

June 19, 1923.

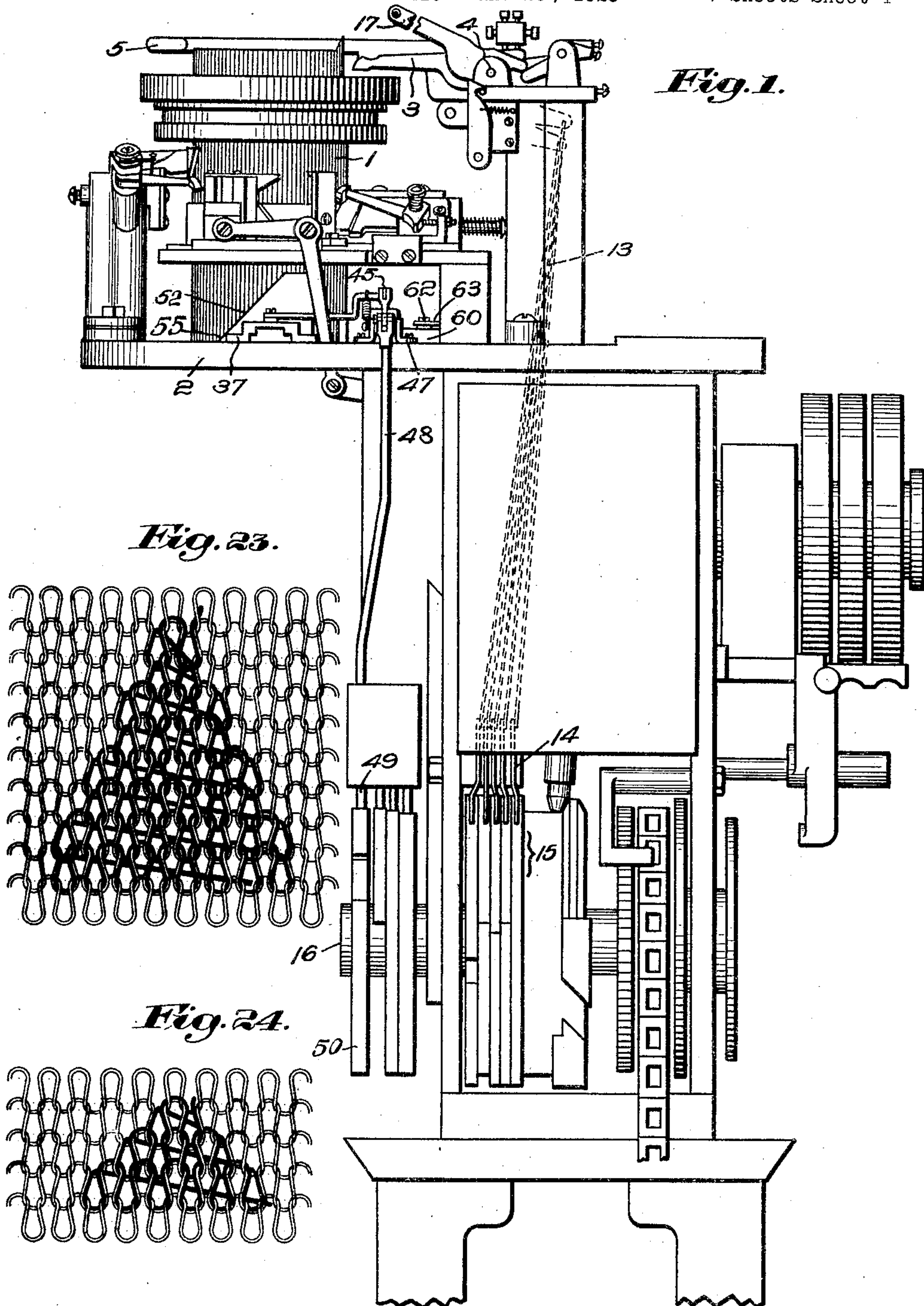
1,459,157

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KNITTING MACHINE AND METHOD OF FORMING REINFORCEMENTS

Filed Jan. 20, 1923

7 Sheets-Sheet 1



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June 19, 1923.

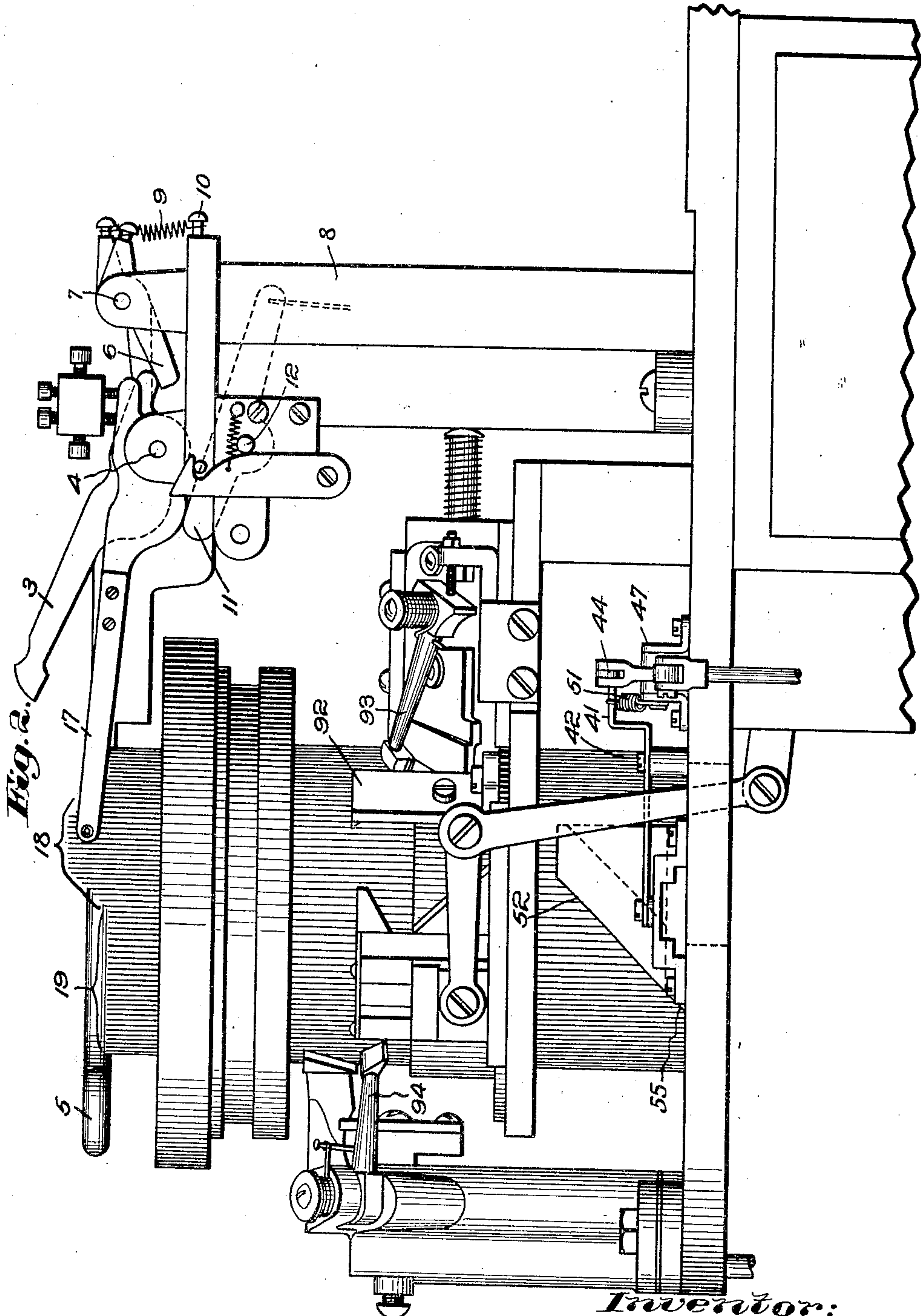
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KNITTING MACHINE AND METHOD OF FORMING REINFORCEMENTS

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7 Sheets-Sheet 2



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1,459,157

KNITTING MACHINE AND METHOD OF FORMING REINFORCEMENTS

Filed Jan. 20, 1923

7 Sheets-Sheet 3

Fig. 6.

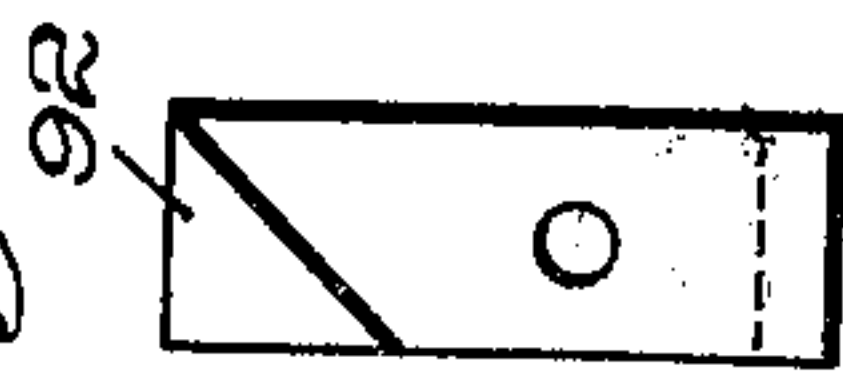


Fig. 7.

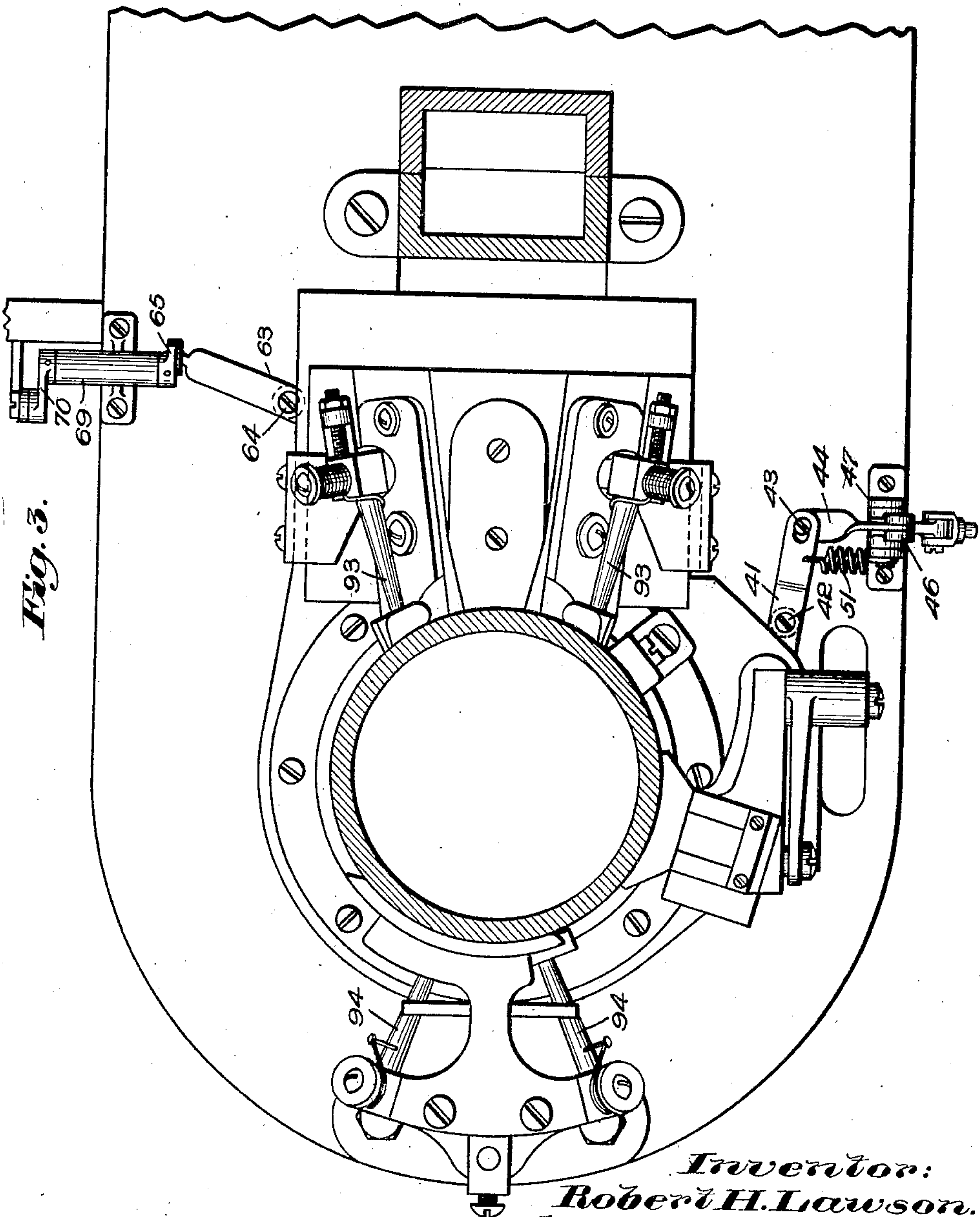
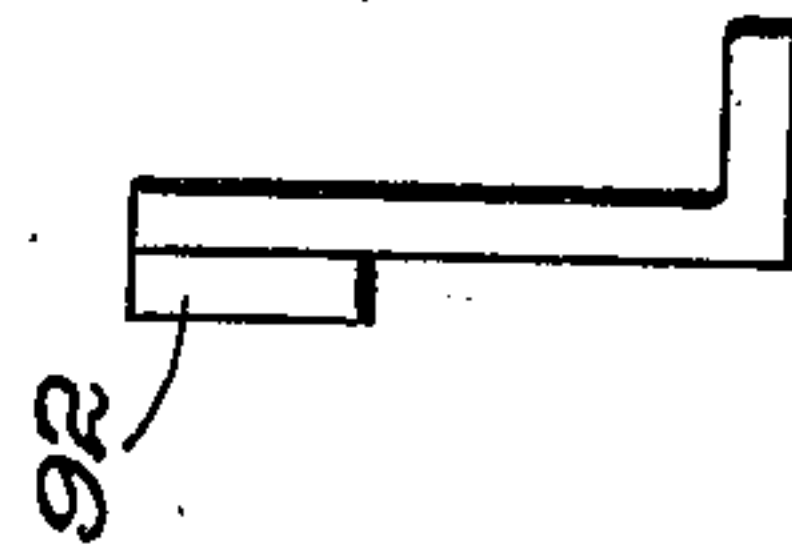


Fig. 3.

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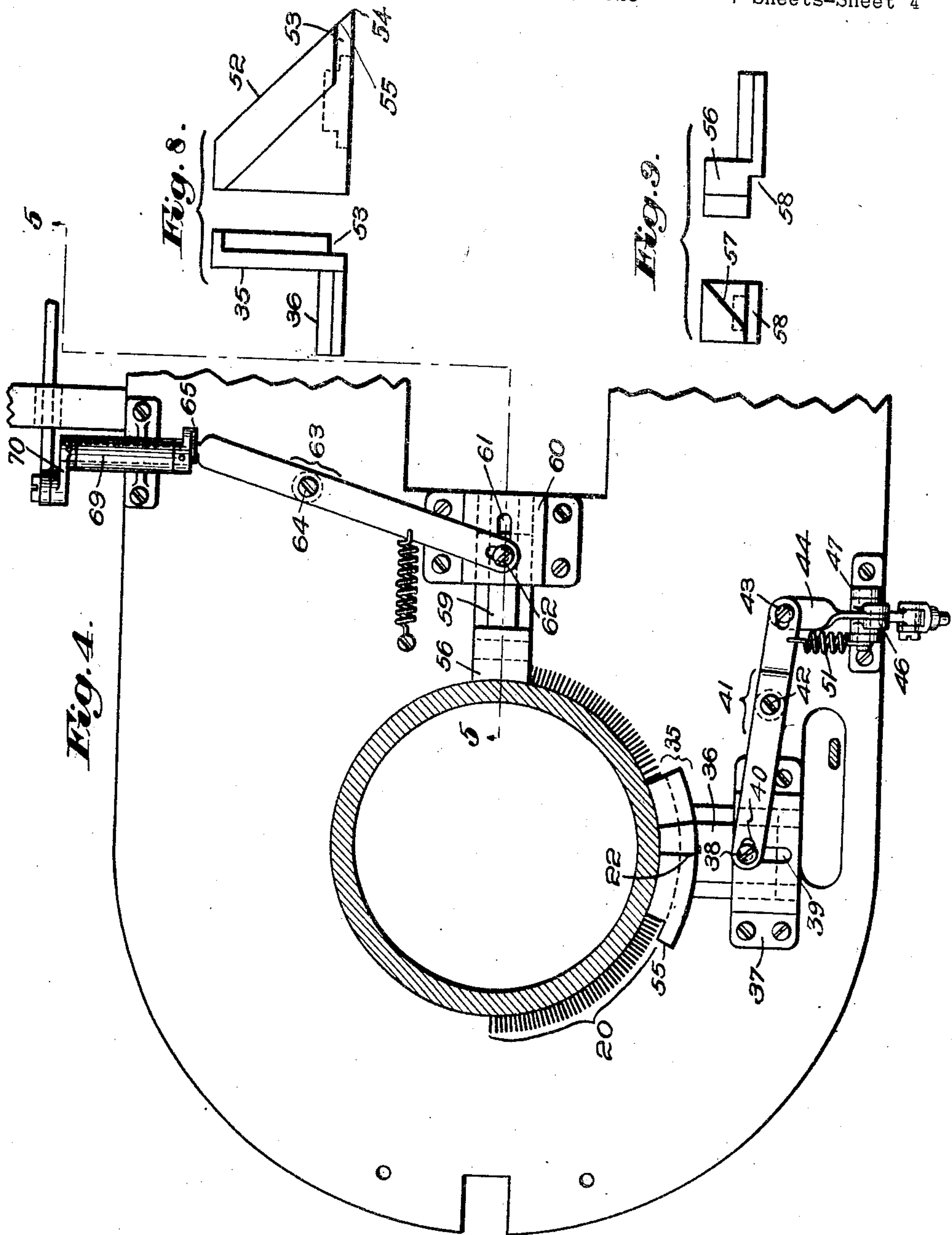
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KNITTING MACHINE AND METHOD OF FORMING REENFORCEMENTS

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7 Sheets-Sheet 4



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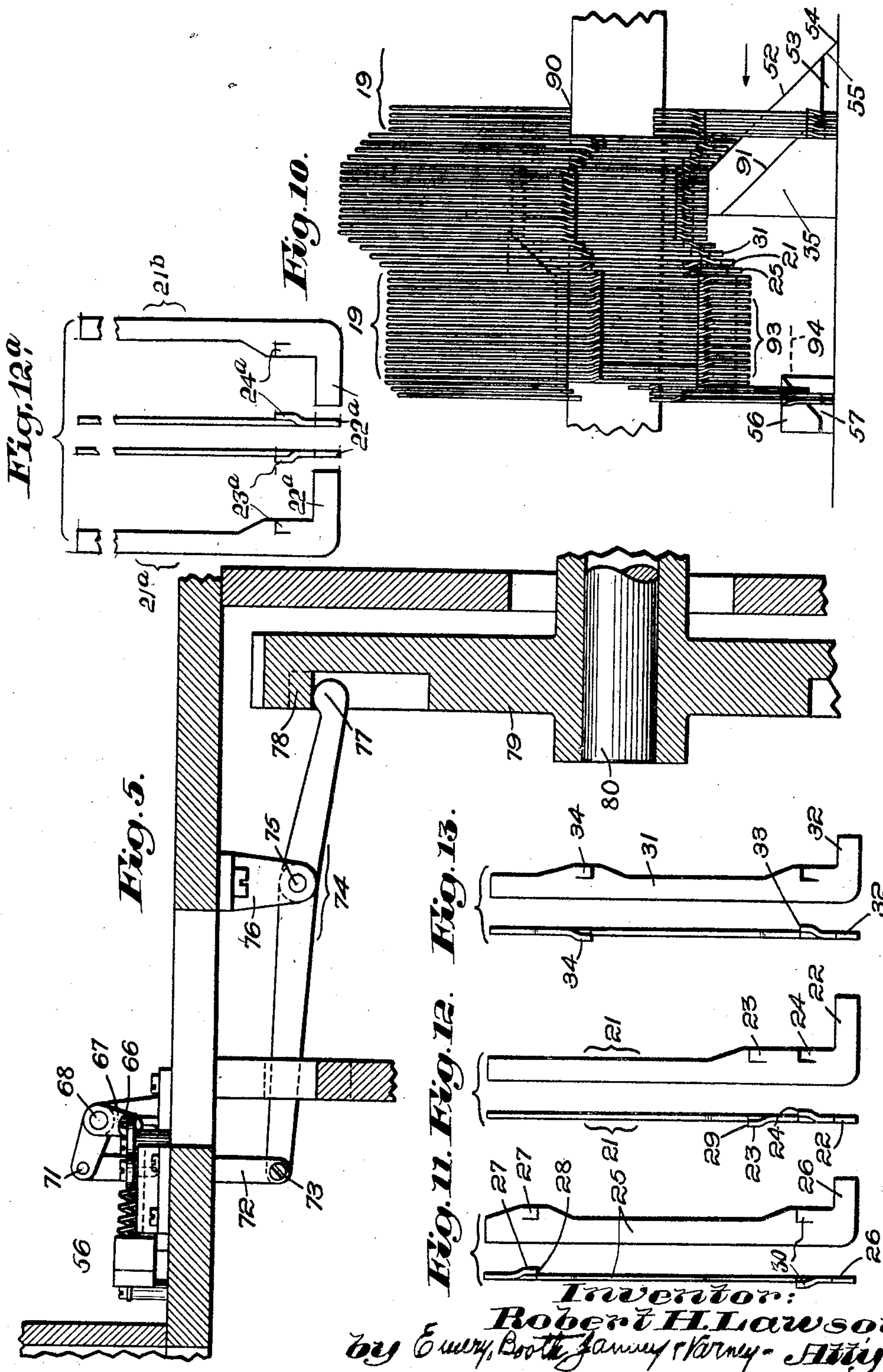
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KNITTING MACHINE AND METHOD OF FORMING REINFORCEMENTS

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7 Sheets-Sheet 5



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1,459,157

KNITTING MACHINE AND METHOD OF FORMING REINFORCEMENTS

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Fig. 14.

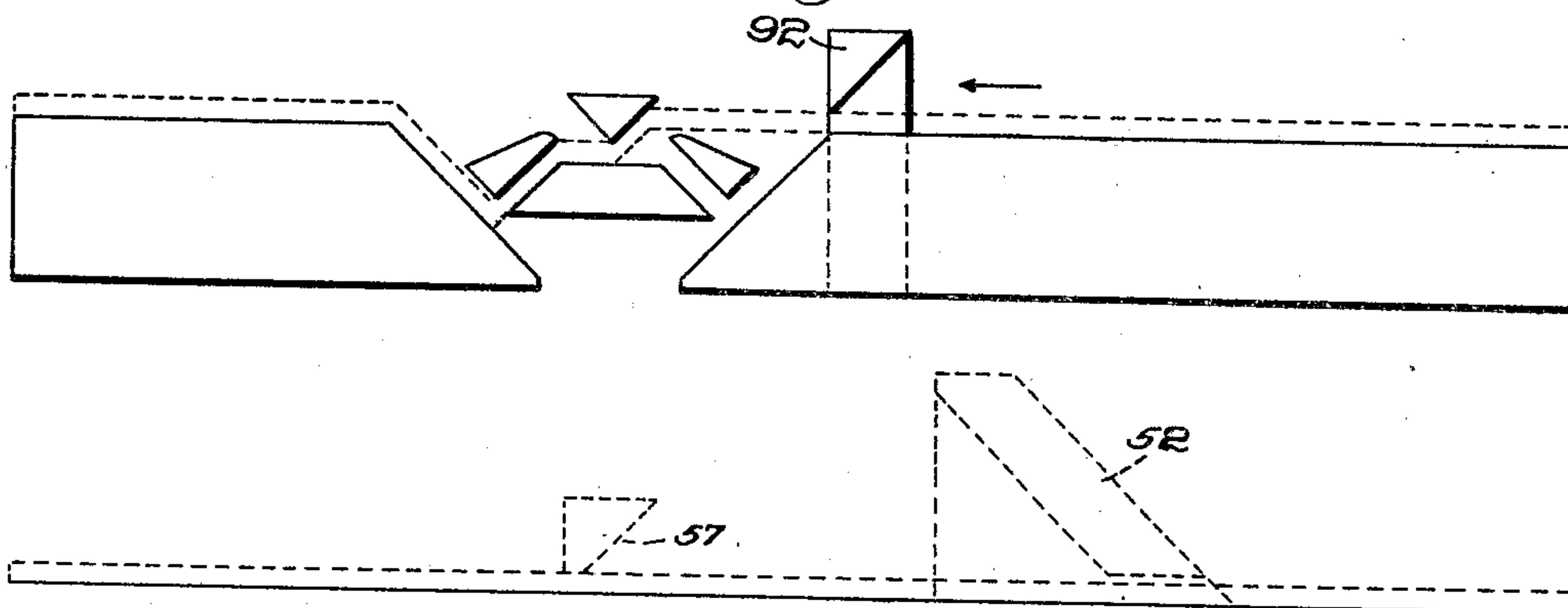


Fig. 15.

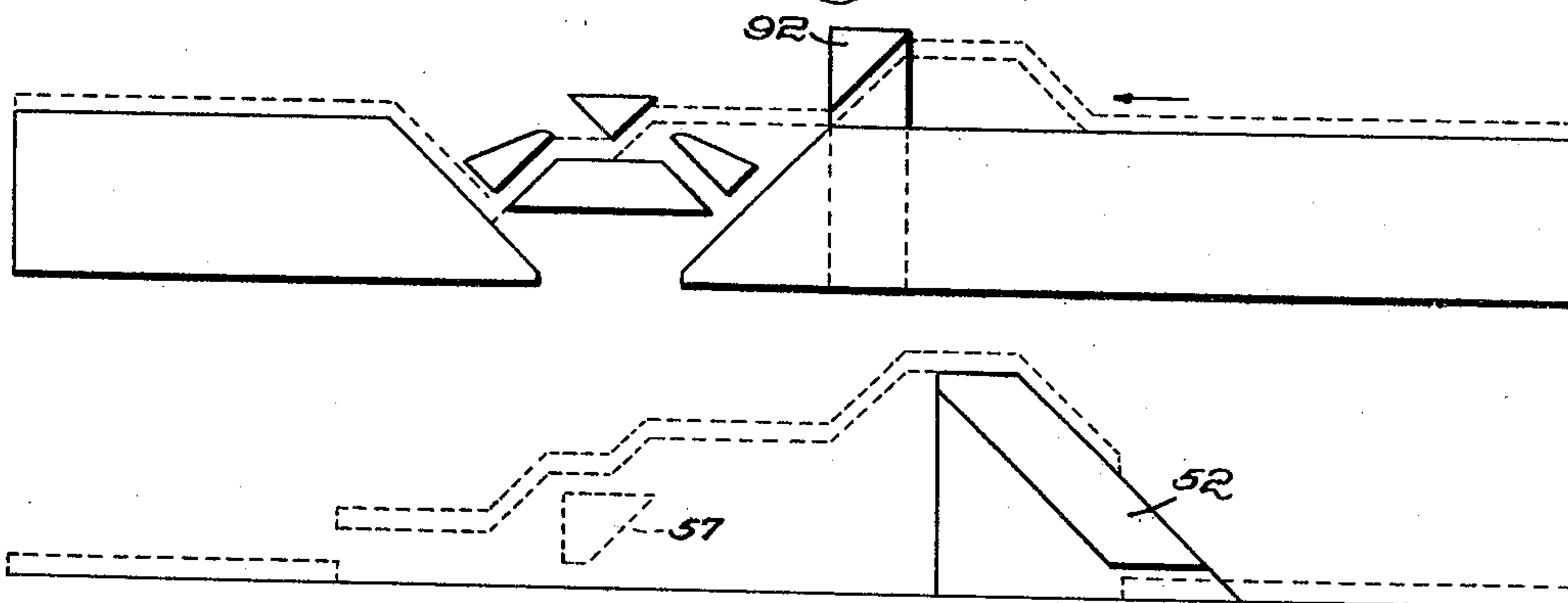
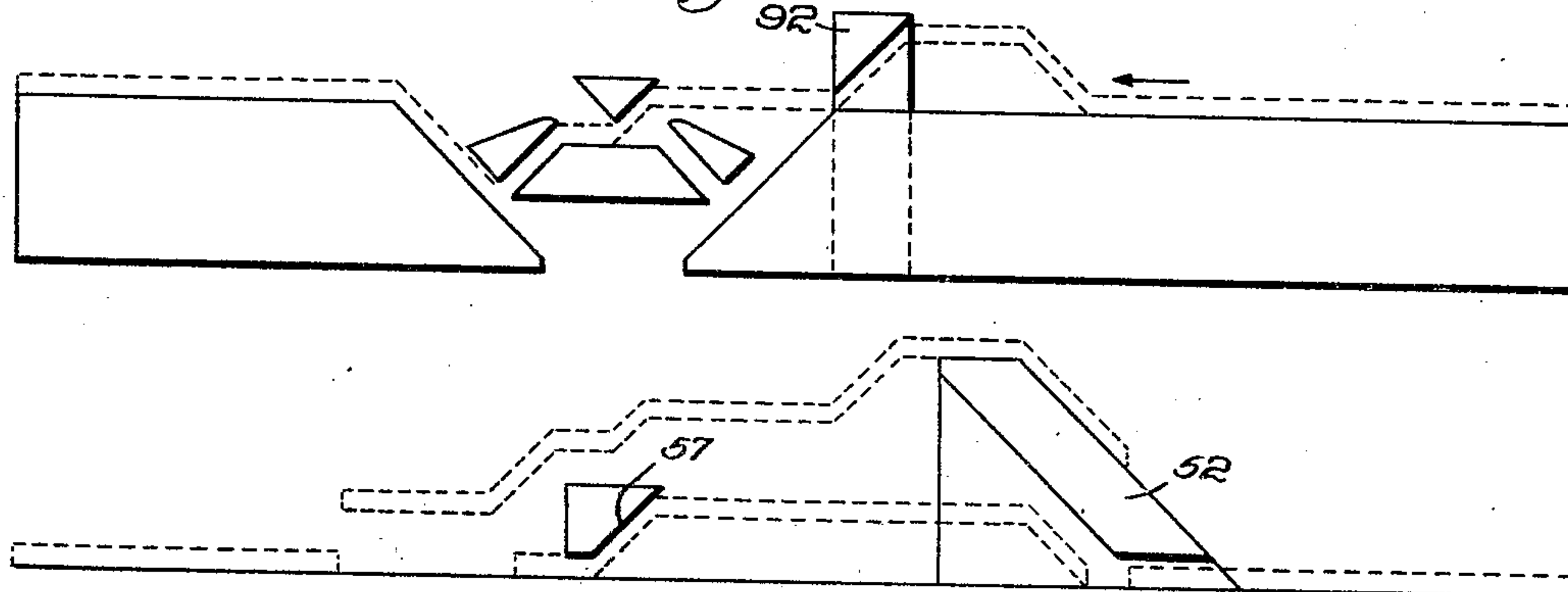


Fig. 16.



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KNITTING MACHINE AND METHOD OF FORMING REENFORCEMENTS

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Fig. 17.

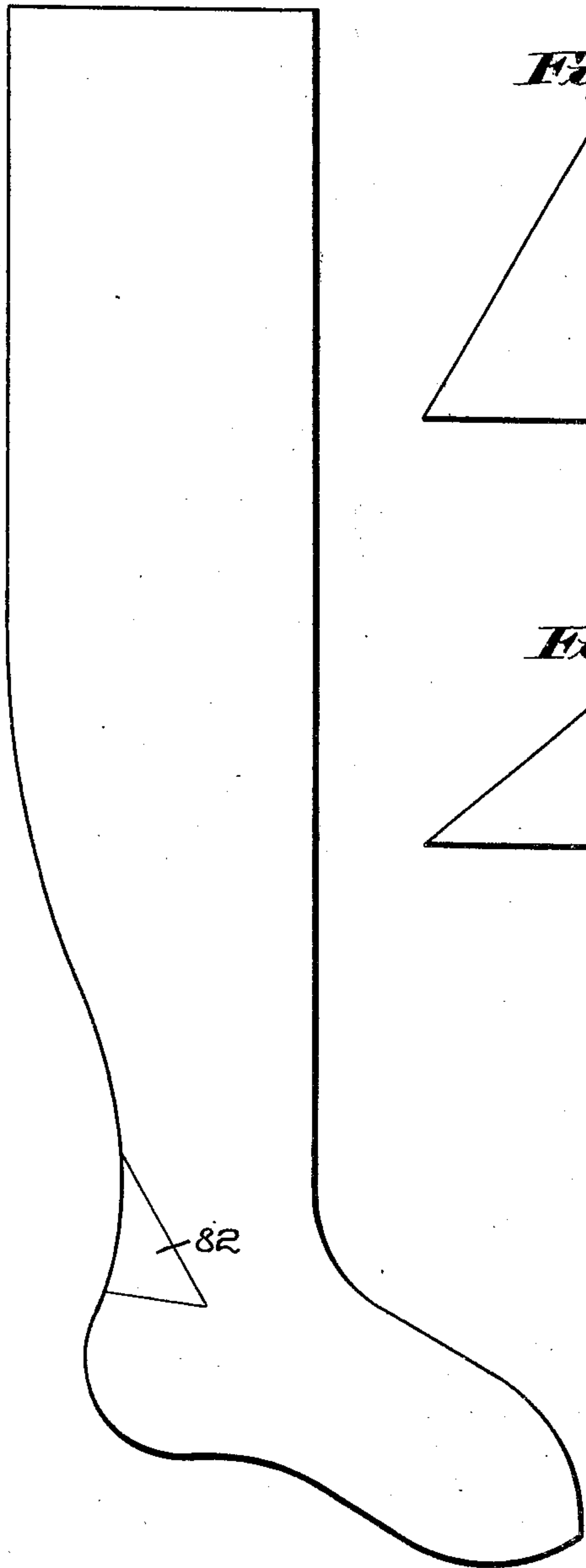


Fig. 18.

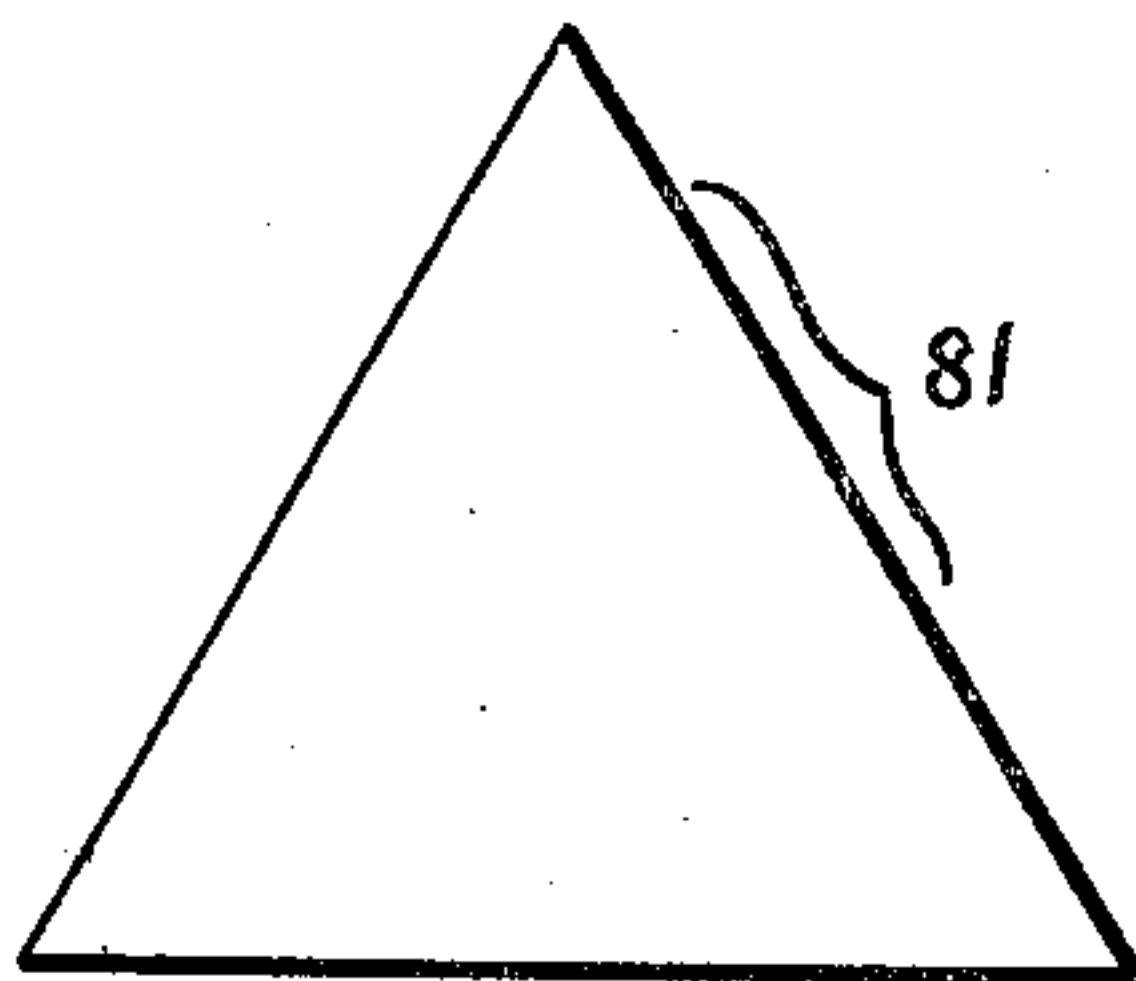


Fig. 19.

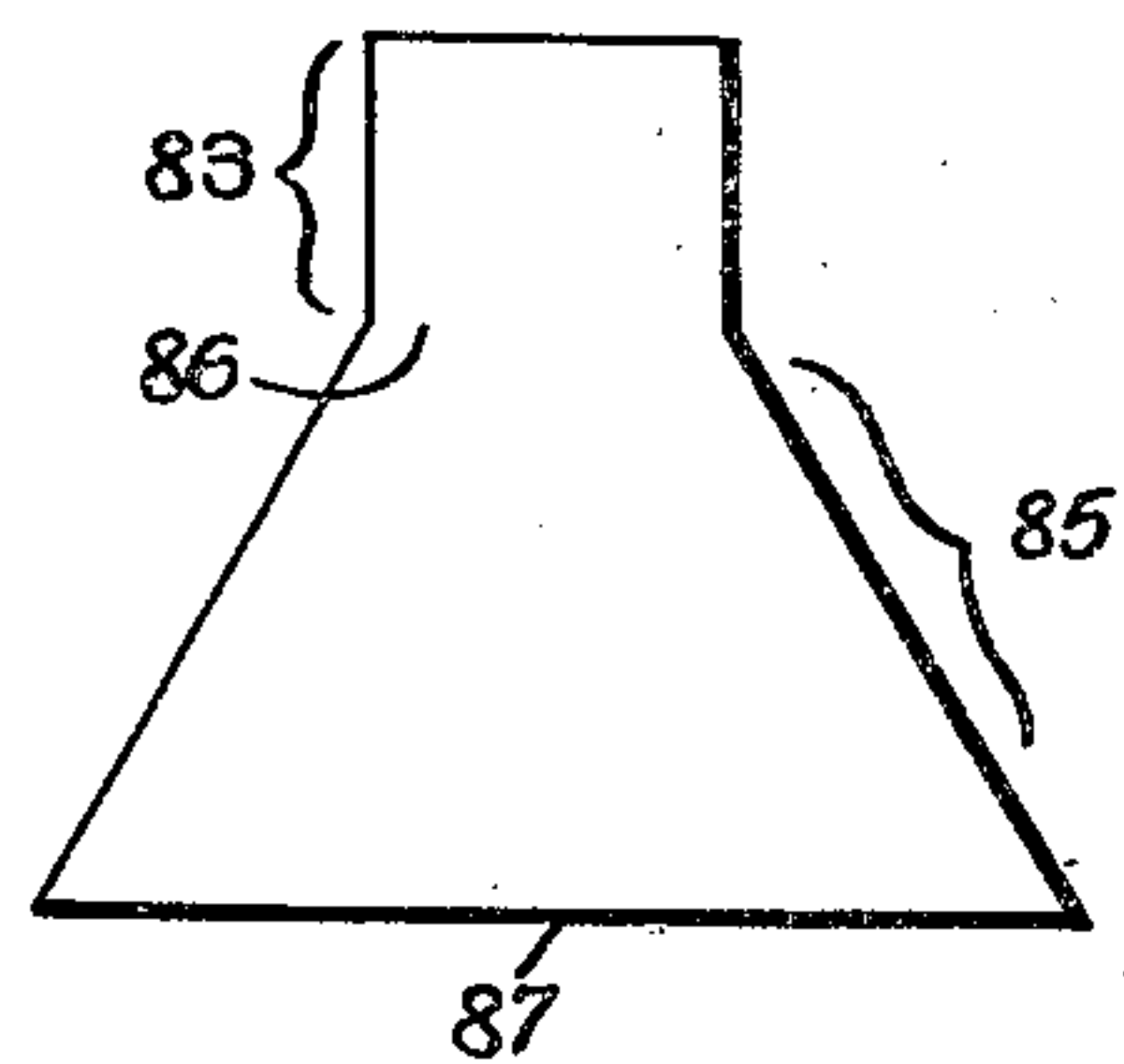


Fig. 20.



Fig. 21.

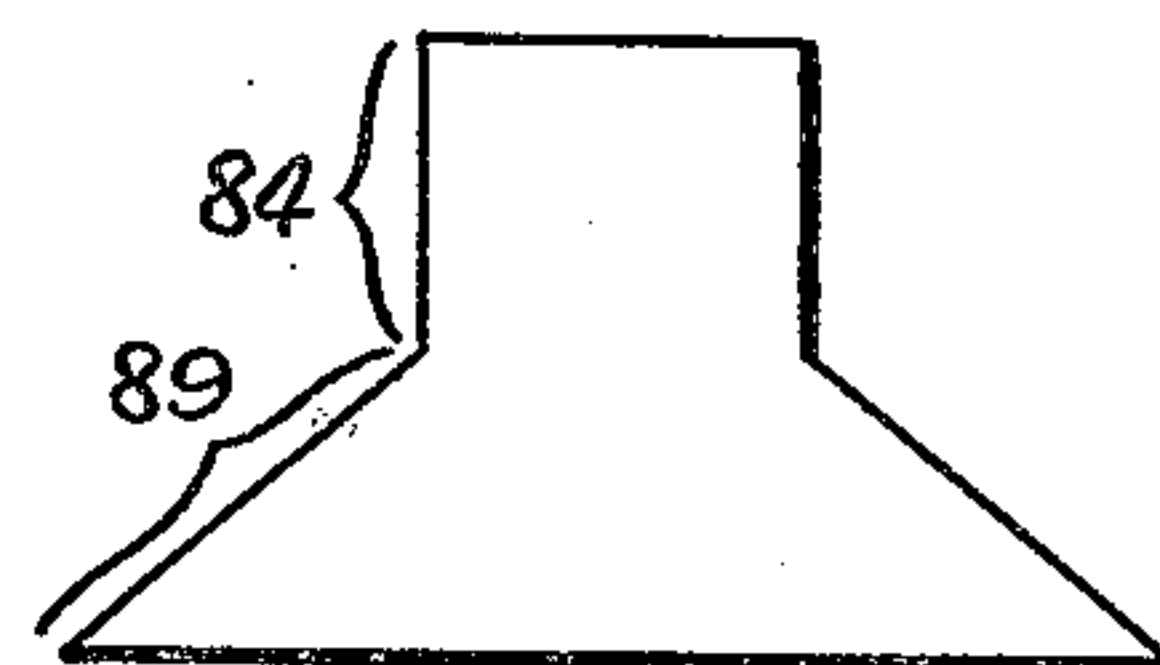
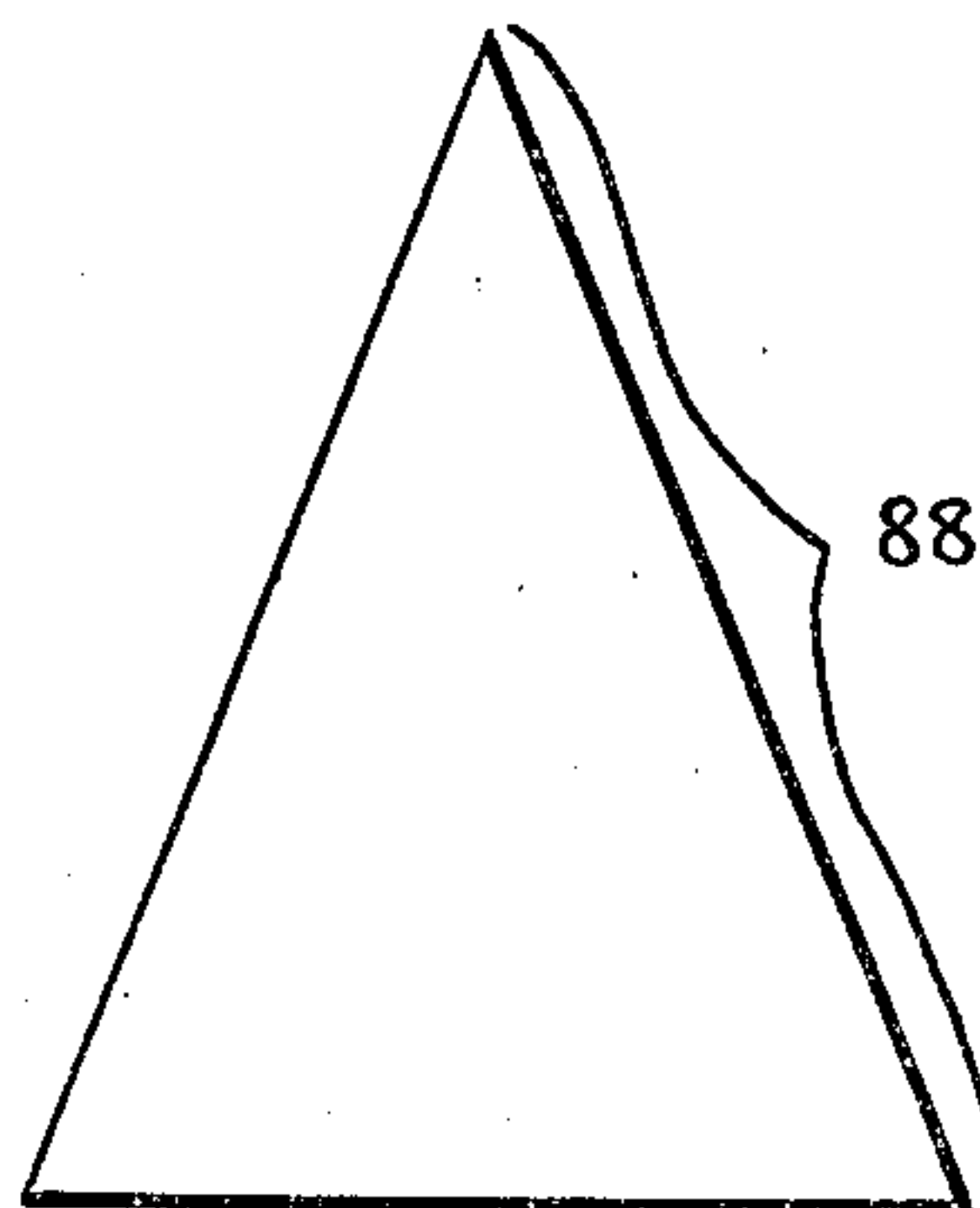


Fig. 22.



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Patented June 19, 1923.

1,459,157

UNITED STATES PATENT OFFICE.

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KNITTING MACHINE AND METHOD OF FORMING REENFORCEMENTS.

Application filed January 20, 1923. Serial No. 613,853.

To all whom it may concern:

Be it known that I, ROBERT H. LAWSON, a citizen of the United States, and a resident of Central Falls, in the county of Providence and State of Rhode Island, have invented an Improvement in Knitting Machines and Methods of Forming Reenforcements, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to knitting machines and particularly to circular stocking knitting machines, and more especially to means for effecting the reenforcement of portions of knitted fabric, particularly stockings, through manipulation of the needles as contradistinguished to manipulation of the yarn feeding means, and to the method involved therein.

In order that the principle of the invention may readily be understood, I have in the accompanying drawings disclosed one embodiment of means for practicing my invention. In said drawings:

Fig. 1 is a front elevation of a knitting machine having my invention applied thereto;

Fig. 2 is a view similar to Fig. 1, but upon an enlarged scale, of the upper part of the knitting machine and representing certain of the needles positioned for receiving the reinforcing yarn;

Fig. 3 is a horizontal section taken through the knitting machine above the narrowing and widening pickers for the needles;

Fig. 4 is a horizontal section taken through the machine below the narrowing and widening pickers, but above the cams for controlling the jacks for certain of the needles;

Fig. 5 is a vertical section taken through a part of the machine frame, and representing a part of the means for controlling one of the jack controlling cams;

Figs. 6 and 7 are respectively an inside elevation and a side elevation of the needle restoring cam for those needles elevated to take the reinforcing yarn;

Fig. 8 shows in edge view and in side elevation one of the cams for controlling the jacks of those needles that take the reinforcing yarn;

Fig. 9 shows in edge view and in side elevation the other of the cams for controlling the jacks of those needles that take the reinforcing yarn;

Fig. 10 represents in elevation certain of the needles that take the reinforcing yarn and their controlling jacks;

Figs. 11, 12 and 13 show in edge view and in side elevation the several forms of jacks for controlling the needles that take the reinforcing yarn; Fig. 12^a shows a modified form of central jacks.

Figs. 14, 15 and 16 are diagrams illustrating the knitting cams and the cams shown in Figs. 6, 7, 8 and 9, in their several positions;

Fig. 17 is a side elevation of a stocking constructed in accordance with my invention;

Figs. 18 to 22 are diagrams showing the contour of a few of the reinforced areas that may be formed in accordance with my invention; and

Figs. 23 and 24 are enlarged details of portions of fabrics reinforced by the mechanism of my invention.

My invention both as to mechanism and method relating, as it does, to circular knitting machines, may be applied to or embodied in various types of such machines, but I have chosen to represent the same as applied to a machine of the well known Banner type disclosed in the patent to Joshua D. Hemphill, No. 933,443, dated September 7, 1909. In this type of machine, the needle cylinder is cylindrical and rotates, while the cams remain stationary, and although the machine disclosed is for the purpose of producing hosiery, it is obviously not limited to this class of work. I will, however, describe my invention as applied to a machine of the said type without in all respects limiting it thereto.

Generally speaking, the machine includes a rotating needle cylinder 1 mounted upon a suitable table 2 constituting a part of the frame of the knitting machine, and as is customary in this type of machine, said cylinder is arranged to be rotated and reciprocated to form the tubular and heel and toe portions of the stocking respectively.

The means for effecting the rotary and reciprocating movements are substantially the same as those shown and described in

the said Hemphill patent and being well known require no further description.

A plurality of yarn feeding elements is provided at the usual position characteristic of the Banner machine and one of the said feeding elements is indicated at 3 in Fig. 1 in its feeding position and is shown in Fig. 2 in its elevated or non-feeding position. Desirably as many as four or five yarn guides may be mounted at the same place to introduce their yarn as called for by the controlling cams, as, for example, for the leg, the heel and toe, and the foot, etc. All of said yarn guides are pivoted at 4 upon a partial ring 5, itself suitably pivoted so that it may be swung up out of action to afford access to the needles or for any other purpose. Said ring 5 is of the type usually employed in the Banner machine equipped with spring beard needles, but obviously my invention may be employed in connection with either spring beard or latch needles and in the latter case a complete circle latch ring may be employed.

Each of the yarn guides thus far referred to, is normally pressed or urged into action by one of a series of levers 6 certain of which are indicated in Figs. 1 and 2 as pivoted at 7 upon a standard 8 rising from the frame of the machine, each lever having attached to its outer or right hand end, viewing Figs. 1 and 2, a coiled spring 9 connected at its lower end to a screw or pin 10 on the standard 8, thus tending to move each of the specified levers into operative position. Such movement of said levers into operative position is, however, at times opposed and overcome by a series of levers, one for each of said yarn guides. One of such levers is indicated at 11 in Figs. 1 and 2 as pivoted at 12 upon the standard 8 and to the outer end of each of said levers, as shown in Fig. 1, there is connected a link or wire 13 extending downward to and connected each to its proper lever 14 riding upon a suitable cam 15 on the cam shaft 16 in a manner not herein necessary to describe, as it is similar to the construction shown in the said Hemphill patent. Assuming that there are four or five levers in the group already referred to, it is evident that according to the dictates of the cams upon the disk or drum 16 the said yarn guides are permitted to act at suitable times as, for example, to supply a yarn or thread for the leg of the stocking, another for the heel, another for the foot, etc.

Each of the said yarn guides supplies its yarn or thread in proximity to the knitting point and each yarn so taken is knitted upon all the needles in action; that is to say, such of said yarn guides as are in action during the knitting of a tubular portion of the stocking feed their yarn or thread to the entire circle of needles, and when the

heel or toe is being knitted, the yarn guide then in action introduces the yarn to all the active needles.

In addition to the said group of yarn guides I provide another yarn guide which I have indicated at 17 in Figs. 1 and 2. Said yarn guide may be mounted at any suitable place but desirably is formed as a lever and is mounted upon the pivotal support 4 for the group of yarn guides. Desirably it is longer than any one of said group of yarn guides so that it may present its reinforcing yarn to the selected needles at a point somewhat removed from the knitting point, the construction and operation of parts being such that the said reinforcing yarn is received under the beards of the needles or within the hooks thereof, but is not knitted until said needles approach or arrive at the knitting point where they receive the regular yarn. Thus at the knitting point the regular yarn and the reinforcing yarn are both knitted into the fabric.

The reinforcing yarn guide 17, in the disclosed embodiment of the invention, has two positions, namely, the feeding position which is that shown in Fig. 2 and the inactive position, which is that shown in Fig. 1. The active position shown in Fig. 2 is, in this embodiment of the invention, occupied during all circular work whether or not the reinforcing yarn is to be taken by the needles, and the inactive position shown in Fig. 1, is taken only during the knitting of the heel and toe, and is then occupied merely so that said yarn guide will not interfere with the idle needles, which at such time occupy an elevated position. The said two positions of the reinforcing yarn guide 17 are given by the proper cam 15 on cam shaft 16, through the proper wire or link 13 and lever 14, said cam 15 being shaped to effect this result.

I am enabled to retain the reinforcing yarn guide 17 in the active position shown in Fig. 2 during all circular work whether or not the fabric is being reinforced, for the reason that the needles which take the reinforcing yarn rise as at 18 for that purpose above the general level 19 of the needles. It will be observed that the active or feeding position of the reinforcing yarn guide 17 is materially higher than the feeding position of the regular yarn guides as indicated at 3 in Fig. 1.

In the disclosed embodiment of my invention the reinforcing yarn guide 17 is for the purpose of introducing the yarn to form the high splice, though obviously my invention may be employed in reinforcing other portions of stockings or other fabrics. Said yarn guide is raised into inactive position for and during the knitting of the heel and toe. Said yarn guide is not thrown into

action for increasing lengths of partial courses, but whenever thrown into action is retained in action throughout entire courses, and in fact for the knitting of the entire stocking except the heel and toe, in this embodiment of the invention. In other words, the said reinforcing yarn guide or finger 17 is not acted upon by means to cause said yarn guide or finger to be in operative position or operation for a successively increasing period to knit a high splice triangular in configuration.

On the contrary, the formation of the high splice is effected wholly through the manipulation and control of certain needles. So far as I am aware I am the first to effect the formation of a reinforced or contrasting zone of knitted fabric with non-parallel sides, through the control of the needles as contrasted with the variable positioning of the reinforcing yarn guide, and such matter is therefore claimed broadly.

Within the scope of my invention the needle control may be effected in any suitable manner. I will describe one type of means for effecting such control without limiting my invention thereto.

In the disclosed embodiment of my invention, I employ a series of jacks indicated as an entirety at 20 in Fig. 4. While said jacks may be placed in the grooves of the desired number of needles below said needles, I have herein represented said jacks as positioned in a semi-circle beneath all the short butt needles, or in other words beneath all but the instep needles.

With relation to one central jack, or in some cases two central jacks, I provide a series of jacks or more, as hereafter set forth, at the right and another series of jacks at the left of said central jack or jacks. In Fig. 12, I have illustrated a single central jack at 21. In this form of my invention, said jack 21 is provided with a long butt 22, and is in this form of my invention, provided at some suitable point and preferably near its lower end with lateral projections 23, 24 extending oppositely. Said projections may be formed in any suitable way, but preferably they are formed by cutting or stamping or dieing out sufficient of the material to provide lateral projections having flat upper edges as shown in Fig. 12. The exact position of said lateral projections is or may be immaterial, but wherever positioned, they are intended in the elevation of said middle jack to engage each projection upon the adjoining jacks at the right and the left.

Within the scope of my invention, I may instead of providing a single central jack 21 with two lateral projections upon the right and the left respectively, provide two central jacks, one having a left projection and the other having a right projection, and in

such case both of said jacks would be provided with long butts 22, and I have shown such a construction in Fig. 12^a wherein such jacks are marked 21^a and 21^b, respectively, the former having lateral projection 23^a and the latter having lateral projection 24^a.

I have represented in Fig. 11 one of the left hand jacks at 25, it being understood that all the left hand jacks are or may be identical in formation, but that the disclosed embodiment of right and left hand jacks are selected more for purposes of illustration, and that the interengaging formation may be otherwise formed within the scope of my invention. Herein each of the jacks 25 is provided with a short butt 26 and with an upper right hand projection 27 which may be struck therefrom or formed or provided in any suitable way, it having a lower level edge 28 adapted to be engaged in the disclosed embodiment of the invention, by the level upper edge 29 of the central jack 21, so that as the jack 21 is elevated, it lifts the adjoining jack 25 in a manner hereinafter more fully referred to.

Said jack 25 is, in the disclosed embodiment of the invention, also provided with a lower but left hand projection 30, the function whereof is similar to that of the left hand projection 23 of the central jack 21. Such function is the lifting and engagement by said lateral projection 30 of the next adjoining jack to the left, it being understood that each of the series of left hand jacks is constructed as shown in Fig. 11, so that each jack as lifted effects as hereinafter described the lifting of the next adjoining jack to the left.

In Fig. 13, I have represented one of the right hand jacks at 31. These jacks are reversed in construction from the left hand jack 25. They are herein provided with short butts 32, with lower right hand projections 33 and upper left hand projections 34. The projection 34 upon the first of the right hand jacks is engaged by the right hand projection 24 of the central jack to effect the lifting of the said first right hand jack, and the right hand projection 33 is provided to engage the upper left hand projection 34 of the next adjoining right hand jack, and so on, so that in sequence and at the proper times the left hand jacks and the right hand jacks will be elevated so as correspondingly to lift their needles into the elevated positions shown in Fig. 2 for receiving the reinforcing yarn, thereby to form a reinforcement such as shown in Fig. 23.

I have stated that the central jack or two central jacks may be provided with a long butt or long butts 22. My invention is not limited in this respect and in certain cases more than two jacks may be provided with long butts as, for example, where above the high splice or other tapered reinforcement

I provide a stripe extending to a greater or less extent lengthwise the stocking, in which case all the needles participating in the formation of said stripe will have jacks provided with long butts 22, and only the end jacks of such series will act by interengagement with right and left jacks respectively, to lift such jacks. I will, however, first describe that embodiment of my invention wherein a single central jack is provided with a long butt as represented at 22 in Fig. 12, in which case a tapered high splice or other tapered reenforcement is provided.

Referring to Figs. 2, 4, 8 and 10, I have represented at 35 a cam which directly controls the elevation in the sequence to be described, of the series of jacks beginning with the central jack 21. The said cam 35 has two radial positions and to that end it is provided with a stem 36 adapted to slide in a suitable bracket or guide 37 shown in Fig. 4 and having a pin or screw 38 extending upwardly through a suitable slot 39 in said bracket or guide. Said pin or screw 38 is received in a slot 40 in a lever 41 pivoted at 42 upon the framing. The end of said lever opposite the slot 40 is pivoted at 43 to a link 44 which at its opposite end is connected to the upper end 45 of a bell crank lever most clearly shown in Fig. 1. Said lever is mounted upon a pivotal pin between ears 46 upon brackets 47 shown most clearly in Fig. 4 and the opposite arm of said bell crank is connected pivotally to a link 48 which at its lower end is connected to or is formed with a plunger 49 adapted to ride upon the cam disk 50 indicated in Fig. 1. A coil spring 51 tends to hold the cam 35 in its inner radial position but at times, depending upon the contour of the cam disk 50, said cam 35 is moved out of action. The formation of the cam disk 50 is such that the cam 35 is in its outer radial or inactive position, except during the formation of the tapered reenforcement herein described or during the formation of any variation of said reenforcement or of the stripe or combined stripe and reenforcement that is being provided upon the stocking being knitted.

Assuming that the cam 35 is in its inner radial or active position, it will act upon the jacks of the series in the manner hereinafter described.

The said cam 35 is provided with an inclined face 52 and said cam as indicated in Figs. 8 and 10 is undercut at 53 to permit the movement thereunder of the short butt jacks when said cam is in its inner radial position. The said inclined face 52 extends to the extreme point 54 of the base of the cam at the portion that is not removed by the undercut. This construction is most clearly indicated in Fig. 4 wherein the prolongation 55 of the inclined face 52 clearly

appears. The length of the long butt 22 is such that when the cam 35 is in its inner radial position, said butt rides upon the inclined face 52, but the shorter butts 26, 32, pass along the undercut 53 excepting where as hereinafter stated said shorter butts have been lifted onto the inclined face 52. The outer radial position of the cam 35 is such that the long butt 22 cannot ride on any part of the inclined face 52 when said cam 35 occupies said outermost radial position.

In addition to the said cam 35 for elevating the jacks, I provide a cam 56 shown most clearly in Figs. 4, 9 and 10, said cam functioning to move jacks from an intermediate level, as indicated in Fig. 10, to the lowermost level when said cam is in its innermost radial position.

Said cam 56, which has an inner inclined face or edge 57 and an undercut portion 58, is mounted for radial movement and to that end is provided with a stem 59 received in a guide or bracket 60 secured to the frame and having a slot 61. Extending upwardly through said slot is a pin or screw 62 upon a lever 63 pivoted at 64 and having a reduced or pointed outer end 65 which enters a slot 66 shown most clearly in Fig. 5 as formed in an arm 67 upon a shaft 68 mounted in a tubular or other suitable bearing 69 shown in Fig. 4. Upon the opposite end of the shaft 68 is fast a lever arm 70 which at its outer end is pivotally connected at 71 to a downwardly extending link 72 having its lower end pivotally connected at 73 to one arm of a lever 74 pivoted at 75 upon a suitable bracket 76 depending from the framing. The end 77 of the lever 74 rides against the internal cam surface 78 of the gear 79 mounted upon a stud shaft 80, said gear 79 being technically known in the Banner machine as the "104 gear." Said gear 79 meshes with a pinion on the main drive shaft. As customarily constructed the main drive shaft makes one revolution to one revolution of the needle cylinder, and the needle cylinder makes four revolution to one revolution of the "104 gear" 79. The internal cam formation 78 thereof is such as to move the cam 56 in and out at the proper times during the formation of the tapered high splice or other reenforcement.

In the construction indicated in Fig. 5 and in order to produce a tapered high splice or the like reenforcement as indicated at 81 in Fig. 18, said cam 56 is moved in and out in alternate courses or in other words said cam 56 is in its outer radial position on every second revolution of the needle cylinder during the formation of the form of high splice shown in Fig. 18.

If a reinforcing stripe be formed upon the stocking,—as, for example, at the back of the leg above the high splice, which itself is

indicated at 82 in Fig. 17, and which stripe may be of any suitable length as, for example, a short length as indicated at 83 in Fig. 19 or at 84 in Fig. 21, or any greater length, as, for example, to the bottom of the welt of the stocking,—said cam 56 occupies its inner radial position constantly throughout the formation of such stripe. If, at the termination of said stripe, it be desired to form a tapered high splice, the upper end of such tapered high splice is preferably truncated as indicated in Fig. 19, and said tapered high splice may have any suitable angle of slope. For example, it may have the same slope as in Fig. 18, such slope being indicated at 85 in Fig. 19, and to form such slope or taper the cam 56 occupies its outer radial position on every second revolution of the needle cylinder during the formation of said tapered high splice or reenforcement,—that is, from the line 86 down to the base 87 of the high splice which base may coincide with the first course of the heel.

A more tapered high splice or reenforcement may be provided as indicated at 88 in Fig. 22 and for the formation thereof the cam 56 occupies its outer radial position on every fourth revolution of the needle cylinder. If on the other hand a less tapered high splice or reenforcement than that shown in Figs. 18 and 19 is desired, the cam 56 may occupy its outer radial position all of the time, but the cam 35 would occupy its inner radial position during the formation of such high splice or reenforcement. The result would be a tapered high splice or reenforcement of the shape indicated at 89 in Figs. 20 and 21 in which construction the reinforcing yarn is taken by an additional needle at each end of the group on each successive course to the base of the high splice.

As clearly indicated in the drawings, the number of the jacks is in this embodiment of the invention, one half the entire number of needles, one jack being provided for each needle except the instep needles. Preferably the machine is equipped with a large number of fine gage needles for making fine mesh stockings, such for example as 240 or 260 needles. It will be observed that I provide what I may term a key jack or key jacks, one such key jack being shown in Fig. 12 and two such key jacks being shown in Fig. 12^a, it being noted that where more than two jacks provided with long butts are employed as for the making of a stripe as hereinbefore stated, said two key jacks are at the right and left hand ends respectively of such series of long butt jacks.

It will be observed that one of the characteristic features of this part of my invention is the delayed interengagement of companion jacks. This is true in this form of

my invention not only as to the key or central jack with reference to the companion jack but of the companion jacks with respect to each other.

While I have used the term jack, I have done this in a broad sense and have also used the term instrumentality in describing such parts or referring thereto in the claims.

I will describe sufficiently the movement of representative jacks during the formation of the tapered high splice and like reenforcement. Assuming for purposes of such description merely, that no stripe is formed above the high splice and that the latter is to commence upon a single needle, namely, that controlled by the central jack 21 of Fig. 12 and which is shown in Fig. 10,—when the period in the operation arrives that the formation of the high splice is to commence, the cam 35 then occupying its inner position for this purpose,—upon the first revolution of the needle cylinder during the making of the high splice, the long butt 22 of said jack 21 rides upon the inclined surface 52 of said cam 35, being directed thereonto by the prolongation 55 of such surface. It will be observed viewing Fig. 10 that there is a considerable space or gap between the lower ends 90 of the needles when they are at the level 19 of Figs. 2 and 10, and the upper ends of the jacks when those jacks are in their lowermost position. As the said central jack 21 rides up along the inclined surface 52 of the cam 35, it, in this embodiment of my invention, engages by its lateral projections 23, 24 the adjoining jacks at left and right numbered 25 and 31 respectively in Fig. 10. Such engagement, however, does not occur until the jack 21 has ridden a substantial distance up the incline 52, and in the meantime said jacks 25 and 31 have moved to the left viewing Fig. 10 along the undercut 53 and then when lifted by the central jack 21 they move up along or near the under side 91 of said cam 35, to a level which is lower than the top of the cam 56. Upon the continued movement of said jacks to the left viewing Fig. 10, the butts 26 and 32 of said jacks 25 and 31 encounter the inclined inner face 57 of the cam 56, and said jacks 25 and 31 are thereupon moved downward to their lowermost level. Upon said first revolution of the needle cylinder in the formation of the high splice the reinforcing yarn is taken only by the single needle which pertains to the central jack 21. After said needle governed by the central jack 21 takes said reinforcing yarn said needle is restored to the level 19 by means of a cam 92 (see Fig. 14), hereinafter more fully described and said central jack 21 travels toward the left viewing Fig. 10 with its lower end at the level 93 of Fig. 10.

Upon the next revolution of the needle cylinder, the said central jack 21 again arrives at the inclined face 52 of the cam 35 and again rides up said inclined face and receives the reinforcing yarn as before, and the adjoining jacks 25, 31 at the left and right of said central jack 21 respectively, again are lifted as before by said central jack and travel toward the left viewing Fig. 10 at an intermediate height at about the level of the line 94 in Fig. 10. Upon said second revolution of the needle cylinder, the cam 56 is out, and hence said two jacks 25, 31 do not engage the inclined face 57 of said cam 56, and hence remain at the level 94. Upon said second revolution the reinforcing yarn is taken only by the needle governed by the said central jack 21. Upon the next, that is, the third revolution of the needle cylinder the central jack 21 again rides up the inclined face 52 of the cam 35, and it is accompanied at the left and right by the adjoining jacks 25, 31 because upon such third revolution of the needle cylinder, said jacks 25, 31 are sufficiently elevated to engage by their butts 26, 32 the inclined face 52 of the cam 35. Therefore upon said third revolution of the needle cylinder the reinforcing yarn is taken by the needles governed by the three jacks referred to, namely, the central jack 21 and a jack 25 and a jack 31 next adjoining the same at the left and right respectively. Upon the fourth course or needle cylinder revolution the reinforcing yarn is taken by the needles of the said three jacks only. On the third revolution referred to, which is the first course upon which the reinforcing yarn is taken by three needles, the jacks 25, 31 pertaining to the two outside needles, begin to act by their lateral projections 30, 33 upon the jacks next adjoining them at the left and right respectively, and the action already described is continued until the tapered high splice or other reenforcement is completed.

Still referring to the form of high splice shown in Fig. 18, it is evident that upon the first and second courses thereof, the reinforcing yarn is taken only by the needle governed by the central jack. Upon the third and fourth courses said reinforcing yarn is taken by three needles. Upon the fifth and sixth courses, the yarn is taken by five needles. Upon the seventh and eighth courses the yarn is taken by seven needles and so on. I have in Fig. 23, upon an enlarged scale, represented the eight courses referred to.

From the foregoing description, it will be understood that I have provided a set of independent needles of which certain needles are to be presented to take yarn—in the disclosed embodiment of the invention, they are to take reinforcing yarn. I provide for the needles—in this form of the invention, for

the short butt or back needles—instrumentalities which are individual to the needles and which in the disclosed embodiment of the invention have movement independent of those needles and which herein, when they function, always function on the same needles. Such instrumentalities in the present embodiment of the invention are jacks and they are herein disclosed as mounted for sliding movement in the needle grooves below the needles. I provide means for pre-selecting, in accordance with the desired needle presentation, a varying and preferably a constantly increasing portion only of said instrumentalities, (herein jacks) from among the entire set thereof, leaving the remainder temporarily idle—it being understood that the desired needle presentation varies in accordance with the shape of the reenforcement or contrasting zone or area. Obviously, any suitable means may be provided for pre-selecting a varying portion of said instrumentalities but in the present case, the pre-selection is brought about by the conjoint or co-operating factors of interengagement of companion jacks and the active or inactive position of the cam 56. Said cam 56 has an inner position which may be termed its active, functioning or positive position and an outer position which may be termed its inactive, non-functioning, negative or idle position.

I provide means to advance said portion of said instrumentalities (or jacks)—as pre-selected—to engage their needles and thereby to present said needles to yarn-taking position. In the present embodiment of the invention, such advancing means is the cam 35.

As already stated, the angle of slope may be varied as desired, and if the cam 56 is out constantly during the making of high splice or like reenforcement, then the widening of the high splice or like reenforcement occurs upon each successive course, one needle being added at each end of the group upon each succeeding course throughout the formation of the high splice or like reenforcement, such a high splice or reenforcement being represented in part in Fig. 24.

The cam 92 for restoring the needles which are elevated through the control of their jacks is secured as indicated in Fig. 2 to the cam cylinder at any suitable position and may or may not be moved out of action at times. It is shown as permanently in position.

The jacks for governing the movement of the needles as hereinbefore described, are of such depth that their lateral projections are radially outside of the needle grooves, and therefore said jacks can readily be applied to existing machines, though in certain cases it is desirable to lengthen the needle cylinders. The needles themselves may be pro-

vided with jacks, if desired, or the butts engaged by the knitting cams may be formed upon the needles themselves.

The machine is provided with the usual
5 narrowing pickers indicated at 93, 93 and with the usual widening pickers indicated at 94, 94 in Fig. 3.

While I have described the preferred form of means for introducing the reinforcing yarn, namely, the yarn guide or finger
10 17 moved as described, it is evident that such feature of my invention may or may not be employed in conjunction with the needle selection, although such features peculiarly
15 cooperate with each other, and therefore both features are claimed, not only in conjunction but separately.

While I have described a construction of reinforce in which the knitting of the stocking begins at the top of the leg, my invention is not limited in this respect and the
20 knitting of the stocking may be begun at the toe and in such case the formation of the high splice or other reenforcement would
25 be reversed.

Having thus described one embodiment of the mechanism of my invention and the best mode known to me for practicing the method of my invention, I desire it to be
30 understood that my invention is not limited to the particular illustrative embodiments shown herein, the scope thereof being set forth in the following claims.

Claims:

35 1. In combination with a circular knitting stocking machine having a high splicing finger, a circular series of movable needles, and means for operating the same for tubular work, and independent jacks in the
40 grooves of the high splicing needles and having preparatory movement independent of the movement of said needles for modifying the movements of the high splicing needles, and means cooperating with the said
45 jacks to cause a successively increasing number of the high splicing needles to take the high splicing yarn, thereby to knit a high splice tapering in configuration.

50 2. A circular knitting machine having independently movable needles and means to introduce a main yarn and a reinforcing yarn, and means including independent instrumentalities individual to and having preparatory movement independent of the
55 movement of a series of said needles and concentric therewith and acting to modify the needle action to effect the formation of a reinforcing or contrasting zone having at least one tapering side.

60 3. A knitting machine having independently movable needles and means to introduce a main yarn and a reinforcing yarn and independent jacks in the needle grooves and having preparatory movement independent of the movement of a series of said
65 needles, and functioning in modification of the needle action to effect the formation of a reinforcing or contrasting zone having oppositely tapering sides.

4. A knitting machine having independ- 70
ently movable needles and means to introduce a main yarn and a reinforcing yarn, a series of separate instrumentalities having interengaging formations for relatively
75 delayed movement, said instrumentalities having preparatory movement distinct from the movement of the needles, thereby functioning to modify the needle action to effect the formation of a tapering high splice.

5. A knitting machine having means to 80
introduce a main yarn and a reinforcing yarn and having independently movable needles, and means including a key jack and delayed-movement-companion jacks moved
85 with delay, among themselves, by movement of the key jack, said jacks co-operating with a series of the needles to present, in a series of courses, an increasing number of
90 needles to receive the reinforcing yarn, thereby to form a tapering reenforcement.

6. A circular knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-
95 reinforced circular work, and means including a series of jacks individual to and having preparatory movement relative to that of each of a group of the said needles, and also including means to impart movement to
100 said jacks in a direction axially of the said needles to move a varying number of needles in a plurality of predetermined courses, to take said reinforcing yarn.

7. As a new article of manufacture, a jack 105
for imparting movement to a knitting needle of the so-called "independent" type, said jack being distinct from but adapted to move independent of its needle preparatorily to needle movement and also with its
110 needle to move the latter, said jack having a lateral projection adapted for temporary interengagement with a companion but independently movable jack for movement of
115 one of said jacks by movement of the other.

8. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of
120 non-reinforced circular work, and means including instrumentalities individual to and having preparatory movement relative to that of each of a group of said needles, and cam means movable into and out of functioning relation to said instrumentalities
125 and participating in the preparatory movement thereof, said instrumentalities and cam means acting to modify the needle action for the formation of the high splice to cause
130

a varying number of needles in a plurality of predetermined courses, to take said reinforcing yarn.

9. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means to modify the needle action for the formation of the high splice, said means including instrumentalities individual to each of a group of said circular series of needles, advancing means to move said instrumentalities in one direction, withdrawing means to move said instrumentalities in another direction, and means to move the withdrawing means out of functioning relation without necessary movement of the advancing means out of functioning relation, thereby to cause an increasing number of needles in a plurality of predetermined courses to take said reinforcing yarn, and thus to effect the formation of a tapered high splice.

10. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means including jacks in the grooves of a group of said needles and having preparatory movement distinct from the subsequently imposed movement of said needles by their jacks to elevate a varying number of needles in a plurality of predetermined courses to the reinforcing yarn, whereby said varying number of needles take the reinforcing yarn in said courses.

11. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means including a plurality of cams independently movable into and out of functioning relation and together functioning in the elevation of a progressively varying number of needles in a plurality of predetermined courses to the reinforcing yarn whereby said progressively varying number of needles take the reinforcing yarn in said courses.

12. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means including instrumentalities in the grooves of the high splice needles and having preparatory movement which is permissively-differentiated among such instrumentalities, and which movement is distinct from the movement of the needles, said means acting

during the knitting of the high splice, to move a varying number of needles in a plurality of predetermined courses, to the reinforcing yarn, whereby said varying number of needles take the reinforcing yarn during the knitting of the high splice.

13. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means including instrumentalities individual to each of the high splice needles, and having preparatory movement which is permissively-differentiated among such instrumentalities and which movement is distinct from the movement of said needles; said means acting during the knitting of the high splice to elevate a varying number of needles in a plurality of predetermined courses, to the reinforcing yarn, whereby said varying number of needles, as so elevated, take the reinforcing yarn during the knitting of the high splice.

14. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and jack means confined to predetermined needle grooves and having movement therein preparatory to the subsequent movement of the corresponding needles by said jack means, thereby to elevate a varying number of needles in a plurality of predetermined courses, to the reinforcing yarn, and means for controlling the action of the jack means.

15. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks having among themselves formations adapted for temporary interengagement, with consequent and permissively-contrasting movement of said jacks, thereby to elevate needles for the production of reinforced work and cam means to control said jacks.

16. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having among themselves movements which are permissively respectively distinct, and which movements are distinct from the yarn-taking movement of the corresponding needles, cam means to control said jacks, and means to place said cam means in active and inactive positions.

17. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having among themselves permissively-preparatory movements which are distinct from the yarn taking movement of the needles, cam means to control said jacks, and means to change the radial position of said cam means.

18. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having among themselves permissively-preparatory movements which are distinct from the yarn taking movement of the needles, and a plurality of cams to control said jacks, at least one of said cams being movable relative to the remainder of the said plurality.

19. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having among themselves permissively-preparatory movements which are distinct from the yarn taking movement of the needles, and a jack elevating and a jack lowering cam, one of said cams being movable relative to the other.

20. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having permissively-contrasting movement among themselves, which movement is preparatory to and distinct from the reinforcing-yarn-taking movement of the needles, a jack elevating cam, and means to render said cam operative at and for the commencement of reinforced work.

21. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having permissively-contrasting movement among themselves, which movement is preparatory to and distinct from the reinforcing-yarn-taking movement

of the needles, a jack elevating cam, means to render said cam operative at and for the commencement of reinforced work, and a jack depressing cam.

22. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having permissively-contrasting movement among themselves, which movement is preparatory to and distinct from the reinforcing-yarn-taking movement of the needles, a jack elevating cam, means to render said cam operative at and for the commencement of reinforced work, a jack depressing cam, and means to render said jack depressing cam active and inactive.

23. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of reinforced work, said jacks having permissively-contrasting movement among themselves, which movement is preparatory to and distinct from the reinforcing-yarn-taking movement of the needles, a jack elevating cam, means to render said cam operative at and for the commencement of reinforced work, a jack depressing cam, and cam means for controlling the periodicity of action of said jack depressing cam.

24. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, jacks to elevate needles for the production of the high splice, said jacks having permissively-contrasting movement among themselves, which movement is preparatory to and distinct from the reinforcing-yarn-taking movement of the needles, a jack elevating cam, means to render said cam operative at and for the commencement of said high splice, a jack depressing cam, and means to control the periodicity of action of said jack depressing cam.

25. A needle controlling instrumentality movable lengthwise of but independently of the needle and having a lateral operating projection, and an associated, needle-controlling instrumentality having a formation positioned for delayed interengagement with said lateral operating projection for functioning in such lengthwise movement.

26. A needle controlling jack slidable in the needle groove, said jack being struc-

turally distinct from and non-connected to its needle, and having capacity for preparatory movement apart from the movement of its needle, having a lateral projection for cooperation with a companion jack, and such companion jack having a formation for delayed interengagement with said lateral projection, for imparting sliding movement to said first mentioned jack.

27. A needle controlling jack slidable in the needle groove, said jack being structurally distinct from and non-connected to its needle, and having capacity for preparatory movement apart from the movement of its needle, having a lateral projection radially beyond said groove, and a companion jack having a formation for delayed interengagement with said lateral projection, for imparting sliding movement to the first mentioned jack.

28. As a new article of manufacture, a jack for imparting movement to a knitting needle of the so-called "independent" type, said jack being distinct from but adapted to move independent of its needle, and also subsequently with its needle to move the latter, said jack having a lateral projection adapted for temporary interengagement with a companion but independently movable jack for delayed movement of one of said jacks by movement of the other.

29. A series of needle controlling jacks slidable in adjacent needle grooves and each having a lateral projection positioned for delayed engagement with an adjacent jack, thereby to function in delayed movement of such adjacent jack.

30. A series of needle controlling jacks each distinct from and adapted to move independently of its needle, said jacks being slidable in adjacent grooves and having interengageable formations, located respectively for temporary, delayed interengagement, whereby one of said jacks functions in imposing, delayed, sliding movement upon an adjacent jack.

31. A series of needle controlling jacks slidable in adjacent grooves and having provisions whereby each jack imposes permissively-delayed sliding movement upon the next jack.

32. A series of jacks slidable in a series of needle grooves, said jacks including a so-called central jack having formations to impose permissively-delayed sliding movement upon the next jack to the right and to the left respectively.

33. A knitting machine having a main yarn finger and a reinforcing yarn finger, means to maintain said reinforcing yarn finger stationary during the formation of a series of courses, each of which is but partially reinforced, and jacks in the grooves of the needles to take the reinforcing yarn, said jacks having permissively-contrasting

movements among themselves, which movements are preparatory to and respectively distinct from the reinforcing yarn-taking movements of the needles, and means for moving said jacks, thereby controlling the needle presentation to said reinforcing yarn finger whereby to effect the reenforcement of parts only, of said series of courses.

34. A circular knitting machine having a main yarn finger and a reinforcing yarn finger, a circular series of needles and knitting cams therefor, means to maintain said reinforcing yarn finger stationary during the formation of a series of circular courses, each of which is but partially reinforced, and means, acting through presentation of a varying number of needles to said stationary reinforcing yarn finger during circular work, to effect the partial reenforcement only, of each of said series of complete circular sources, said latter means including instrumentalities individual to each of a series of the needles to take the reinforcing yarn, said instrumentalities having capacity for preparatory movement distinct from the subsequently imposed, reinforcing yarn-taking movement of the corresponding needles, and two cams for controlling said instrumentalities, one of said cams being movable independently of the other, into and out of functioning relation to said instrumentalities.

35. A circular knitting machine having a main yarn finger and a reinforcing yarn finger, a circular series of needles and knitting cams therefor, means to maintain said reinforcing yarn finger stationary during the formation of a series of circular courses, each of which is but partially reinforced, and instrumentalities individual to each of a group of said needles, said instrumentalities having formations positioned for temporary, delayed interengagement and movement, and acting during circular work to present a varying number of needles to said stationary reinforcing yarn finger to effect reenforcement only upon the needles so presented.

36. A circular knitting machine having a main yarn finger and a reinforcing yarn finger, a circular series of needles and knitting cams therefor, means to maintain said reinforcing yarn finger stationary during the formation of a series of circular courses, each of which is but partially reinforced, and means including jacks in selected needle grooves and having among themselves permissively-differentiated movement distinct from but followed by movement of the corresponding needles, and co-acting means to cause said instrumentalities to act during circular work to present an increasing number of needles to said stationary reinforcing yarn finger to effect a tapered reenforcement.

37. A circular stocking knitting machine

- having a main yarn finger and a reinforcing yarn finger, a circular series of needles and knitting cams therefor, means to maintain said reinforcing yarn finger stationary and in yarn feeding position during all circular work, means to move said reinforcing yarn finger out of feeding position for and during heel and toe knitting, and sliding instrumentalities individual to and having movement distinct from each of the needles to receive reinforcing yarn, and a series of which instrumentalities have functioning formations positioned for delayed interengagement, said instrumentalities acting in a series of successive courses to elevate an increasing number of needles to receive reinforcing yarn from said reinforcing yarn finger, thereby to effect the formation during circular knitting of a tapered reenforcement.
38. A circular stocking knitting machine having a main yarn finger and a reinforcing yarn finger, a circular series of needles and knitting cams therefor, means to maintain said reinforcing yarn finger stationary and in yarn feeding position during all circular work, means to move said reinforcing yarn finger out of feeding position for and during heel and toe knitting, and reinforcing-needle jacks in the grooves of the high splice needles and having preparatory and permissively-contrasting movement distinct from the reinforcing-yarn-taking movement of said needles, and acting during and for the knitting of the high splice, to elevate, in a series of successive courses, an increasing number of needles, to receive reinforcing yarn from said stationarily positioned reinforcing yarn finger, thereby to effect the formation of a tapered high splice.
39. A circular knitting machine having a needle cylinder with a series of needles and having one or more regular yarn fingers movable into and out of action and having a predetermined, lowest position, for feeding, and a reinforcing yarn finger having a feeding position substantially remote circumferentially from said regular yarn finger or fingers, the feeding position of said reinforcing yarn finger being higher than that of the said regular yarn finger or fingers, and means to present selected needles to said reinforcing yarn finger, said means including instrumentalities individual to each of said selected needles and having capacity for preparatory movement distinct from the yarn taking movement of such needles, and also movement with said needles to present them to the reinforcing yarn finger, said instrumentalities being movable only in concentric relation with respect to the needle cylinder, and means to move said instrumentalities in such concentric relation.
40. A circular knitting machine having one or more regular yarn fingers movable into and out of action and having a predetermined lowest position for feeding, and a reinforcing yarn finger having a feeding position substantially remote circumferentially from said regular yarn finger or fingers, the feeding position of said reinforcing yarn finger being higher than that of the said regular yarn finger or fingers, and means to present selected needles to said reinforcing yarn finger, said means including instrumentalities individual to each of said selected needles and having capacity for preparatory movement distinct from the reinforcing-yarn-taking movement of the needles, and means co-operating with said jacks to cause in a series of successive courses, the lifting of a gradually increasing number of needles, to take the reinforcing yarn at said feeding position of said reinforcing yarn finger.
41. In a knitting machine for making fabric with contrasting zones or areas, a series of independently movable needles, and a corresponding series of jacks each having preparatory movement independent of its needle and also movement with its needle, each of a plurality of said jacks having a lateral formation for engagement with a companion jack, whereby each jack having a lateral formation is moved through engagement of a companion jack with that lateral formation.
42. In a knitting machine for making fabric with contrasting zones or areas, a series of independently movable needles, and a corresponding series of jacks each having movement independent of its needle and also with its needle, each of a plurality of said jacks having a lateral formation positioned for delayed engagement with a companion jack, whereby each jack having a lateral formation is moved through engagement of a companion jack with that lateral formation.
43. In a knitting machine for making fabric with contrasting zones or areas, a series of independently movable needles, and a corresponding series of jacks each having movement independent of its needle and also with its needle, each of a plurality of said jacks having a lateral formation to be engaged by a companion jack, each lateral formation being so positioned lengthwise its jack as to compel movement of such jack only after initial movement of that companion jack which is to engage such lateral formation and thereby cause movement.
44. In a knitting machine for making fabric with contrasting zones or areas, a series of separately movable knitting instrumentalities each of a plurality of which has a lateral formation positioned for delayed engagement with a companion instrumentality of said series, whereby each instrumentality having a lateral formation is moved through engagement of a companion instrumentality of said series therewith.
45. In a knitting machine for making fabric with contrasting zones or areas, a

series of separately movable knitting instrumentalities each of a plurality of which has a lateral formation for engagement with a companion instrumentality of said series, each lateral formation being so positioned lengthwise its instrumentality as to compel movement of such instrumentality only after initial movement of that companion instrumentality of the series which is to engage such lateral formation.

46. In a knitting machine for making fabric with contrasting zones or areas, a series of butted independent jacks for a series of knitting needles, and having movement independent of such needles preparatorily to needle movement, certain of said jacks having butts of one formation and one or more other of said jacks having a butt of a contrasting formation, said jack or jacks having such contrasting-formation butt constituting a key jack or jacks and the other jacks of the series having lateral formations for interengagement with and movement by a companion jack of the series, whereby commencing with the key jack or jacks each jack moves a companion jack.

47. In a knitting machine for making fabric with contrasting zones or areas, a series of butted jacks for a series of knitting needles, and having movement independent of such needles, certain of said jacks having butts of one formation and one or more other of said jacks having a butt of a contrasting formation, said jack or jacks having such contrasting-formation butt constituting a key jack or jacks and the other jacks of the series having lateral formations for interengagement with and movement by a companion jack of the series, whereby commencing with the key jack or jacks each jack moves a companion jack, each lateral formation being so positioned lengthwise its jack that such jack is moved only after initial movement of the jack which engages such lateral formation.

48. In a knitting machine for making fabric with contrasting zones or areas, a series of needles, and a series of instrumentalities individual thereto but having preparatory movement independent thereof and also movement therewith, each of said instrumentalities having a formation whereby it is individually moved toward its needle, and each of a plurality at least of said instrumentalities having a lateral formation to be engaged by and its instrumentality moved by a companion instrumentality of the series.

49. In a knitting machine for making fabric with contrasting zones or areas, a series of needles, and a series of independent instrumentalities individual thereto but having preparatory movement independent thereof and also movement therewith, each of said instrumentalities having a formation

whereby it is individually moved toward its needle, and each of a plurality at least of said instrumentalities having a lateral formation to be engaged by and its instrumentality moved by a companion instrumentality of the series, in combination with advancing cam means to engage the first mentioned formation and thereby move such instrumentality individually toward its needle.

50. In a knitting machine for making fabric with contrasting zones or areas, a series of needles and a series of independent instrumentalities individual thereto but having preparatory movement independent thereof and also movement therewith, each of said instrumentalities having a formation whereby it is individually moved toward its needle, and each of a plurality at least of said instrumentalities having a lateral formation to be engaged by and its instrumentality moved by a companion instrumentality of the series, in combination with advancing cam means to engage the first mentioned formation and thereby move such instrumentality individually toward its needle, and retracting cam means to engage said first mentioned formation and thereby move such instrumentality individually from its needle.

51. In a knitting machine for making fabric with contrasting zones or areas, a series of needles, and a series of independent instrumentalities individual thereto but having preparatory movement independent thereof and also therewith, each of said instrumentalities having a formation whereby it is individually moved toward its needle, and each of a plurality at least of said instrumentalities having a lateral formation to be engaged by and its instrumentality moved by a companion instrumentality of the series, in combination with advancing cam means to engage the first mentioned formation and thereby move such instrumentality individually toward its needle, retracting cam means to engage said first mentioned formation and thereby move such instrumentality individually from its needle, and means to render the advancing cam means active or inactive.

52. In a knitting machine for making fabric with contrasting zones or areas, a series of needles, and a series of independent instrumentalities individual thereto but having preparatory movement independent thereof and also therewith, each of said instrumentalities having a formation whereby it is individually moved toward its needle, and each of a plurality at least of said instrumentalities having a lateral formation to be engaged by and its instrumentality moved by a companion instrumentality of the series, in combination with advancing cam means to engage the first mentioned

formation and thereby move such instrumentality individually toward its needle, retracting cam means to engage said first mentioned formation and thereby move such instrumentality individually from its needle, and means to render the retracting cam means active or inactive.

53. A series of independent knitting needles; a series of independent instrumentalities therefor and having preparatory movement independent of said needles and also having needle-actuating movement with said needles, companion members of said instrumentalities having interengaging formations, and at least one of said instrumentalities being a key member of the series, and adapted to engage and move a companion instrumentality of the series through engagement of the inter-engaging formations of said key member and said companion instrumentality; and that companion instrumentality being adapted to move another instrumentality of the series by reason of the interengagement of their formations.

54. A series of independent knitting needles; a series of independent instrumentalities therefor and having preparatory movement independent of said needles and also having needle-actuating movement with said needles, companion members of said instrumentalities having interengaging formations, and at least one of said instrumentalities being a key member of the series, and adapted to engage and move a companion instrumentality of the series through engagement of the interengaging formations of said key member and said companion instrumentality; and that companion instrumentality being adapted to move another instrumentality of the series by reason of the interengagement of their formations; means for advancing said instrumentalities; means for retracting said instrumentalities; and means for rendering inactive at least one of said two means.

55. A series of independent knitting needles; a series of independent instrumentalities therefor and having preparatory movement independent of said needles and also having needle-actuating movement with said needles, companion members of said instrumentalities having interengaging formations, and at least one of said instrumentalities being a key member of the series, and adapted to engage and move a companion instrumentality of the series through engagement of the interengaging formations of said key member and said companion instrumentality; and that companion instrumentality being adapted to move another instrumentality of the series by reason of the interengagement of their formations; means for advancing said instrumentalities; means for retracting said instrumentalities; and means

for rendering said retracting means inactive without necessary inactivity of said advancing means.

56. In a knitting machine for making fabric with contrasting zones or areas, a series of independent butted jacks for a series of knitting needles and having preparatory movement independent of such needles, a plurality of said jacks having short butts and at least one other of said jacks having a long butt, said jack or jacks having a long butt constituting a key jack or jacks and the short butted jacks of the series having lateral formations for interengagement with and movement by a companion short butt jack whereby commencing with the key jack or jacks each jack moves a companion jack.

57. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means to modify the needle action for the formation of the high splice, said means including instrumentalities individual to and movable preliminarily to movement of and also movable with each of a group of said circular series of needles, advancing means to move said instrumentalities in one direction, withdrawing means to move said instrumentalities in another direction, and means to move the withdrawing means out of functioning relation without necessary movement of the advancing means out of functioning relation, thereby to cause an increasing number of needles in a plurality of predetermined courses to take said reinforcing yarn.

58. A circular stocking knitting machine having means to introduce a main yarn and a reinforcing yarn, a circular series of independently movable needles having means to operate the same for the production of non-reinforced circular work, and means to modify the needle action for the formation of the high splice, said means including instrumentalities individual to and movable preliminarily to movement of and also movable with each of a group of said circular series of needles, advancing means to move said instrumentalities in one direction, withdrawing means to move said instrumentalities in another direction, said advancing means and said withdrawing means being independently controllable.

59. A knitting machine having means to introduce a main yarn and a reinforcing yarn, a series of independently movable needles having means to operate the same for the production of non-reinforced work, jacks to elevate the needles for the production of reinforced work and having preparatory, permissively-contrasting movement independent of the reinforcing-yarn-taking

movement of the needles, cam means to control said jacks, and means to place said cam means in active and inactive positions.

60. A knitting machine having a main yarn finger and a reinforcing yarn finger, means to maintain said reinforcing yarn finger stationary during the formation of a series of courses, each of which is but partially reinforced, and instrumentalities individual to each of the needles that is to take the reinforcing yarn, said instrumentalities having preparatory sliding movement axially of said needles distinct from the yarn-taking-movement of the needles, said instrumentalities also having movement with the needles thereby to effect the needle presentation to the reinforcing yarn finger whereby to effect the reenforcement of parts only, of said series of courses.

61. That method of knitting so-called seamless hosiery, comprising knitting the leg portion seamlessly by rotary knitting upon a complete circle of needles and feeding a regular yarn to the entire circle of needles during the knitting of such leg portion; supporting a reinforcing yarn in fixed position so as to be taken by all needles presented thereto; and in a series of successive complete courses forming a tapered high splice reenforcement by moving independently of their needles and preparatorily to the needle movement of corresponding needles, a gradually increasing number of needle jacks; causing such preparatory movement of such needle jacks to result in the presentation of a corresponding, gradually increasing number of heel needles to said reinforcing yarn, and causing such needles to take said yarn; then withdrawing the reinforcing yarn and its support wholly out of functioning position; rendering the instep needles idle while holding their loops; forming the heel by a narrowing and widening operation; then returning the idle instep needles to action and knitting the foot; and then knitting the toe.

62. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles and yarn feeding means; instrumentalities individual to at least a group of said needles and having movement independent of such needles; means for pre-selecting by preparatory movement thereof, a portion only of said instrumentalities in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining instrumentalities to be temporarily idle; and means to advance said instrumentalities as pre-selected, to engage their needles and thereby to move said needles into yarn-taking position.

63. In a knitting machine for making fabric with contrasting zones or areas, a grooved needle carrier having a set of inde-

pendent needles in said grooves; yarn feeding means; instrumentalities individual to at least a group of said needles in said grooves and having movement independent of such needles; means for pre-selecting by preparatory movement thereof a portion only of said instrumentalities in said grooves in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining instrumentalities to be idle temporarily in their grooves; and means to advance said instrumentalities in their grooves as pre-selected, sufficiently to engage their needles and to move said needles into yarn-taking position.

64. In a knitting machine for making fabric with contrasting zones or areas, a grooved needle carrier having a set of independent needles in said grooves; yarn feeding means, jacks in said grooves below at least a group of said needles and having movement in said grooves independent of the needles therein; means for pre-selecting by preparatory movement thereof in their grooves a portion only of said jacks in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining jacks to be temporarily idle in their grooves; and means to advance in their grooves said jacks as pre-selected, sufficiently to engage their needles therein and to move said needles into yarn-taking position.

65. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; instrumentalities individual to at least a group of said needles and having movement independent of such needles; means to move a portion only of said instrumentalities into an intermediate position according to pre-selection, while permitting others of said instrumentalities to remain temporarily unmoved; and means to move the intermediately positioned instrumentalities sufficiently to engage their needles and to move said needles into yarn-taking position.

66. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved needle carrier therefor; yarn feeding means; jacks in the needle grooves individual to at least a group of said needles and having movement independent of such needles; means to move less than all of said jacks into an intermediate position in their grooves in accordance with pre-selection; and means to move said intermediately positioned jacks so as to engage their needles and move them into yarn-taking position in accordance with such pre-selection of said jacks.

67. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; instrumentalities individual to at

least a group of said needles and having movement independent of such needles; means for pre-selecting by preparatory movement thereof a portion only of said instrumentalities in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining instrumentalities to be temporarily idle; and cam means to act upon such pre-selected instrumentalities to move the latter into engagement with their needles and then to move their needles into yarn-taking position.

68. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved carrier therefor; yarn feeding means; jacks mounted in the grooves of said needles and individual to at least a group thereof and having movement independent of their needles; means including a cam for pre-selecting by imparting preparatory movement thereto, a portion only of said jacks in said grooves in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining jacks to be temporarily idle in their grooves; and means to move said pre-selected jacks in their grooves sufficiently to engage their needles and thereby to move said needles into yarn-taking position.

69. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved carrier therefor; yarn feeding means; jacks mounted in the grooves of said needles and individual to at least a group thereof and having movement independent of their needles; means including a cam for imparting preparatory movement to and thus pre-selecting a portion only of said jacks in said grooves in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining jacks to be temporarily idle in their grooves; and cam means to move the pre-selected jacks in their grooves sufficiently to engage their needles and thereby move the latter into yarn-taking position.

70. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved carrier therefor; yarn feeding means; jacks mounted in the grooves of said needles and individual to at least a group thereof and having movement independent of their needles; means including a cam for imparting preparatory movement to and thus pre-selecting a portion only of said jacks in said grooves in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining jacks to be temporarily idle in their grooves; cam means to move the pre-selected jacks in their grooves sufficiently to engage their needles

and thereby move the latter into yarn-taking position; and means for rendering said cam means active or inactive.

71. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; instrumentalities individual to at least a group of said needles and having movement independent of such needles; means for pre-selecting by preparatory movement thereof, a portion only of said instrumentalities in accordance with the desired needle presentation, said means including an instrumentality-retracting cam; and means to move the pre-selected instrumentalities to engage their needles and thereby to move the latter into yarn-taking position.

72. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; instrumentalities individual to at least a group of said needles and having movement independent of such needles; means for pre-selecting a portion of said instrumentalities in accordance with the desired needle presentation, such means including means to advance certain of said instrumentalities to an intermediate position and means to retract said intermediately advanced instrumentalities from said intermediate position; and means to advance the pre-selected instrumentalities to engage their needles and move the latter into yarn-taking position.

73. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved needle carrier therefor; yarn feeding means; jacks in said grooves individual to at least a group of said needles and having movement independent of such needles; means for pre-selecting a portion only of said instrumentalities in accordance with the desired needle presentation, such means including means to advance selected jacks to an intermediate position and cam means to retract said jacks from said intermediate position; and cam means for moving the pre-selected jacks sufficiently in their grooves to engage their needles and to move the latter into yarn-taking position.

74. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles, a grooved needle carrier therefor; yarn feeding means; jacks in said grooves individual to at least a group of said needles and having movement independent of such needles; means for pre-selecting a portion only of said instrumentalities in accordance with the desired needle presentation, such means including means to advance selected jacks in their grooves to an intermediate position; cam means to retract said intermediately advanced jacks in their grooves; means to render said cam means selectively active and inactive; and

cam means to move the pre-selected jacks in their grooves sufficiently to engage their needles and to move the latter into yarn-taking position.

75. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved carrier for said needles; yarn feeding means; jacks in said grooves individual to at least a group of said needles and each adapted, when functioning, to function always on the same needle and having movement independent of their needles; means for pre-selecting by preparatory movement thereof a portion only of said jacks in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining jacks to be temporarily idle in their grooves; and means to advance in their grooves said jacks as pre-selected sufficiently to engage their needles and to move the latter into yarn-taking position.

76. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; a grooved carrier for said needles; yarn feeding means; jacks in said grooves individual to at least a group of said needles and each adapted, when functioning, to function always on the same needle and having movement independent of their needles; means for pre-selecting by preparatory movement thereof a portion only of said jacks in accordance with the desired needle presentation to the yarn feeding means, thereby permitting the remaining jacks to be temporarily idle in their grooves; cam means to engage in their grooves the pre-selected jacks and to move them therein sufficiently to engage their needles and to move the latter into yarn-taking position; and means to move said cam means into non-functioning position.

77. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; a grooved needle carrier for said needles; jacks in said grooves individual to at least a group of said needles and having movement independent of such needles preparatory to needle movement; means for pre-selecting a portion only of said jacks in accordance with the desired needle presentation to the yarn feeding means, said means including interengaging formations upon companion jacks; and means to advance said pre-selected jacks in their grooves to engage their needles and to move the latter into yarn-taking position.

78. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles, yarn feeding means; a grooved needle carrier for said needles; jacks in said grooves individual to at least a group of said needles and having movement independent of such needles; means

for pre-selecting a portion only of said jacks in accordance with the desired needle presentation to the yarn feeding means, said means including interengaging formations upon companion jacks, and also including a jack retracting cam; and means to move the pre-selected jacks in their grooves sufficiently to engage their needles and to move the latter into yarn-taking position.

79. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; a grooved needle carrier for said needles, jacks in said grooves individual to at least a group of said needles and having movement independent of such needles; means for pre-selecting a portion only of said jacks in accordance with the desired needle presentation to the yarn feeding means, said means including interengaging formations upon companion jacks, and also including a jack retracting cam; a cam to advance pre-selected jacks in their grooves sufficiently to engage their needles and to move the latter into yarn-taking position; and means to render one of said cams non-functioning without necessarily rendering the other of said cams non-functioning.

80. In a knitting machine for making fabric with contrasting zones or areas, a set of independent needles; yarn feeding means; a needle carrier; instrumentalities individual to at least a group of said needles and having movement independent of such needles, preparatory to needle movement; means for pre-selecting a portion only of said instrumentalities in accordance with the desired needle presentation to the yarn feeding means, said means including inter-engaging formations upon companion instrumentalities; and means to advance said pre-selected instrumentalities to engage their needles and move the latter into yarn-taking position.

81. In a knitting machine for making fabric with contrasting zones or areas, a series of independent instrumentalities for a series of needles and having movement independent of such needles preparatory to needle movement; certain of said instrumentalities having operating portions of one formation, and one or more other of said instrumentalities having operating portions of a contrasting formation, said instrumentality or instrumentalities having such contrasting formation constituting a key or keys, and the said other instrumentalities of the series having lateral formations for inter-engagement with and movement by a companion instrumentality of the series, whereby commencing with the key or keys, each instrumentality moves a companion instrumentality.

82. In a knitting machine for making fabric with contrasting zones or areas, a series of independent, reciprocable butted instru-

mentalities, a plurality of such instrumentalities having short butts and at least one other of said instrumentalities having a long butt, said instrumentality or instrumentalities having a long butt constituting a key member or members of the series, and the short butt instrumentalities of the series each having a lateral formation for delayed inter-engagement with and movement by a companion short butt instrumentality, whereby commencing with the key member or members, each instrumentality moves a companion instrumentality.

83. A knitting machine having means to introduce a main yarn and a reinforcing yarn, a series of independently movable needles having means to operate the same for the production of non-reinforced work, jacks to elevate the needles for the production of reinforced work and having preparatory movement distinct from the reinforcing-yarn-taking movement of the needles, and cam means to control said jacks.

84. A knitting machine having in combination a carrier with substantially parallel guiding formations, and a series of to-and-fro movable needle controlling instrumentalities in substantial parallelism in said guiding formations respectively, each of said instrumentalities being distinct from and adapted to move independently of its needle, and having inter-engaging formations located respectively for temporary, delayed inter-engagement whereby one of said instrumentalities functions in imposing delayed movement upon an adjacent instrumentality of the series.

85. A knitting machine having in combination a needle carrier with substantially parallel guiding formations for needles or jacks; and a series of independent reciprocable instrumentalities in substantial parallelism in said guiding formations respectively, and having interengaging formations located respectively for temporary, delayed interengagement, whereby one of said instrumentalities functions in imposing delayed movement upon an adjacent instrumentality of the series and whereby said delayed movement is continued throughout the said series.

86. In the method of knitting upon a series of needles; feeding a regular yarn to the entire series of needles; supporting a reinforcing yarn to be taken by needles presented thereto; and in a series of successive complete courses forming a tapered reinforcement by moving independently of their needles and preparatory to needle movement of corresponding needles, a progressively varying number of needle jacks throughout a series of such jacks; causing such preparatory movement of such needle jacks to result in the presentation of a corresponding, pro-

gressively varying number of needles to said reinforcing yarn, and causing said needles to take such reinforcing yarn.

87. In the method of knitting upon a series of needles; feeding a regular yarn to the entire series of needles; supporting a reinforcing yarn to be taken by needles presented thereto; and in a series of successive complete courses forming a tapered reinforcement by moving independently of their needles and preparatory to needle movement of corresponding needles, a gradually increasing number of needle jacks; causing such preparatory movement of such needle jacks to result in the presentation of a corresponding, gradually increasing number of needles to said reinforcing yarn, and causing said needles to take said reinforcing yarn.

88. A knitting machine containing in combination a needle carrier having a series of substantially parallel guiding formations for needles or jacks; a series of independently reciprocable instrumentalities received by said guiding formations respectively; means to initiate reciprocation of one of said instrumentalities along its guiding formation; and means to cause reciprocation of that one of said instrumentalities merely to initiate reciprocation of a neighboring instrumentality of the said series along its guiding formation without thereby completing functioning reciprocation of said neighboring instrumentality.

89. A knitting machine containing, in combination, a series of independently, reciprocable needles; means to effect initiating movement for yarn-taking reciprocation of one of said needles; and means to cause such initiating movement for the said reciprocation of that one of said needles to effect initiating movement for the yarn-taking reciprocation of a neighboring needle of the said series.

90. A knitting machine containing, in combination, a series of independently, reciprocable needles; means to effect initiating movement for yarn-taking reciprocation of one of said needles; and means to cause such initiating movement for the said reciprocation of that one of said needles to effect initiating movement for the yarn-taking reciprocation of a neighboring needle of the said series, and for continuing such initiating movement throughout the said series.

91. A knitting machine having yarn feeding means, a series of independently movable instrumentalities in substantial parallelism, for causing the taking of yarn by the needles, means for moving one of said instrumentalities to cause the taking of yarn by one needle, means whereby said instrumentality in its said movement causes shorter movement of another of said instru-

mentalities, and such action is permissibly continued throughout the series, and means to complete said shorter movements, thereby causing yarn taking by the series of needles.

5 92. A knitting machine containing in combination a needle carrier having a series of substantially parallel guiding formations for needles or jacks; a series of separately-operable instrumentalities received for to-and-fro functioning movement
10 along said guiding formations respectively; means to initiate to-and-fro functioning movement of one of said instrumentalities along its guiding formation; and means to
15 cause the functioning movement of that one of said instrumentalities merely to initiate to-and-fro functioning movement of a neighboring instrumentality of the said series along its guiding formation, without there-
20 by completing the said functioning movement of said neighboring instrumentality.

93. A knitting machine containing in combination a needle carrier having a series of substantially parallel guiding formations for needles or jacks; a series of
25 separately-operable, variation-selecting instrumentalities received by said guiding

formations respectively; means to initiate a selecting operation of one instrumentality of said series along its guiding formation; 30 and means to cause such selecting operation of that one instrumentality to initiate a progression of related selecting operations by others of said series along their guiding formations respectively. 35

94. A knitting machine containing in combination a needle carrier having a series of substantially parallel guiding formations for needles or jacks; a series of separately-operable, variation-selecting instrumentalities received by said guiding formations respectively; means to initiate a selecting operation of one instrumentality of said series along its guiding formation; 40 and means to cause such selecting operation by that one instrumentality merely to initiate a related selecting operation by another instrumentality of the series along its guiding formation, without thereby completing the selecting operation of said other 45 instrumentality. 50

In testimony whereof, I have signed my name to this specification.

ROBERT H. LAWSON.