the three previous quarters of its throw, such an arrangement tending to allow the setting of the stitch lock to take place in the best position within the work according to variations in the thickness of the work.

Thread locking arrangements are provided to cooperate with the thread measuring roll 237 to allow thread to be pulled off from the supply without at the same time pulling thread from the sewing instrumentalities and to allow the thread measured off from the supply to be used up correctly in the machine cycle.

These locking arrangements (Figs. 3, 13, 20 and 21) comprise two thread gripping devices arranged, one indicated at 63 between the thread supply and the thread measuring lever and the other indicated at 65 between the thread measuring lever and the sewing instrumentalities. The lower lock 63 is positioned at a level below that of the roll 235 and is mounted somewhat forwardly of the roll 237 on the vertical plate 217. The lower lock 63 comprises a thread engaging block 283 supported by a small bent bracket 285 secured to the vertical plate 217. The block 283 has on its right face a rounded rib 287 which extends forwardly and rearwardly of the machine and is received in a similarly shaped groove in the bracket 285 so that the block may rock about the axis of the rib to engage the thread evenly. A second thread-engaging block 289 cooperates with the thread-engaging block 283 to grip the thread and block 289 is formed on the one end of a stem 291 which extends through the vertical plate 217 within a sleeve 293 which is rotatably mounted in a boss 295 formed on the plate 217, but is prevented from endwise movement therein. The stem 291 is held against rotation and has a quick-acting thread 297 thereon with which meshes a similar thread on the inside of the sleeve 293. An arm 299 is secured on one end of the sleeve 293 and is connected by a link 301 to the upper end of a floating lever 303 (Fig. 14) which is pivotally connected at 304 between its ends to the upper end of a curved arm 305 of a bell crank lever 307 mounted to rock about a horizontal pin 309 secured to the vertical plate 217. Another arm of the bell crank lever 307 has a cam roll 313 extending from its lower end which engages in a cam groove in the cam member 59 secured to the rotary sleeve 51 on the shaft 49.

The thread engaging faces of the thread engaging blocks 283, 289 are of substantial length so that very effective locking of the thread is obtained during the setting of the stitch.

The upper lock is formed in part by the stationary thread guiding roll 241 (Figs. 13 and 14) and in part by the thread locking element 65 which comprises a thread clamping shoe arranged to be urged downwardly against the roll 241 to clamp the thread. To this end the clamping member 65 is mounted on a pivot 315 on the forward end of an arm 317 which is fast on a shaft 319 rotatable in the vertical plate 217 and on the other side of said plate the shaft has fast to it an arm 321 connected to a link 323, the lower end of this link being connected to the rear end of the floating lever 303. The ear 57 (Fig. 2) has formed on it a boss having a bore in it in which a plunger 325 (Fig. 14) is housed. The plunger 325 is urged upwardly by a spring 327 to bear against the end of the floating lever 303. The plunger 325 tends to rock the floating lever 303 about pivot 304 on the bell crank lever 307 in a counterclockwise direction looked at from the right and thus tends to swing the clamping shoe 65 down on to the thread passing over the roll 241 and also tends to rotate the threaded sleeve 293 associated with the lower thread lock to cause the thread-engaging block 289 to be moved towards the cooperating thread engaging block 283. One or other of the two upper and lower thread locking devices locks the thread at all times and assuming the upper thread lock to be closed and the lower lock open, the mechanism operates at the correct time in the cycle of the machine to lower the pivot 304 on which the floating lever 303 is mounted, and owing to the fact that the rear end of the floating lever is supported in a stationary position by the spring pressed plunger 325 while the upper lock 65 is closed the lowering of the pivot 304 will cause the forward end of lever 303 to move downwardly quicker than the pivot itself moves. Sometime before the pivot 304 is lowered as far as possible by its cam (e. g. when it has been lowered about half way) the downward movement of the forward end of the floating lever will have rocked the threaded sleeve 293 so far that the thread-engaging block 289 of the lower thread lock will grip the thread against the cooperating stationary thread-engaging block 283. When this has occurred further downward movement of the forward end of the lever 303 is prevented and continued movement in a counter-clockwise direction of the pivot 304 will cause the floating lever 303 to pivot about the pivotal connection at its upper end with link 301 and thus the rear end of the floating lever will now move downwardly and cause the clamping shoe 65 to rise out of contact with the thread. During this downward movement of the floating lever 303 the plunger 325 will be moved downwardly compressing the spring behind it to maintain the lower lock closed upon the thread. When the bell crank lever 307 is later swung in a clockwise direction by its cam 59, the floating lever 303 is constrained by the plunger to move in a counter-clockwise direction about the pivot at its upper end thus lowering the clamping shoe 65 on to the thread roll 241. Immediately the downward movement of this clamping shoe is arrested by contact with the thread on the roll, the rear end of the lever 303 is held stationary and continued upward movement of lever 303 causes the lower thread-lock 63 to unclamp the thread. An auxiliary tension spring 329 (Fig. 2) is coupled to the short arm 299 secured to the threaded sleeve 293 and assists the spring pressed plunger 325 to maintain lower thread lock 63 in thread-clamping position until the thread is clamped by the upper lock.

The rotary take-up device (Figs. 22, 23, 37 and 38) for paying thread out to the sewing instrumentalities at the correct rate for the formation of the stitches and for drawing the formed stitches down on to the work and to set the thread locks within the work is situated at the right hand end of the horizontal shaft 49 and comprises a single thread take-up roll 331 mounted eccentrically upon a pinion 333 which is itself eccentrically carried upon a disc 335 secured to the sleeve 51 close to the right of the vertical plate 217 which sleeve is rotated around the shaft

49 having a rocking movement about its axis as the sleeve rotates. The sleeve is rotated by a crank 337 operated by a link 339 from the train of gears which rotates the sleeve. The shaft 49 carries at one end a pinion 341 which meshes with the pinion 333 on which the take-up roll is carried eccentrically and the rotary movement of the sleeve 51 about the shaft 49 and the rocking movement of the shaft combine to cause the thread take-up roll to move at a constantly varying speed in a closed non-circular path non-symmetrical about the axis of the shaft 49. The construction and arrangement of this rotary take-up device are similar to that of the rotary take-up device described in an application for Patent Serial No. 623,378 filed July 19, 1932.

Means for feeding the work step by step through the machine comprises a horizontally swinging work-supporting table 161 and cooperating presser-foot 281 illustrated in Figs. 14, 26 and 29.

The work table 161 comprises a member 343 which, in plan, is more or less of a horseshoe shape joined by a bridge piece at the front of the machine, the upper surface of which constitutes the work-support. At its rear member 343 has formed on it a long downwardly extending vertical sleeve 345 which surrounds a stationary and vertical spindle 347 the axis of which is positioned in the needle and awl plane rearward of the axis about which the needle and awl rock and secured at its lower end in a stationary lug 349 (Fig. 14). The sleeve 345 rests at its lower end upon a ball race 351 mounted in lug 349. The sleeve 345 extends along the stationary spindle 347 for about three-quarters of the length of the latter and the member 343 has further formed on it a second shorter sleeve 353 which embraces the top of the stationary spindle. A fixed support 355 for the spindle projects forwardly from the machine head between the two sleeves 345 and 353 on the member 343. The member 343 has an integral arm 357 which has pivotally connected to it a short double link 359. The rear end of link 359 is pivotally connected to the ends of a link 361 the members of which are of the same length as the link 359. The forward ends of the double link 361 are pivoted on vertical pivot pins 363 between the members of a bifurcated bracket 365 mounted on fixed vertical pivot studs 367. The length of the members of bracket 365 is the same as that of link 361 and the said pivot studs 367 occupy such a position that in one position of the double link 361 the pivotal connections between the double link 361 and the short link 359 become coaxial with the pivot studs 367. The studs 367 extend above and below bracket 365 so that link 361 can swing freely about its pivot 363. A further link 369 is connected to the pivotal connection between link 361 and link 359 and is pivoted at one end to a cam lever 371 which rotates about a fixed shaft 373 and engages the cam block 35. When the said cam lever 371 is rocked link 361 is rocked about the pivot 363 thus swinging link 359 and causing movement of the work table 161 about spindle 347. The extent of lever 371 and the proportions of the various links are such that when link 361 is swung as far over towards the left by the cam as possible, the axis of the pivotal connection between the double link 361 and the short link 359 comes into coaxial relation with the pivot studs 367, as referred to above. This fact ensures that the work table shall, at the end of its movement in the direction of feed, always occupy the same position relatively to the needle and awl. Adjustment of the position of bracket 365 about pivot studs 367 changes the position in the machine of the pivot connection 363 and thereby alters the direction of the path through which the pivotal connection at the rear end of the link 361 moves, thus adjusting the distance through which the work table is swung about the stationary spindle 347 by the action of the cam. The arrangement is such that variation in the extent of movement of the work table 161 due to adjustment of the adjustable bracket 365 is obtained by a variation in the position limiting the back feeding movement of the table 161. The adjustment in the position of bracket 365 is effected by movement of either one of two hand levers 375, 377 each with a suitable friction lock which are coupled to bracket 365 and extend towards opposite sides of the machine within convenient reach, respectively of the left and right hands of the operator.

The work supporting portion of the work table 161 has a curved slot 379 concentric with the axis of the stationary spindle 347 through which the needle and awl pass.

The work table constitutes one of a pair of work feeding members which carry the work from right to left in a stepwise manner and the presser foot 281 is arranged to grip the work when the table is at the right hand end of its swinging movement and to carry it so far that when the awl and needle enter the work the latter will be adequately held by the presser foot. As above stated, the work table moves to a constant position to the left regardless of the adjustment of bracket 365 and the presser foot also moves to a similar position. This arrangement enables the presser foot to support the work against the action of the awl close to the right hand side of the latter for all lengths of work feed.

To support the presser foot the work table member 343 has a pair of upstanding ears 381 near its rear which have bearings for a horizontal pin 383 on which a curved presser foot lever 385 is pivoted. The forward end of lever 385 extends over the work table and the presser foot 281 is secured thereto to overlie the work table over the right hand end of the slot 379. A lug 387 (Figs. 14, 18 and 19) formed on the presser foot lever 385 has universally connected to it a link 389 which is similarly connected to the forward end of an arm 393 of a yoke 395 freely mounted on a shaft 397 which yoke has at its right end an arm 399 which lies beside and is coupled to an arm 401 of a bell-crank lever 403 mounted to rock about the shaft 397. The bell crank lever 403 is prevented from moving along the said shaft by the adjacent parts. The other arm 405 of bell-crank lever 403 is connected by a rod 407 to a link 409 (see also Figs. 24 and 25). The forward end of link 409 is connected by a pin 411 with the stirrup 279 which is located in a guideway in a block 412 secured to the machine frame. The finger 269 bears against the underside of the stirrup 279 to control the stroke of the thread measuring lever. The spring 277 (Fig. 3) normally urges the finger 269 upwardly and tends to lift the stirrup 279 and therefore the forward end of link 409, thus tending to urge the presser foot towards the work table. The rear end of link 409 is connected by a rod 413 to an arm of a

bell-crank lever 415 operated by cam 265 to lift the presser foot away from the work at the correct times. The lower end of rod 413 is connected to the lever 415 by a bolt 416 which passes through a slot 417 in the bell-crank lever, whereby the movement imparted to the rod by the action of the cam may be varied.

The mechanism for urging the presser foot down on to the work is automatically locked in position each time when the presser foot has been urged against the work by the spring controlled finger 269 on the stirrup 279 in order to hold the presser foot against movement upwardly as the result of upthrust on it due to upward pressure exerted on the work by the piercing action of the awl. For this purpose the rear end of link 409 to which bell crank lever 415 is connected is, except for the small amount of swinging movement above referred to, held in fixed position during work feed and the forward end of link 409 has loosely mounted upon pin 411 a pair of depending wedge plates 419, 421 (Fig. 25) located side by side but spaced apart somewhat. The outer faces of the two wedge plates are parallel and the wedge plates are located within the fixed guideway 412, the front and rear sides of the guideway bridging across the space between the wedge plates. The inner opposing faces of wedge plates 419, 421 are relatively inclined so that the space between them gradually diminishes towards their ends. The lower ends of the plates are turned towards each other and have a tongue and groove connection 423 with each other to maintain them in relation. Also loosely carried by the pin 411 is a central wedge member 425 which extends centrally of the space between wedge plates 419, 421 and member 425 is so tapered that its sides lie parallel with the inclined sides of the wedge plates. The diameter of the bearing in the central wedge member 425 is slightly greater than that of the pin 411 which supports it and a bent leaf spring 427 resting upon the inner faces of the inturned lower ends of the wedge plates 419, 421 engages the bottom of the central wedge member 425 and urges it upwardly against the underside of the said pin 411 while the outer wedge members (the diameters of the bearings in which are also slightly greater than that of the said pin) are urged downwardly against the upper surface of the said pin. A relatively fixed bar 429 projects into the gap between the central wedge member 425 and the wedge plate 421 near the bottom of the latter and a series of steel rollers 431 of the same length as the width of the wedge plates are supported on the bar 429 and arranged one above the other in the space between the plate and the member, the rollers being of such a diameter that no two rollers can lie directly one behind the other but are caused to lie in a staggered relation so that alternate rollers engage respectively the central wedge member 425 and against the side of the wedge plate 421. The bar 429 is tapered on its upper face (as shown in Fig. 24) and can be adjusted to change the initial setting of the rolls. A presser foot locking finger 433 passes rearwardly into the gap between the wedge plate 421 and the central wedge member 425 and lies over the topmost roller 431 and is mounted to rock about a pivot 435 and has an arm 437 pivoted to the upper end of a spring pressed plunger 439 mounted in the upper end of a rod 441, the lower end of which is connected to a bell crank lever 443 rocked, when the presser foot is to be locked against the work, by a cam 445 (Fig. 4) on the main shaft 15. The finger 433 in moving downwardly presses the rollers which exert great side pressure against both the central wedge member 425 and the side wedge plate 421 with which they contact, thus urging the latter against the side of its guideway and locking the central wedge member 425 to the wedge plate 421 against downward movement. The wedge member 425 is supported laterally by a spacing piece 447 arranged between the central wedge member 425 and the wedge plate 419. The locking effect of the device arises from the fact that the bearings for the pin 411 both in the central wedge member and also in the wedge plates are larger in diameter than the pin and any tendency for downward movement of the pin due to lifting the presser foot causes a slight downward movement of the central wedge member 425 relatively to the wedge plates. Such movement is immediately resisted by the rollers. After a work feeding movement has finished and the presser foot has been lifted, returned idly to its right and allowed to engage the work once more preparatory to effecting another work feeding movement, the locking finger 433 is raised out of contact with the rollers so that the spring-urged finger 269 forming part of the thread measuring means and which engages the stirrup 279 may lift the latter to urge the presser foot against the work. After this has occurred, the locking finger 433 is once more lowered to lock the presser foot against the work.

Means is provided in the machine for automatically lifting the presser foot to a position in which it is well clear of the work. This means comprises a lever 669 which is allowed to come into position to be operated on by a cam 671 when the speed at which the machine runs has dropped and a brake is thrown in to stop the machine. The said lever operates by means of a rod 449 (Figs. 3 and 14) through a three-arm lever 451 to unlock the presser foot locking device by depressing the spring pressed plunger 439 to which the forward arm 437 of the locking finger is connected and to lift and maintain the presser foot out of contact with the work. When the treadle is depressed to cause the machine to be restarted the presser foot is again lowered and locked in work engaging position.

The presser foot may have a grooving knife 452 secured to its under face to cut within the upper face of the work a shallow groove in which the stitches may lie. When the presser foot has such a grooving knife secured to it, it is desirable that the presser foot shall be pressed just sufficiently hard against the work during the time that it is being moved idly towards the right after having completed a feeding movement to cut the groove. To this end the arm 399 (Figs. 14, 18 and 19) which is formed on the yoke 395 carrying the arm 393 and connected to the presser foot link 389 is coupled to one arm 401 of lever 403 by an eccentric coupling which can be made use of to lock arm 399 and lever 403 rigidly together when the presser foot has no grooving knife and is to be lifted above the work during its idle movement towards the right but can be adjusted to allow arm 399 to be urged downwardly relatively to the bell crank lever by a spring 463 to cause the presser foot to be urged against the work in spite of the upward swinging movement of lever 403 which tends to lift the presser foot away from the work. This eccentric coupling comprises a pin 453 which is rotatably mounted

in the arm 399 and extends into an enlarged opening 455 in the adjacent arm 401, of lever 403 as shown in Fig. 19. The pin carries within the opening 455 an eccentric disc 457 the diameter of which is less than the diameter of the said opening and also carries a head 459 (Fig. 14) by which it can be rotated. The arm 401 of lever 403 has projecting laterally from it a lug 461 which extends behind arm 399, the arrangement being such that the eccentric disc 457, when using a presser foot which has no grooving knife, engages the forward side of the opening 455 in the lever 403 and at this time lug 461 on the lever abuts against the rear side of arm 399 and thus couples the arm rigidly to the lever as shown in Figs. 18 and 19. When using a presser foot which has the grooving knife 452 on its underface, the eccentric disc 457 can be rotated through about one hundred and eighty degrees to provide a clearance between the front side of the opening 455 and the eccentric and thus allow arm 399 and the presser foot lever 385 to move forwardly and downwardly relatively to the lever 403 to allow the presser foot to remain pressed against the work in spite of the lifting action of lever 403. The spring 463 which urges the presser foot downwardly is housed in the lug 461 on lever 403 and tends to urge through a plunger 465, the arm 399 in a direction to maintain the presser foot against the work.

The machine is also provided with an edge gauge which can be easily assembled in the machine when desired and which can be brought into operation when for example it is desired to stitch a shoe the projection of the sole margin of which increases in width from the toe end towards the joint of the shoe and in which it is desired that the stitches shall lie on the sole margin a constant distance from the edge thereof.

This edge gauge comprises, as shown in Figs. 27 and 28, a shank 467 which is slidably mounted in a guideway formed in the right bracket 79 which supports the needle and awl, the guideway extending downwardly and rearwardly at an angle of about fifteen degrees and to the right of the machine from its forward end at an angle of about thirty degrees to the plane of the needle. The forward end 469 of the edge gauge proper is curved towards the needle and, when the edge gauge is in its most forward position, lies just above the work table 161 close behind the needle and awl path. The shank of the edge gauge has formed upon it a projection 471 which engages the forward face of a small cam 473 which is mounted to rock about a vertical axis and operates to move the edge gage forwardly, being held against the cam merely by the pressure of the work against the edge gauge. This arrangement enables the edge gauge to be drawn forwardly out of its guideway without difficulty if for example it is desired to substitute another edge gauge of different thickness. The downward inclination of the guideway for the edge gauge causes the sole-guiding face of the edge gauge to move downwardly below the level of the work table if the edge gauge is adjusted so far rearwardly that it lies behind rear edge of the work table. This arrangement allows the operator tipping the work so that the edge of the sole margin extends below and behind the work table while maintaining the sole edge in engagement with the edge gauge. The edge gauge can be moved forwardly into operating position by the snail cam 473 which is secured to the upper end of a vertical shaft 475 in a fixed bearing bracket 477 (see also Fig. 2). This shaft has gear teeth 479 formed axially along its lower end with which teeth a gear sector 481 meshes (see also Figs. 26 and 29). This gear sector is fixed to an arm 483 at the end of a hand lever 485 rotatably mounted on a vertical shaft 487. The other end of lever 485 is provided with a hand piece by which the lever may be rocked about shaft 487 to move the edge gauge. A friction device (not shown) is provided to bear against the lever to hold it in position. The lever is also provided with an adjustable screw 489 and a lug 491 which abut against a fixed stop face 493 and an adjustable screw 495 to limit rotation of the lever. The right end of lever 485 has a pin 497 on which is mounted one end of a rod 499. This rod has collars 501, 503 secured to it which are adjustable along opposite sides of a stud 505 on the hand lever 377 through which stud the rod extends. By moving the hand lever the work feeding movements of the work table and presser foot (and therefore the length of the stitches being made) is adjusted. The feed adjusting lever 377 moves over a segment 507 having holes 509 in which pins may be positioned to enable the operator to move the lever readily between predetermined positions.

The collar 503 may be so positioned relatively to the feed adjusting lever 377 that when the lever is moved forwardly to cause long stitches to be made along the waist of a shoe the edge gauge 469 (which will not be used when sewing in the waist) will be moved to an inoperative position, the work being guided by the forward edge of the work table. The collar 501 on the rod 499 may be so positioned relatively to the feed adjusting lever that when the lever is moved rearwardly to cause short stitches to be made when the forepart of the shoe is reached, the edge gauge is moved forwardly into an operative position, the precise position into which the edge gauge is so moved being determined by the setting of the rearward collar relatively to the feed lever.

The machine has a fudge knife which can be used to cut a shallow channel in the underside of the work, (i. e. in the welt of a welted shoe). This fudge knife comprises a stem 511 (Figs. 26 and 27) which is mounted in a holder 513 on the upper end of a rod 515 (see also Fig. 2) positioned to the right of the needle plane. The upper end of the stem 511 is bent towards the left and has on it a cutting edge which projects through the slot 379 to cut the channel in the work as it is fed by the work table and presser foot. The rod 515 passes downwardly through a sleeve 517 rotatably mounted in the bearing bracket 477 and the rod 515 has formed on it a thread which engages with a thread on the interior of sleeve 517. The sleeve has a gear sector 519 secured to its lower end to rotate it.

The gear sector meshes with the gear sector 481 so that when sector 481 is swung by lever 485 to cause the edge gauge to move into operative position the sleeve 517 last mentioned is rotated in such a direction that the rod 515 carrying the fudge knife is caused to move upwardly into operative position. If it is required to use the edge gauge without the fudge knife, the latter can easily be removed from its holder 513.

The machine is provided on the front side of the column with a wax pot 521 (Fig. 1) through which the thread passes from the supply on its way to the thread measuring device. The thread passes upwardly from this wax pot over and be-

tween the members of a tension device from which the thread passes to the thread measuring device. In order to ensure that the thread will be held under sufficient tension for it to be laid unfailingly in the needle barb by the looper, a friction thread tension device is provided between the rotary take-up roll 331 and the looper. This auxiliary thread controlling device comprises a downwardly extending leaf spring 523 (Fig. 13) secured to the rear of the member 213 on the upper end of which the thread hook 39 is formed and which spring operates, as the said member 213 moves rearwardly in laying the thread in the barb of the needle, to grip the thread yieldingly against a hub of the arm 317 which carries the thread clamping shoe 65 of the upper thread lock and thereby to make sure that the thread which is being laid in the needle barb by the looper is in tension between the looper and thread hook even if the rotary take up is at the time paying out more thread than is needed.

The construction of the countershaft and high and low speed driving clutch will now be described. The countershaft 525 (Fig. 1) is supported in bearings 527, 529 secured to the machine near the lower end of the column and has fast and loose pulleys 531, 533 over which a belt passes from suitable line shafting. The countershaft has freely mounted on it a relatively small grooved pulley 535 coupled by a round belt 537 to a relatively large pulley 539 (Fig. 39) mounted on the main shaft 15 and a relatively large grooved pulley 541 which is arranged on shaft 525 behind the smaller pulley 535 is coupled by a belt 543 to a relatively small pulley 545 (Fig. 39) on the main shaft. Secured to the countershaft so as to rotate therewith but being movable axially along it between the large and small pulleys 541 and 535 is a driving member 547 in the form of a disc which has fixed to its rear face a leather ring 548 arranged to engage and grip the large pulley 541 when the driving member 547 is moved rearwardly. The driving member 547 also has fixed on its front face a leather ring 551 which engages the small pulley 535 when moved forwardly. The driving member 547 has fixed to it a pin 553 which passes through a slot extending along and passing through the axis of the countershaft 525. A spring pressed plunger 555 mounted in the countershaft engages the pin 553 and normally presses the driving member forwardly into engagement with the small pulley 535 so that the small pulley is normally coupled to the countershaft. A circular plate 557 is secured to the countershaft in front of the small pulley and has a leather ring 559 secured to its rear face. The relatively small pulley 535 is free to move to a slight extent along the shaft and when the driving member 547 is moved along the shaft into engagement with it, the relatively small pulley is urged against the plate 557 and clamped between it and the driving member when the machine is being started. The driving member 547 is arranged to be moved to cause the machine to run at high speed against the action of the spring pressed plunger 555 away from the small pulley towards and into engagement with the large pulley by a treadle 561, normally raised by a spring 562 connected by an upwardly extending link 563 having universal connections at its ends to an arm 565 extending laterally from the end of a screw 567 which is threaded into and through a fixed sleeve 569 supported by a bracket 570 on the machine column. The rear end of this screw bears against the forward end of a stud 571 mounted in a bore in the forward end of the countershaft and bears at its rear end against the pin 553 in the driving member 547. The arrangement is such that when the treadle is raised the driving member engages the small driving pulley and by depressing the treadle the screw 567 is moved rearwardly moving the driving member rearwardly out of engagement with the small pulley and into engagement with the large pulley. The arrangement of the pulleys of the high and low speed driving clutch on the main shaft 15 of the machine is as follows. A bell-shaped member 573 encloses the left end of shaft 15 and pulley 545 is formed on the outside portion of the bell-shaped member. As shown in Fig. 39, the pulley 545 has two grooves in either of which the belt may be run to give a choice of high speeds.

To the rim of the bell shaped member 573 is secured a disc-like member 575 which has a relatively long sleeve 577 encircling shaft 15 and is rotatably mounted upon a bush 578. Thus the disc like member 575 forms a carrying member for the bell-shaped member 573. The relatively large pulley 539 is formed as an annulus mounted on the periphery of the disc-like member 575 and is prevented from moving axially by contact with, respectively, a face on the bell-shaped member 573 and a radial flange on member 575. A radial bolt 579 (Figs. 39 and 40) passes through the relatively large pulley 539 and clamps to the inner face thereof a small block 580 within a recess 581 cut in the member 575. The recess 581 is approximately twice the length of the block 580 and provides a lost motion device between the high speed and low speed pulleys 545 and 539. The block 580 has a pin 583 projecting from its left face and engages the forked end of a short swinging lever 585, the inner end of lever 585 being wedge shaped engages a recess in a stem 589 parallel to the main shaft 15 and housed within the sleeve 577 of the disc-like member. The said short swinging lever is pivoted about midway of its length on a pin 591 extending from member 575. The left hand end of the stem 589 projects beyond the end of shaft 15 and is turned inwardly across the latter. Shaft 15 has a bore 593 containing a sliding rod 595 (normally urged towards the right by a spring 597) and its left end is threaded. Nuts 599 are provided on the threaded end of rod 595 to couple the rod to the stem 589 through which it passes. The right hand end of rod 595 has fixed in it a pin 601 which projects radially through a slot in the main shaft, 15. The pin 601 has secured on it a cam piece 603 outside the main shaft.

The disc-like member 575 is formed with a coned recess 605 to be engaged by a leather covered part 607 on a clutch member 609 keyed to and slidingly mounted on the main shaft 15. The right face of part 607 is arranged to be moved towards the right, when the machine is to be stopped, into engagement with a leather braking ring 611 secured on the left face of the clutch supporting bracket 19. The clutch member 609 has a hub member on its right surrounding the main shaft and having an inclined groove 615 around its periphery. Freely mounted in groove 615 is a swash ring 617 having extending from it a little below the axis thereof pins 619 which are rotatably mounted in a swinging lever surrounding the hub 613 of clutch member 609. The lever 621 has formed on it a ball 623 confined in spherical recesses in the ends of two axially alined screws 625 adjustably mounted in clutch

supporting bracket 19 parallel to the main shaft. The lower side of lever 621 has pivoted on a pin 627 fixed in it a block 629 arranged to be engaged by a block 631 forming a hook on a clutch-controlling lever 633. When the hooked end of lever 633 engages the block 629 on lever 621 the part 607 of the clutch member 609 is held out of engagement with the recess 605 in member 575 against the action of springs 635 mounted in recesses formed in the hub 613 of the clutch member 609 and engaging a collar 637 on the main shaft 15, which springs tend to thrust the coned part of the clutch member into engagement with the recess 605. Also when the hooked end of the clutch lever is in engagement with the block on the swinging lever the right face of the coned part of the clutch member 609 is brought into engagement with the leather braking ring 611 on the left end of bracket 19 to stop the machine. The clutch member 609 rides into engagement with the driving member 575 when the clutch lever 633 is out of engagement with the block 629 and because the pins 619 are below the axis of the main shaft 15 the swinging lever is caused to swing idly about the ball 623. When, however, the clutch lever 633 is allowed to engage the block 629 the swinging lever is prevented from swinging towards the left and is held stationary so that the clutch member 609 is moved to the right, withdrawing it from engagement with the disc-like member 575 and moving the clutch member into engagement with the clutch supporting bracket to stop the machine. As will be clear from what has already been said when the clutch lever 633 is moved downwardly away from the block 629, the springs 635 in the clutch member move the clutch member towards the left so as to disengage it from the bracket 19 and move it into engagement with the disc-like member 575 to drive the machine.

The clutch lever 633 is secured mid-way of its length on a horizontal shaft 639 rotatably mounted in the bracket 19 and the right arm 640 of the lever 633 has a horizontal pivot 641 carrying a spring latch 643. The rear end of shaft 639 to which the clutch lever 633 is secured has fixed on it an arm 645 and has threaded through it a vertical adjustable screw 647 arranged to be engaged by the upper end of a cam member 649 secured on a shaft 651 rotatably mounted in a bearing on the bracket 19. The shaft 651 has fixed to it an arm 653 which is connected by a rod 655 to the treadle 561. This arrangement is such that during depression of the treadle 561 the upper end of the cam member 649 engages the lower end of the screw 647 in the arm 645 and thereby rocks shaft 639 in a direction to disengage the hooked end of the clutch lever 633 from the block 629 to allow the clutch to be closed. Pivotally mounted on a stud 659 fixed in the bracket 19 is a cam lever 657. The lower end of the cam lever has on it a roll 661 (Fig. 43) actuated by a cam face 663 on cam 649. The lower end of cam lever 657 also has fixed on it a plate 665 over which latch 643 snaps when the treadle is pressed fully down. The upper arm of cam lever 657 has formed on it a ball 667 which enters a recess in the lever 669 (Figs. 41 and 42), previously referred to as forming part of the mechanism for raising the presser foot on stopping. The forward end of lever 669 is arranged at different times to be engaged by the cam piece 603 and also by a cam 671 on the main shaft. The rear end of lever 669 is secured to a substantially vertical pin 673 rotatably mounted in a block 675 secured to a rocking shaft 677 rotatably mounted in bearings at the rear of the machine so that lever 669 can swing to rotate the rocking shaft 677 and can swing laterally so that its forward end moves along the main shaft. The pin 673 to which lever 669 is secured has fixed on its upper end a finger piece 679 the end of which enters a recess in a spring pressed horizontal plunger 681 (Fig. 41) mounted in block 675. The plunger 681 is arranged to engage a pin 683 fixed on the machine frame when lever 669 is raised to hold the lever in this position.

When the machine is to be stopped the small pulley 535 on the countershaft 525 is coupled to the driving member 547, the relatively large pulley 539 on the main shaft 15 being thereby driven. The small pulley 545 on the main shaft 15 will rotate idly the relatively large pulley 541 on the countershaft 525 which pulley at this time is freely rotatable on the countershaft. The lever 669 will in previously stopping of the machine have been raised by its cam 671 on the main shaft and will be held in raised position by the spring plunger 681 and will, through the rocking shaft 677 be holding the presser foot raised and also the lower thread lock 63 unlocked, the upper thread lock having been also unlocked. When the treadle 561 is first depressed the cam member 649 is swung upwardly and through the vertical lever 657 which it actuates, swinging lever 669 away from its cam 671 and releasing the spring plunger 681 so that lever 669 can swing downwardly towards the main shaft and shaft 677 can rotate to allow the presser foot to drop and the lower thread lock to be closed. Upon further depression of the treadle the upper end of cam member 649 engages the lower end of screw 647 on the clutch lever and rocks shaft 639 in a direction to disengage the hooked end of the clutch lever from block 629 and allows the clutch to close, the machine being driven at the slow speed. When the treadle is still further depressed the arm 640 is raised still further by the cam 649 until latch 643 engages plate 665 on the lower end of cam lever 657 and during this further downward movement of the treadle the driving member 547 on countershaft 525 is moved along the shaft out of engagement with small pulley 535 on the countershaft and into engagement with large pulley 541, the machine being then driven at the high speed. When the machine is being driven at high speed large pulley 539 on the main shaft is being driven by the engagement of the recess 581 in the periphery of the disc-like member 575 with the block 580 on the inner face of large pulley 539 and small pulley 535 on the countershaft then disengaged from the driving member 547 on the countershaft, is driven idly. Owing to the fact that recess 581 in the disc-like member 575 is wider than the block 580 relative movement about the axis of the main shaft between member 575 and large pulley 539 takes place when the speed of the main shaft is changed from the low speed to the high speed and vice versa. This relative movement causes lever 585 to swing about its pivot 591 and through its wedge shaped inner end 587 to move stem 589 and rod 595. The springs 597 urge the rod towards the right and hold one face of the recess in the stem 589 against the swinging lever 585. The arrangement is such that when the machine is being driven at the high speed the cam 603 secured to the rod 595 is at the right end of its movement along the main shaft and when the machine is being driven at the low speed the

cam 603 is at the left end of its movement. When the cam is at the right end of its movement it is removed from beneath lever 669 and when it is at the left end of its movement it is beneath said lever and raises the forward end of this lever.

If when the machine is being driven at the high speed it is desired that it shall be driven at the slow speed, the treadle 561 may be allowed to rise so far only that the driving member 547 on countershaft 525 moves out of engagement with large pulley 541 and into engagement with small pulley 535. When the change of speed takes place the relative movement between member 575 and large pulley 539 on the main shaft takes place and cam 603 is moved to the left along the main shaft and comes beneath the end of lever 669. As the main shaft rotates the lever 669 is raised somewhat by the cam 603 but the lever is prevented from swinging laterally by reason of its being held in its left-hand position by cam 649 and lever 657 which the cam operates. While the main shaft 15 is being driven at the slow speed, the clutch lever 633 is held in its inoperative position by the engagement of latch 643 on arm 640 with plate 665 on lever 657.

When the treadle is allowed to rise fully cam 649 which it operates releases lever 657 and when cam 603 raises the lever 669 this lever can swing to the right over cam 671 on the main shaft, when a low part of the latter cam comes into a position to allow it to do so. When a high part of cam 671 engages lever 669 as the cam rotates this lever is rocked upwardly thereby rotating shaft 677 in a direction to unlock and raise the presser foot 281 and to unlock the lower thread lock 63. Lever 669 is held in its raised position by plunger 681 during any further rotation of the main shaft. When lever 669 swings to the right after being raised by cam 603 it swings the lower end of lever 657 to the left and releases latch 643 on arm 640 from plate 665 on the lower end of lever 657, so that the left end of the clutch lever 633 can be raised, by a spring not shown to position the hooked end of the lever in the path of the block 629 on lever 621. Thereafter the lower end of lever 621 moves to the left and its swinging movement is stopped. As the main shaft continues to rotate the clutch member 609 is moved out of engagement with the disc-like member 575 and into engagement with the braking ring 611 on the clutch bracket 19 to stop the main shaft.

It will be seen that this stopping arrangement is such as to bring the machine to rest always at the same point in the machine cycle without undue shock even though the machine be running at high speed and the treadle be completely released suddenly. The definiteness of the stopping position is assured by the fact that the application of the brake is directly controlled by the swash ring 617 on the main shaft 15 while the absence of shock is due to the impossibility of the swash ring becoming operative until the speed of the main shaft has fallen to the low driving speed, for it is only when the low speed driving pulley on the main shaft catches up the high speed pulley that the lost motion device consisting of the block 580 on the low speed pulley 539 and the recess 581 in the disc like member 575 becomes active to stop the machine.

The mechanism for lifting the presser foot out of contact with the work as the machine comes to rest comprises the three-arm lever 451 (Figs. 14, 15 and 16) which is rotatably mounted on a shaft 685. Lever 451 has an upwardly extending arm 687 to which the rod 449 is connected. Rod 449 is connected at its end to an arm 689 (Fig. 3) secured to the shaft 677 at the rear of the machine, which is rocked when lever 669 is rocked by its cam 671 so that lever 451 is rocked whenever the machine stops. Lever 451 also has an arm 691 formed as a cam face 693 engaging a roll 695 on the spring-pressed plunger 439 to which arm 437 of the presser foot locking finger 433 is connected. Lever 451 also has a short arm 697 carrying a pin 699. A manual adjustable presser foot lifting lever 701 is mounted upon an eccentric disc 703 (Fig. 15) formed on one end of shaft 685 and lever 701 lies close against lever 451. Lever 701 has a rearwardly extending nose 705 which overlies a lug 707 projecting from link 407 and lever 701 also has a forwardly projecting arm 709 which lies above pin 699 on lever 451.

As the machine comes to rest, shaft 677 at the rear of the machine is rocked in a clockwise direction looked at from the right and thus causes lever 451 to rock about shaft 685. As lever 451 is rocked the cam face 693 moves across and depresses the plunger 439, as shown in Fig. 14, thereby raising finger 433 and unlocking the wedge members 419, 421 of the presser foot locking device. When this has occurred pin 699 on arm 697 raises arm 709 of lever 701 thereby lowering nose 705 and raising the presser foot out of contact with the work. The eccentric disc 703 has an upwardly extending handle 711 (Figs. 15, 16) secured to it by which the disc may be rotated to raise or lower lever 701 bodily so that the extent of the rocking movement imparted to it by pin 699 when the lever 451 is rocked may be varied to cause the presser foot to be raised, as the machine stops, a greater or less amount in accordance with the thickness of the work, it being desirable that the lifting lever 701 be so adjusted when working on thin work that the presser foot is not lifted an undue amount above the work. If the presser foot were lifted a large amount above the work it would, when lowered on to the work next put into the machine, be caused to strike against the work with excessive force by the spring 277. Handle 711 on the eccentric disc 703 carries a spring pressed plunger 713 which moves over a sector 715 and serves, by engaging in one of a series of notches in the sector, to retain the handle in any position into which it may have been adjusted. Lever 451 has an upwardly extending handle 717 (shown in Figs. 2 and 3) secured to it which may be used to rock said lever in a direction to raise the presser foot at any time to allow the work to be removed from the machine.

The mechanism for unlocking the lower thread lock 63 comprises the arm 299 (Figs. 20 and 21) which is secured at its forward end on the left end of sleeve 293 associated with the lower lock. The rear end of arm 299 has fixed in it a pin 719 (Fig. 14) which passes through a slot formed in the upper end of a rod 721 which at its lower end is pivotally connected to an arm of a bell-crank lever 723 pivoted on a stud 725 fixed in the left side of ear 57. The other arm of bell crank lever 723 has pivotally connected to it the end of a rod 727 which rod extends rearwardly and is pivotally connected to an arm 729 (Fig. 3) secured to the shaft 677 at the rear of the machine. As shaft 677 is rotated as the machine comes to rest the threaded sleeve 293 of the lower thread lock is rotated and unlocks the lower thread lock. During the unlocking of the lower thread lock as the machine comes to rest the clamping shoe 65 of the upper thread lock which at this time

is raised above roll 241 is raised still further above the roll. Thus both the upper and lower thread locks are opened when the machine comes to rest to allow thread to be pulled freely through them and thus enable the operator to withdraw the work from the machine before severing the threads.

Means for lubricating the machine will now be described. In the hollow arm 53 of the machine base at the left hand end of the driven sleeve which surrounds the rotary takeup rock shaft 49 is an oil pump which comprises a pump bracket 731 (Fig. 37) extending upwardly into the forward lower end of the hollow arm shaft 49 from a plate 733 which is secured to the lower side of the hollow arm. The pump bracket 731 has slidingly mounted in a bore in it a vertical plunger 735 the upper end of which is pivotally connected by a pin 737 to the lower end of a link 739 the upper end of which embraces an eccentric 741 on the shaft 49, the arrangement being such that as the shaft is rocked the plunger is moved up and down. The lower end of the pump bracket 731 has formed in it a number of holes 743 through which the oil in the hollow arm passes and has within it a cylindrical gauze filter 745 through which the oil is drawn by the pump plunger 735 as it rises into the pump. Just above the filter the vertical bore in the pump bracket is a ball valve 747. Between the lower end of the plunger 735 and the ball valve 747 the bore in the pump bracket has an oil passage 749 which has in it a second ball valve 751. From the oil passage 749 a pipe 753 passes through the hollow arm and along the column of the machine to a bar indicated at 755 in Fig. 13 fixed in the upper part of a casing 756 on the machine. The bar 755 has formed in it a main oil passage 757 which extends along the bar and lateral oil passages 759. The lateral passages have fixed in them tubes carrying in their outer ends wicks which extent over cranks 18, 20, 25, 27 of the needle and awl driving mechanisms. The bar also has extending from it and connected to the main oil passage 757 a pipe which extends over the bevel gears 29, 31. Another pipe 761 along which oil is forced by the pump is fixed in the passage 757 and this pipe delivers oil into an oil chamber 758 in the upper portion of the head casting to lubricate the moving parts therein. The overflow of oil from chamber 758 passes down a bore 763 (Fig. 30) in the head casting on to the gearing 23 which drives the second crank shaft 21 and then to the gearing 55 which drives the driven sleeve 51 surrounding the third horizontal shaft 49 and back to the forward end of the hollow arm 53. The bearings of the main shaft 15 are lubricated by oil thrown off by the cranks of the needle and awl driving mechanisms. The bearings for the crank shaft 21 are lubricated by oil thrown off by the cranks of the needle and awl driving mechanisms. The box like chamber 758 in the upper portion of the head casting has formed in it a well into which oil forced up by the pump into the chamber flows and the crank mechanism 171, 173, 175 which drives the shuttle dips into this oil as it is rotated, and thus throws oil on to the spiral gears 43, 165 which drive the shuttle shaft and the cam track and cam roll of the thread lifter mechanism which are positioned in the chamber. Oil is also thrown by the said crank mechanism on to the upper end of the vertical shaft 33 which is bored axially and laterally so that oil can pass down the vertical bore in the shaft and along the lateral bores to passages in the cam block 35 on the said shaft which is positioned in an intermediate compartment 9 in the head casting which actuates the needle guide, thread hook and work feeding mechanisms. The cam block 35 has formed in it a chamber, not shown, filled with felt and the passages in the cam block connect the chamber and the cam grooves so that the various cam faces are continually lubricated. The vertical shaft 373 which actuates the work table to feed the work is also bored axially downward from its upper end and oil thrown off by the shuttle driving crank mechanism passes down the vertical bore in the said shaft and along lateral passages in the shaft to lubricate the cam lever. Any surplus oil which collects in the intermediate compartment drains down into the hollow arm 53 to the pump.

The manner in which the various instrumentalities of the illustrative machine cooperate in the stitching of a sole to the bottom of a welted shoe will now be described with reference to Figures 44 to 50. In the diagram of Figure 50 the several indicated ordinates represent degrees of rotation of the main shaft of the machine and the abscissae are indicative of the nature of the movements of the various instrumentalities throughout a complete machine cycle as follows:—

The line A—A represents the rising and falling movements of needle guide 37. The line B—B represents the needle movements. The line C—C represents the awl movements. The line D—D represents the rising movements of presser-foot 281. The line E—E represents the feeding movements of the presser-foot and table 161. The line F—F represents the movements of the presser-foot locking mechanism. The line G—G represents the rising movements of the thread lifter 163. The line H—H represents the thread measuring movements of lever 239 The line I—I represents the movements of thread locking devices 63 and 65. The line J—J represents the thread hook movements. The line K—K represents the movements of spring 523 on the thread hook. The line L—L represents the transverse movements of the looper 61. The line M—M represents the forward and rearward looper movements. The line N—N represents the action of the take-up 331. The line O—O represents the shuttle movements. The line P—P represents the movements of the presser-foot and thread lock 63 as the machine comes to rest. The line X—X indicates the surface of the work table 161.

When the operator has assured himself that the shoe is properly positioned on the work table 161 and that the forward edge of the latter is properly seated in the crease of the shoe he will, while grasping the loose ends of the shuttle thread and needle thread to assist the formation of the first stitch or two, depress the starting treadle 561 of the machine. The action of depressing the treadle allows the presser foot 261 to descend upon and become locked against the work close to the needle and awl, and allows the lower thread lock 63 to close upon the thread. The clutch upon the main shaft 15 then becomes engaged and the main shaft is rotated at low speed. Continued depression of the treadle causes the driving member 547 on the counter shaft to move into driving engagement with the large pulley 541 on the counter shaft to drive the machine at high speed.

As the main shaft of the machine rotates, the needle 67 first rises to its highest position (indicated at *a* on the line B—B) reaching this position after the shaft has rotated through about

sixty-five degrees. Thereafter the needle descends fairly rapidly through the work and reaches its lowest position (indicated at *b* on the line B—B) after the shaft has rotated through about one hundred and forty-five degrees. The needle barb is below the work while the main shaft rotates from about one hundred and fifteen degrees to about one hundred and seventy-five degrees and while it is below the work the thread is laid in it by the looper. The needle then continues to rise once more to its highest position (along the path *b c* on the line B—B) after the main shaft has rotated through about two hundred and twenty-five degrees. The needle then descends along the path *c—d* while the main shaft rotates through approximately a further sixty degrees and remains substantially in the position indicated at *d* above the work table during the completion of the machine cycle.

As the needle rises to the top of its stroke during the first sixty-five degrees of rotation of the main shaft the needle guide **37** remains at its highest position (as indicated by the portion to the left of the point *a* on the line A—A). As the needle is lowered towards the work to pierce it, the needle guide follows the needle down, at about the same speed until the shaft has rotated through about one hundred and twenty degrees when it reaches a point (indicated at *b* on the line A—A) above the work until the needle has commenced to rise through the work, the needle guide remaining in this position while the main shaft rotates through about forty-five degrees. As the needle rises to draw the loop of thread up through the work the needle guide also rises as shown by the path *c d* but somewhat more slowly than the needle so that the needle barb almost rises into contact with the needle guide which latter serves to prevent the thread from being drawn off the needle barb by the shuttle. When the needle commences to descend somewhat from the position indicated at *c* on the line B—B to allow the thread loop to be lifted out of its barb by the shuttle, the needle guide follows it down closely, still holding the thread in the needle barb until it reaches the position indicated at *e* on the line A—A when the needle barb advances slightly relatively to the needle guide and the shuttle then pulls the thread out of the needle barb. Thereafter towards the end of the cycle the needle guide rises again to its highest position. The indicated timing of the needle guide is such that the guide retains the thread loop on the needle for a short while after the shuttle would otherwise remove it from the needle and so as to ensure not only that when the loop is finally pulled off the needle it will ride smoothly out of barb but that the needle point will have descended to such a position as to be no longer able to strike the bight of needle thread extending from work to the rear of the shuttle. The awl **69** will rise upwardly in the plane of the needle, for piercing the work immediately as the machine starts into operation and will commence to pierce the work after the main shaft has rotated through about fifteen degrees, the time on the line C—C at which the awl commences to pierce the work being indicated by the point *a* on that line. The awl continues to rise through the work and reaches its highest point (indicated by the point *b*) after the main shaft has rotated through about forty-five degrees. The awl remains in this position until the needle has reached the top of its stroke and has partially descended towards the work and when the main shaft has rotated through about eighty-five degrees the awl commences to descend through the work, the point of the awl being close to the point of the needle and retiring downwardly at approximately the same speed as that at which the needle is lowered. The awl leaves the work after the main shaft has rotated through about one hundred and fifteen degrees and continues to descend until the shaft has rotated through about one hundred and fifty-five degrees, the descent of the awl being indicated on the line C—C of the diagram between the points *c* and *d*. Then soon after the needle has commenced to rise from its lowest position to take the thread loop up through the work, the awl is raised somewhat (its point still remaining below the work however) as indicated between the points *d* and *e* on the line C—C, in order that the needle segment may be swung rearwardly sufficiently far to raise the needle to its highest position without fouling the awl segment. After the needle has passed through its lowest position and, at the end of a complete rotation of the main shaft, will be moving upwardly from this position to pierce the work once more.

The presser foot **281** having been allowed to drop on to and to become locked against the work, it will remain stationary in this position while the main shaft rotates through just over thirty degrees and will, during the next forty degrees or so of the rotation of the main shaft, be raised gradually out of contact with the work as indicated between the points *a—b* on line D—D.

When the main shaft has rotated through about fifty-five degrees (i. e. after the presser foot has started to lift from the work) the presser foot and work table **161** commence to make their idle or return movement towards the right of the machine and continue this movement while the main shaft rotates about through a further forty degrees as indicated between the points *a—b* on line E—E. Just about the time when the presser foot reaches the top of its lifting movement (i. e. after the shaft has rotated through just over seventy degrees) the wedge locking mechanism **419, 421, 425** which normally locks the presser foot against being moved upwardly by the work piercing action of the awl starts to become unlocked as indicated between the points *a—b* on line F—F. The presser foot starts to fall once more towards the work immediately as it reaches its highest position and comes into yielding engagement with the work after the main shaft has rotated through about one hundred and ten degrees (as indicated by the point *c* on the line D—D) that is just after the presser foot and work table have concluded their return movement towards the right of the machine. The presser foot locking mechanism will be coming into action as the presser foot descends towards the work as indicated between the points *b* and *c* on the line F—F and will lock the presser foot against the work after the main shaft has rotated through about one hundred and twenty degrees. At this time therefore the presser foot and work table will be stationary at the right end of their return back feeding stroke and the work will be firmly clamped between them. The presser foot and work table remain in this position until the main shaft has rotated through approximately one hundred and ninety-six degrees and then commence to move towards the left at as nearly as possible a constant speed to cause stitch formation and setting in a position to the left of the needle plane. The feeding movement

of the work continues evenly until about six degrees before the completion of the rotation of the main shaft when the presser foot and work table come to rest, the former lying close to the needle and awl plane and remaining in this position, locked against the work, until it is raised once more in the next cycle of the machine. The commencement and end of the feeding movement are indicated respectively by the points *c d* on the line E—E. When the feeding movement of the presser foot and work table has proceeded about half way the cam lever **415** which normally acts to lift the presser foot imparts to the presser foot a gradual movement towards the work of a slight extent to compensate for the lifting action on the presser foot which the presser foot link **389** would otherwise exercise during the latter half of the work feeding movement. The thread lifter **163** only comes into operation after the needle has drawn a loop of thread up through the work and remains in a downward and rearward inoperative position while the main shaft is rotating through about one hundred and eighty degrees (i. e. until after the needle has begun to rise up through the work) from its initial position. At this time however the thread lifter commences to swing forward and upwardly as indicated between the points *a—b* on the line G—G and engages the right hand limb of the thread loop extending from the needle when the shaft has rotated through about one hundred and ninety-five degrees. After having engaged the thread, the thread lifter continues to swing upwardly and forwardly to open the loop for the entry of the shuttle beak up to the point indicated by *b* on the line G—G and then retires rearwardly and downwardly when the shuttle beak has engaged the thread as indicated by the part *b, c* of the line G—G. When the thread lifter has thus regained its original position, it remains inactive there during the completion of the machine cycle.

The pulling off of the thread from the thread supply takes place about half way through the cycle, the thread measuring lever **239** remaining stationary in its highest position until the presser-foot locking mechanism has operated to lock the presser foot in pressing engagement with the work, i. e., when the main shaft has rotated through about one hundred and twenty degrees. When this has occurred (and the extent to which the thread measuring lever **239** will be swung by its cam, thereby automatically determined in accordance with the thickness of the work beneath the presser foot) the thread measuring lever will be swung downwardly by its cam, as indicated between the points *a b* on the line H—H to pull off thread from the supply as the mainshaft rotates from about one hundred and twenty degrees to about two hundred and twenty degrees. The lower thread lock **63** must be unlocked before the thread measuring lever is actuated to allow the thread measuring lever to pull off thread from the supply. The lower lock remains in gripping engagement with the thread while the main shaft is making approximately its first twenty degrees of rotation and after that time (and as the main shaft rotates approximately through a further fifty degrees) the lock **63** becomes unlocked and the upper lock **65** becomes locked upon the thread. This change over of the thread locks is indicated between the points *a b* of the line I—I and at a point about midway between the points *a* and *b* both the upper and lower thread locks are in engagement with the thread for an instant. The lower thread lock remains unlocked and the upper lock remains locked upon the thread until the thread measuring lever has completed its thread pulling stroke (i. e. until the main shaft has rotated through about two hundred and twenty degrees). Immediately this has terminated, the upper thread lock commences to unlock and the lower thread lock to lock upon the thread, this change over being indicated by the portion *c d* of the line I—I and taking place while the main shaft is rotating approximately from two hundred and twenty-five degrees to two hundred and seventy-five degrees. The thread measuring lever remains stationary for a short time (as indicated by the portion *b—c* of the line H—H) during a part of the time when the changeover in the thread locks is taking place but while the lower lock is still moving into engagement with the thread, the thread measuring lever commences to rise, as indicated by the portion *c—d* of the line H—H, to release thread for stitch formation. The paying off of thread by the thread measurer takes place while the main shaft is rotating from approximately two hundred and fifty degrees to three hundred and thirty-five degrees and when the thread measuring lever has finished its upward movement in paying off thread, it rests there during the remainder of the cycle.

The thread hook **39** has a purely forward and rearward movement and remains in its forward inoperative position while the main shaft rotates from its initial stationary position through about seventy degrees. As the main shaft rotates further through about fifty-five degrees, the thread hook is moved rearwardly (as indicated by the points *a b* on the line J—J) to engage and draw back the thread and remains in its rearward position (as the looper moves across the needle in front of the latter) until the main shaft has rotated through about one hundred and fifty degrees, after which it moves forwardly again to release the thread (as indicated by the points *c—d* on the line J—J) until the main shaft has rotated through about one hundred and ninety-five degrees from its initial position and remains idly in its forward position throughout the remainder of the cycle. The leaf spring **523** secured to the rear side of the thread hook constitutes an auxiliary thread tension device and moves rearwardly with the thread hook (as indicated by the points *a—b* on the line K—K) to grip the thread against the hub of the arm **317** aforementioned to apply additional tension to the thread as the main shaft rotates from the position it occupies after having rotated through about ninety degrees to that which it occupies after having rotated through about one hundred and seventy-five degrees. By this time the looper will have laid the thread in the needle barb. The leaf spring **523** thereafter moves forwardly with the thread hook to release the thread, as indicated by the points *c d* on the line K—K and remains out of engagement with the thread during the completion of the cycle. Immediately the main shaft starts to rotate, the looper **61** commences to move towards the left from in front of the awl, as indicated by the portions between the points *a b* on the line L—L, reaching its extreme left hand position to the left of the needle after the main shaft has rotated through about sixty degrees. The looper starts to move rearwardly from its forward position soon after the main shaft starts to rotate and continues to move rearwardly while the main shaft rotates through

about sixty degrees indicated by the points *a b* on the line M—M. The looper remains in its rearward and extreme leftward position until the main shaft has rotated through approximately ninety-five degrees, when it starts to move forwardly (as indicated by the points *c d* on the line M—M) and to the right (as indicated by the points *c d* on the line L—L). The forward movement of the looper continues until the main shaft has rotated through nearly one hundred and forty degrees when the looper lies just in front of the needle and the looper thereafter moves rearwardly once more, as indicated between the points *d* and *e* on the line M—M, until when the shaft has rotated through almost one hundred and sixty degrees. The looper is then in its rearmost position having laid the thread in the needle barb. It then moves forwardly once more into its forward position as the shaft rotates through approximately a further thirty degrees, as indicated between the points *e* and *f* and remains in this position until the main shaft has completed its rotation.

The movement of the looper towards the right continues until the main shaft has rotated through almost one hundred and sixty degrees and the looper passes across the front of the needle when the main shaft has rotated through nearly one hundred and forty degrees. Immediately after the looper has reached its extreme right hand position, it commences to move towards the left as indicated by the portion *d e* of the line L—L until it lies once more in front of the awl path. The looper remains at rest in this position practically throughout the remainder of the cycle but commences to move almost imperceptibly towards the left at the extreme end of the cycle. The fact that the looper has been returned from its extreme right hand and rearward position to be in front of the awl path as the awl commences to rise towards the work (which it does during the latter portion of a cycle of the machine) ensures that the bight of thread extending between the looper and the work will not ocupy such a position as would render it liable to be pierced by the rising awl. In Figure 35 the dotted line X—X indicates the path of the eye of the looper with relation to the needle viewing this path perpendicularly to the general plane in which the eye moves, the position in which the needle intersects this plane being shown at Y. At Z is shown the position in which the looper eye, as indicated, dwells while the machine main shaft is rotating through about the last one hundred and seventy degrees of the cycle.

The rotary take-up roll **331** would as soon as the main shaft commences to rotate, move to effect setting within the work of the thread lock of the stitch last formed, but since it is assumed in the description now being given that the machine is just starting in operation on a shoe no previous stitch will have been made in the work, and the take-up device will merely operate to pull downwardly somewhat upon the threads held by the operator. During any succeeding cycle of the machine, however, the take-up device will operate to complete the setting of the lock of the stitch last formed within the work (the lower thread lock being locked on the thread and the upper lock unlocked) by the time the main shaft has rotated through about ten degrees, it being understood that the work will have been fed away from the stitching point by the presser foot and table one stitch length during the formation of the stitch and before the stitch setting takes place. The time in the machine cycle at which the stitch is finally set is indicated by the point *a* on the line N—N this line being indicative of the amount of thread paid out by the take-up device in a machine cycle to the sewing instrumentalities and pulled down from them to set the stitch lock within the work.

Immediately the thread engaging roll **331** of the take-up device has passed through the stitch setting position it commences to rise towards the work relatively slowly as indicated by the position *a b* on the line N—N to allow the looper to move rearwardly and towards the left in the early part of the cycle without straining the looper or the thread. During the time that the looper is moving in its curved path in front of the needle to lay the thread within the needle barb and the thread hook moves the thread rearwardly on the left of the needle, the take-up roll rises still closer to the work and commences to pay out thread somewhat more rapidly to allow of its being handled by the various instrumentalities without excessive tension being imparted to it. This portion of the function of the take-up device is indicated between the points *b* and *c* on the line N—N. When the thread loop has been laid in the needle barb and the needle starts to rise rapidly to draw the thread loop up through the work and to allow the thread lifter to open the thread loop for the reception of the shuttle beak, the thread take-up roll moves closer towards the work and pays out thread at an increasing speed, this portion of the thread paying out function of the take-up device being indicated between the points *c* and *d* on the line N—N. Immediately the shuttle beak has entered the thread loop and commences to lift the loop over the body of the shuttle, it is necessary that thread be paid out by the take-up very rapidly to enable the loop to pass over the shuttle easily and in order that this may occur, the thread take-up roll moves rapidly still closer to the underside of the work and pays out thread at an increasing speed. The function of the thread take-up roll in paying out thread at this period is indicated between the points *d* and *e* on the line N—N. Immediately the thread loop has passed over the highest part of the shuttle (which it does just before the main shaft has rotated through two hundred and eighty degrees) the thread take up roll moves downwards away from the work throughout the remainder of the cycle to draw the thread down rapidly over the shuttle and then to draw down by means of the loop of needle thread, a portion of the thread issuing from the shuttle into contact with the work ready for the stitch lock to be set within the work during the next cycle of the machine. This last mentioned thread-drawing down operation of the take-up device is indicated by the steeply sloping portion to the right of the point *e* on the line N—N.

The shuttle **47** which rotates twice in each cycle of the machine, is so positioned angularly in the machine that in the stopping position of the machine its beak is just to the left of the lower point in its path. The shuttle rotates in a counter clockwise direction when looked at from the front and the first of its two rotations is idle, that is to say, that the shuttle beak does not engage the thread during that time. The shuttle beak enters into the thread loop held open for it by the thread lifter **163**, during the second of its rotations when the main shaft has rotated through about two hundred and fifteen degrees (as indicated by the

point *a* on the line O—O) and thereafter rotates at an increased speed, to carry the thread loop over the shuttle. The thread loop is actually pulled off the shuttle by the take-up device when the machine has rotated through about three hundred and twenty degrees, as indicated by the point *b* on the line O—O.

When the stitching around the shoe is completed the operator allows the treadle to rise to its highest position to disengage the clutch and allow the machine to come to rest. As the treadle rises to its highest position and the speed of the machine drops during a succeeding cycle, the forward end of the forwardly and rearwardly extending lever **669** which is associated with the rocking shaft at the rear of the machine is lifted by the small cam **603** aforementioned (as indicated between the points *a b* on the line P—P) and thereafter swings along the main shaft towards the right (as indicated between the points *b c* on the line P—P) until the forward end of the lever rests upon its operating cam **671** on the main shaft. Continued movement of the main shaft serves to rock the forward end of the forwardly and rearwardly extending lever **669** upwardly, thereby rocking the rocking shaft **677** at the rear of the machine and consequently lifting the presser foot **281** and unlocking the lower thread lock **63**. The presser becomes lifted just before the completion of the rotation of main shaft (as indicated by the point *d* on the line P—P) and immediately this rotation has been completed, the driving clutch on the main shaft is automatically disengaged and the clutch member **609** which is keyed to the shaft is brought up against the stationary braking face **611** to arrest the shaft when the parts are in their correct stopping position. The lower thread lock **63** is opened automatically during the early portion of the rocking movement of the rocking shaft **677** after the main shaft has rotated through about two hundred and eighty-five degrees in the last cycle of the machine, as indicated by the point *e* on the line P—P.

To provide still further safeguard against the possibility of the awl piercing the thread, the looper-actuating mechanism may be modified so that, at the time the awl rises to pierce the work and during the long dwell of the looper, the looper will be positioned slightly to the left of the path of the awl movement (i. e., to the left of the point Z in Fig. 35,) thereby further ensuring that the thread passing from the looper will be positioned well out of the rising path of the awl. It is a virtue of the peculiar movement given to the looper in the illustrative machine (whether it be that shown by and previously described with reference to Fig. 35, or that modification thereof just described) that as the laying of the needle thread in the needle barb is accomplished without the looper eye moving in a looped path about the needle path, the legs of the loop drawn up by the needle are not crossed and consequently there is not only a reduced tendency for stranding of the thread, but a more attractive appearance is given to the completed stitch.

The thread lifter **163** of the machine which opens the loop of thread taken up by the needle for the reception of the shuttle beak moves upwardly and forwardly to open the loop and then commences its retirement soon after the shuttle beak has engaged the loop, but before the loop has left the needle barb, the retirement being an uninterrupted movement to its end. It may happen that when the machine is working at extreme high speeds, a certain amount of "whip" or slackness will develop in that leg of the loop passing up from the work directly to the needle when the shuttle beak has engaged the loop and, if this occurred, the thread lifter might foul that leg of the thread in retiring downwardly after the shuttle beak has engaged the thread. In order to avoid this possibility, the mechanism for operating the thread lifter may, if desired, be so modified that after the thread lifter has opened the thread loop and the shuttle beak has engaged it, the thread lifter descends only part way towards its position of rest during the completion of the machine cycle, and completes its descent early in the next cycle of the machine when there will be no thread passing up to the needle from the work.

In Fig. 44, the machine is shown at that point in its cycle at which the loop of needle thread is being drawn up through the work, a position corresponding to that indicated in Fig. 50, when the main shaft has rotated some 190 degrees from its starting position.

In Figs. 45 and 46, the machine is shown in the position which it occupies after the main shaft has rotated some 215 degrees, at which time the presser foot and work table have commenced their movement to the left. In these two figures, the needle guide is shown trapping the thread in the needle barb.

In Fig. 47, the machine is shown in the position which it occupies after the main shaft has rotated some 340 degrees and as the needle loop having left the shuttle is being pulled down to the work, it being observed that the shuttle driver **48** at this time has its trailing end in contact with the shuttle owing to the relative movement of the shuttle and driver which has allowed the loop to pass off the shuttle. The feed movement of the presser foot and table are nearly completed.

In Figs. 48 and 49, the machine is shown in its stopped position with the presser foot **281** lifted.

The vertical plate **217** which projects close against the right hand face of the upper and lower thread locks may be heated by an electric cartridge so that the wax on waxed thread passing through the locks from the wax pot **521** may be kept softened. A brass plate **336** (Fig. 2) may be provided to lie close to and parallel to the right hand face of the disc **335** carrying the take-up roll, and this plate may also be heated so that heat radiates to the left from it on to the said disc to maintain waxed thread passing around the take-up roll in flexible and softened condition. The said plate may, in addition to carrying an electric resistance heating element by which the plate as a whole is heated, carry a second resistance heating element which is so positioned in the plate that it lies directly opposite the position which the take-up roll **331** occupies when the machine is stopped, thus ensuring that ample heat will reach the take-up roll when the machine is temporarily stationary. Either or both of the said heating elements in the said brass plate may, if desired, comprise naked elements which, instead of being hidden in bores in the body of the said brass plate may be directly exposed to the atmosphere on that side nearer the disc carrying the take-up roll so that the heat radiated by them is the more intense. The said brass plate **336** may be pivoted at its rear on a fixed vertical pivot so that it may be swung away from the said disc **335** to allow thread to be threaded easily around the take-up roll **331** by

hand when threading up the machine. The shuttle of the machine may also be heated by a thermostatically controlled electric heating element located in its carrying bracket 179.

In order still further to heat the thread on its way to the looper, a readily detachable upstanding flue 767 (Fig. 1) may be provided which is positioned over the wax pot 521 which is secured to the front of the machine column below the thread locking and take-up devices. The said flue is sufficiently large at its lower end to collect all the hot air and vapours arising from and from immediately about the hot wax pot and communicates with a duct 769 at its upper end, the opposite sides of which duct lie close against the vertical plate 217 carrying the thread locks and the brass plate 336 just mentioned, respectively. The thread passes from the wax pot upwardly along this flue to the thread locking and take-up devices and therefore is subjected, for practically the whole of its length from the wax pot to the looper, to the action of the hot air and fumes arising from the wax pot. A loose tool and work supporting platform 771 is preferably as usual provided on the front of the machine column at a level below that of the take up and thread locking devices, and this acts to shield the operator from the heat of the wax pot, the said flue 767 extending through and closely fitting within an opening in said platform. The front wall of the duct 769 above said platform is hinged so that it can be swung downwardly when the aforesaid pivoted brass plate 336 is swung aside and the path of the thread between the platform and the looper be thus fully exposed for easy rethreading.

In order completely to guard against the waxed thread becoming chilled and hardened by draughts of cold air as it moves upwardly from a fixed tension wheel immediately above the wax pot to the lower thread lock, a fixed comparatively small bore tube may be secured to the machine within aforesaid flue 767 of a length to extend substantially the whole of the distance from the fixed tension wheel to the lower thread lock, and through which the thread passes upwardly and by which it is shielded.

The driving and stopping mechanism herein illustrated and described, the presser-foot mechanism, the looper mechanism, and certain features of the thread handling mechanism including the pull-off mechanism form the subject-matter of the following divisional applications: Serial No. 7,016 filed February 18, 1935; Serial No. 12,608 filed March 23, 1935; Serial No. 19,810 filed May 4, 1935; and Serial No. 18,129 filed April 25, 1935.

The nature and scope of the invention having been indicated, and a construction embodying the several features of the invention having been specifically described, what is claimed is:

1. A lockstitch outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl mounted to operate permanently in the same plane from opposite sides of the work, a presser-foot, a work support, a feed carriage mounted to move back and forth in the direction of feed upon which the presser-foot and the work support are mounted, mechanism for actuating the presser-foot comprising a pivotal lever and connections between the lever and the presser-foot acting when the lever is moved in opposite directions to raise and lower the presser-foot, a movable support on which the lever is fulcrumed, a spring acting to force the presser-foot yieldingly against the work when the support is unlocked, and means for locking and releasing the support during each stitch forming cycle of the machine.

2. A lockstitch outsole shoe sewing machine having, in combination, stitch forming and work feeding devices including a curved needle, a curved awl, a presser-foot and a work support, a feed carriage pivotally mounted to swing back and forth in the direction of feed upon which the presser-foot and the work support are mounted, a shaft, actuating connections between the shaft and the feed carriage comprising a swinging link, and means for adjusting the fulcrum of the link about a center in alignment with the other end of the link at one limit of its swinging movement to vary the extent of the feeding movements imparted to the feed carriage.

3. A lockstitch outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl operating from opposite sides of the work, two shafts arranged to rotate in opposite directions, two cranks on one of said shafts, actuating connections between one of said cranks and the needle, actuating connections between the other of said cranks and the awl, two cranks on the other shaft, connections between one of said last mentioned cranks and the needle actuating connections for modifying the movements imparted to the needle by the first mentioned crank shaft, and connections between the other of said last mentioned cranks and the awl actuating connections for modifying the movements imparted to the awl by the first mentioned crank shaft.

4. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the needle for actuating the needle, a second shaft, a crank on said second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the needle.

5. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the needle for actuating the needle, a second shaft arranged to run at twice the speed of the first shaft, a crank on said second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the needle.

6. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the needle for actuating the needle, a second shaft arranged to rotate in the opposite direction from the first shaft, a crank on said shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the needle.

7. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the needle for actuating the needle, a second shaft arranged to rotate in the opposite direction to the first shaft and at twice the speed, a crank on said

second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the needle.

8. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a curved awl, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the awl for actuating the awl, a second shaft, a crank on said second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the awl.

9. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a curved awl, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the awl for actuating the awl, a second shaft arranged to rotate at twice the speed of said first mentioned shaft, a crank on said second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the awl.

10. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a curved awl, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the awl for actuating the awl, a second shaft arranged to rotate in the opposite direction to said first mentioned shaft, a crank on said second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the awl.

11. A sewing machine having, in combination with the other stitch forming devices, a curved hook needle, a curved awl, a continuously rotating shaft, a crank on the shaft, a lever mounted on the crank, connections between the lever and the awl for actuating the awl, a second shaft arranged to rotate in the opposite direction to said first mentioned shaft and at twice the speed, a crank on said second shaft, and a connection between said last mentioned crank and said lever for oscillating the lever to modify the movements imparted to the awl.

12. A lockstitch outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl, operating from opposite sides of the work, two shafts arranged to rotate one at twice the speed of the other, two cranks on one of said shafts, actuating connections between one of said cranks and the needle, actuating connections between the other of said cranks and the awl, two cranks on the other shaft, connections between one of said last mentioned cranks and said needle, actuating connections for modifying the movements imparted to the needle by the first mentioned crank shaft, and connections between the other of said last mentioned cranks and said awl actuating connections for modifying the movements imparted to the awl by the first mentioned crank shaft.

13. A lockstitch outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl operating from opposite sides of the work, two shafts arranged to rotate one at twice the speed of the other and in opposite directions, two cranks on one of said shafts, actuating connections between one of said cranks and the needle, actuating connections between the other of said cranks and the awl, two cranks on the other shaft, connections between one of said last mentioned cranks and said needle actuating connections for modifying the movements imparted to the needle by the first mentioned crank shaft, and connections between the other of said last mentioned cranks and said awl actuating connections for modifying the movements imparted to the awl by the first mentioned crank shaft.

14. A lockstitch outsole shoe sewing machine having, in combination, work feeding and stitch forming devices including a work support, a presser-foot, a curved hook needle and a curved awl, means for actuating said work feeding and stitch forming devices comprising a plurality of horizontally arranged constantly rotating shafts, a constantly rotating vertical shaft, cams carried by said shafts, and lever and link connections between said cams and certain of said work feeding and stitch forming devices.

15. A lockstitch outsole shoe sewing machine having, in combination, work feeding and stitch forming devices including a work support, a presser-foot, a curved hook needle and a curved awl, means for actuating said work feeding and stitch forming devices comprising a plurality of horizontally arranged constantly rotating shafts located below and to the rear of the sewing point, a constantly rotating vertical shaft located to the rear and to one side of the sewing point, connections between said horizontal shafts and said work feeding and stitch forming devices for actuating certain of said devices, cams on said vertical shaft, and connections between said cams and said work feeding and stitch forming devices for operating other of said work feeding and stitch forming devices.

16. A lockstitch outsole shoe sewing machine having, in combination, work feeding and stitch forming devices including a feed carriage, a work support, a presser-foot, a curved hook needle and a curved awl operating from opposite sides of the work, a shuttle, a means for actuating said work feeding and stitch forming devices comprising a plurality of constantly rotating horizontal shafts located below and to the rear of the sewing point, connections between said shafts and the needle and awl for actuating the needle and awl, a constantly rotating vertical shaft located to the rear of the sewing point, connections between said vertical shaft and the shuttle for actuating the shuttle, cams on said vertical shaft, and connections between said cams and said work feeding and stitch forming devices for actuating certain other of said work feeding and stitch forming devices.

17. A lockstitch outsole shoe sewing machine having, in combination, work feeding and stitch forming devices including a feed carriage, a work support, a presser-foot, a curved hook needle and a curved awl operating from opposite sides of the work, a shuttle, a needle guide, a thread arm, a needle threading looper, a take-up, a pull-off, a thread lock located between the pull-off and the work, a thread lock located between the pull-off and the supply and a loop spreader, two shafts extending in the direction of feed, actuating connections between said shafts and the needle and awl, connections actuated from one of said shafts for unlocking and lifting the presser-foot, a plurality of additional shafts parallel to said main shaft, connections from said additional shafts for actuating the take-up, thread locks and looper,

a vertical shaft, and connections from said vertical shaft for actuating the loop spreader, the thread arm, the needle guide, the feed carriage, and the shuttle.

18. An outsole shoe sewing machine having, in combination, stitch forming and work feeding devices including a curved hook needle, a curved awl, a presser-foot and a work support, a feed carriage arranged to move back and forth in the direction of feed upon which the presser-foot and the work support are mounted, a channel cutter mounted on the presser-foot, means for holding the presser-foot in contact with the work during the back feed of the feed carriage, and means for back feeding the carriage while the awl is in the work.

19. An outsole shoe sewing machine having, in combination, stitch forming and work feeding devices including a cuved hook needle, a curved awl, a presser-foot and a work support, a feed carriage arranged to move back and forth in the direction of feed upon which the presser-foot and the work support are mounted, a channel cutter mounted on the presser-foot, and means for holding the presser-foot in contact with the work during the back feed of the feed carriage.

20. An outsole shoe sewing machine having, in combination, a work support, a presser-foot, a feed carriage upon which the work support and presser-foot are mounted, a curved hook needle and a curved awl mounted to operate permanently in the same plane from opposite sides of the work, a channel cutter mounted on the presser-foot, and means for holding the presser-foot in contact with the work during the back feed of the feed carriage.

21. An outsole shoe sewing machine having, in combination, a work support, a presser-foot, a feed carriage upon which the work support and presser-foot are mounted, a curved hook needle and a curved awl mounted to operate permanently in the same plane from opposite sides of the work, a channel cutter mounted on the presser-foot, means for holding the presser-foot in contact with the work during the back feed of the feed carriage, and means for back feeding the feed carriage while the awl is in the work.

22. An outsole shoe sewing machine having, in combination, a feed carriage, a work support and a presser-foot mounted upon said carriage, a curved hook needle and a curved awl operating permanently in the same plane from opposite sides of the work, mechanism for moving the feed carriage back and forth in the direction of feed to feed the work, mechanism for raising the presser-foot from the work during the back feed of the feed carriage, and means for rendering said mechanism inoperative to raise the presser-foot whereby the presser-foot is caused to remain in contact with the work during the back feed of the feed carriage.

23. An outsole shoe sewing machine having, in combination, a feed carriage, a work support and a presser-foot mounted upon said carriage, a curved hook needle and a curved awl operating permanently in the same plane from opposite sides of the work, mechanism for actuating the presser-foot to hold the work clamped between the work support and presser-foot during the forward feed of the feed carriage and for holding the presser-foot raised from the work during the back feed of the feed carriage, and means for adjusting said mechanism to hold the presser-foot yieldingly against the work during the back feed of the feed carriage.

24. A lockstitch outsole shoe sewing machine having, in combination, stitch forming devices, a work support, a presser-foot, mechanism for actuating the presser-foot comprising a pivoted lever, connections between the lever and the presser-foot acting when the lever is moved in opposite directions to raise and lower the presser-foot, a movable support on which the lever is fulcrumed, a spring acting to force the presser-foot yieldingly against the work when the support is unlocked, means for locking the support against movement in either direction and for unlocking the support during each stitch forming cycle, a thread measuring pull-off, means for actuating the pull-off comprising a swinging link and connections between the link and the pull-off, and connections actuated from said movable support for adjusting the fulcrum of said link to vary the extent of the movements imparted to the pull-off upon a variation in the thickness of the work between the work support and presser-foot.

25. A lockstitch outsole shoe sewing machine having, in combination, stitch forming devices, a work support, a presser-foot movable towards and from the work support, a thread measuring pull-off, means for actuating the pull-off comprising a swinging link and connections between the link and the pull-off, and connections actuated from the presser-foot for adjusting the fulcrum of the link about a center in alignment with the other end of the link at one limit of its swinging movement to vary the extent of the movements imparted to the pull-off upon a variation in the thickness of the work between the work support and presser-foot.

26. An outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl mounted to remain permanently in the same plane with relation to each other, needle and awl segments, supporting brackets on opposite sides of the needle and awl segments, in one of which brackets the needle segment is pivotally mounted and held against axial movement, a spindle rigid with the awl segment mounted in said brackets concentric with the needle segment, and means for axially adjusting said spindle to align the needle and awl.

27. An outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl mounted to remain permanently in the same plane with relation to each other, needle and awl segments, brackets on opposite sides of the needle and awl segments in which the needle and awl segments are concentrically mounted, and means for relatively adjusting said segments axially to align the needle and awl.

28. An outsole shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl mounted to remain permanently in the same plane with relation to each other, needle and awl segments, brackets on opposite sides of the needle and awl segments, a spindle rigid with the awl segment and having a bearing in both brackets, a sleeve rigid with the needle segment having a bearing in one of said brackets, concentric with said spindle, a bearing sleeve for the spindle mounted in the other bracket, and means for adjusting said sleeve axially to align the needle and awl.

29. An outsole shoe sewing machine having, in combination, stitch forming devices including

a curved hook needle, a needle guide, a loop taker, and a loop spreader for opening each loop of needle thread drawn through the work and for presenting the spread loop to the loop taker, and means for actuating the needle guide to retain a loop of thread on the needle after the loop taker would otherwise remove it.

30. A shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl operating from opposite sides of the work, a looper arranged to move across and outside the path of the needle and awl in looping and to return by the same path after the looping operation, and means for actuating the looper to retain it in a position in front of the awl path while the awl engages the work to insure that the thread between the looper and the needle will not contact with the awl.

31. A shoe sewing machine having, in combination, stitch forming devices including a curved hook needle and a curved awl operating from opposite sides of the work, a looper arranged to move across and outside the path of the needle and awl in looping and to return by the same path after the looping operation, a take-up for drawing thread through the looper, and means for actuating the looper to retain it in a position in front of the needle and awl while each stitch is being set to prevent straining of the looper.

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