May 17, 1932. A. E. STEWART 1,859,256

KNITTING MACHINE

Filed Oct. 5, 1928 7 Sheets-Sheet 1

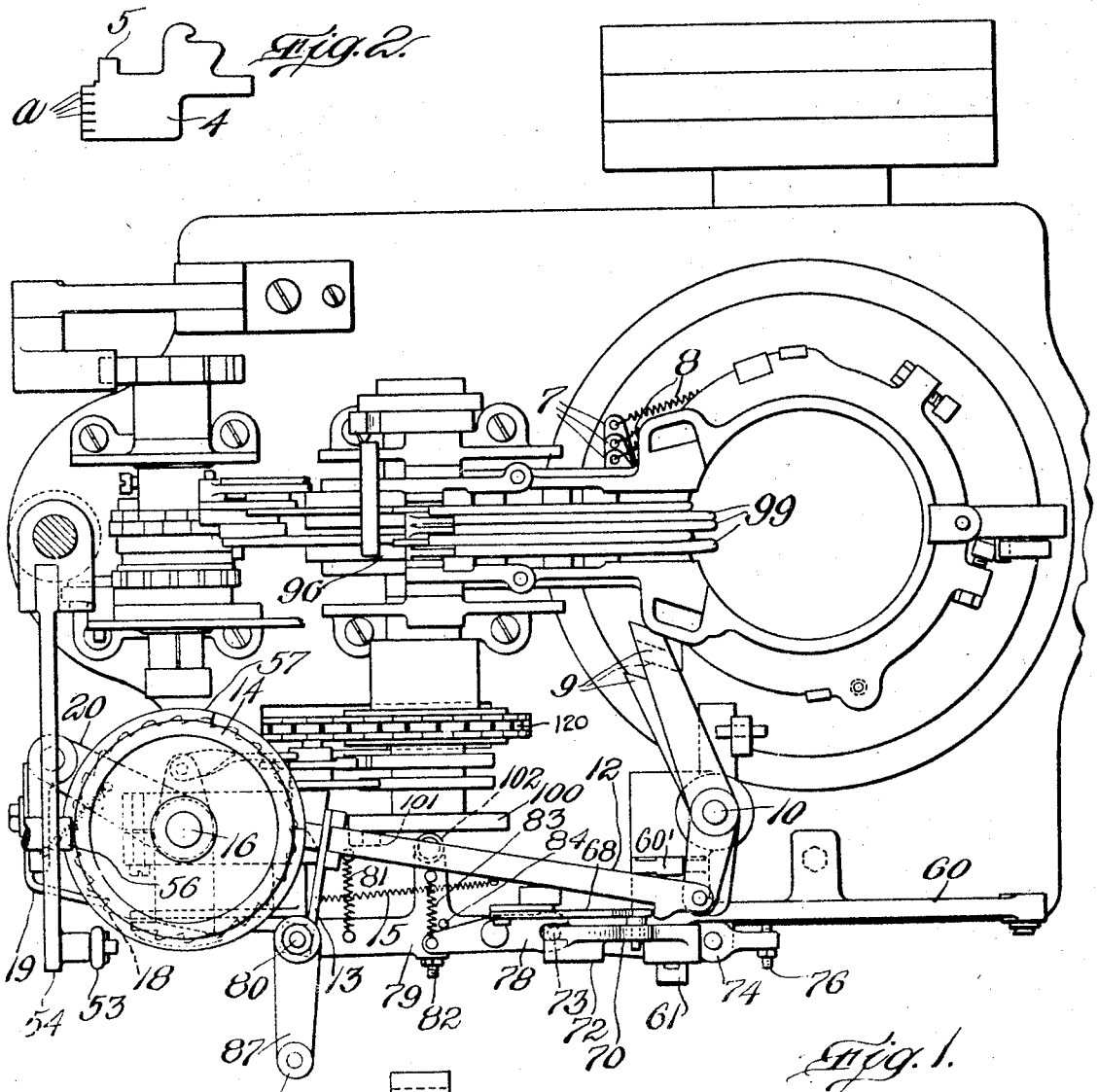


Fig. 2.

Fig. 1.

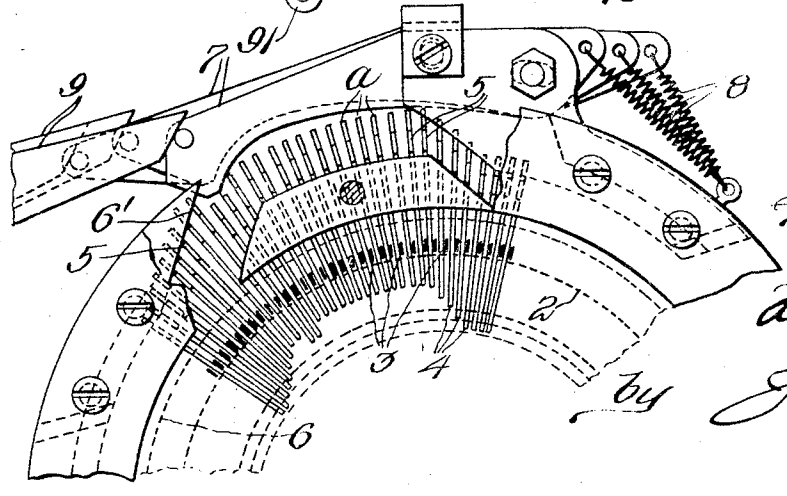


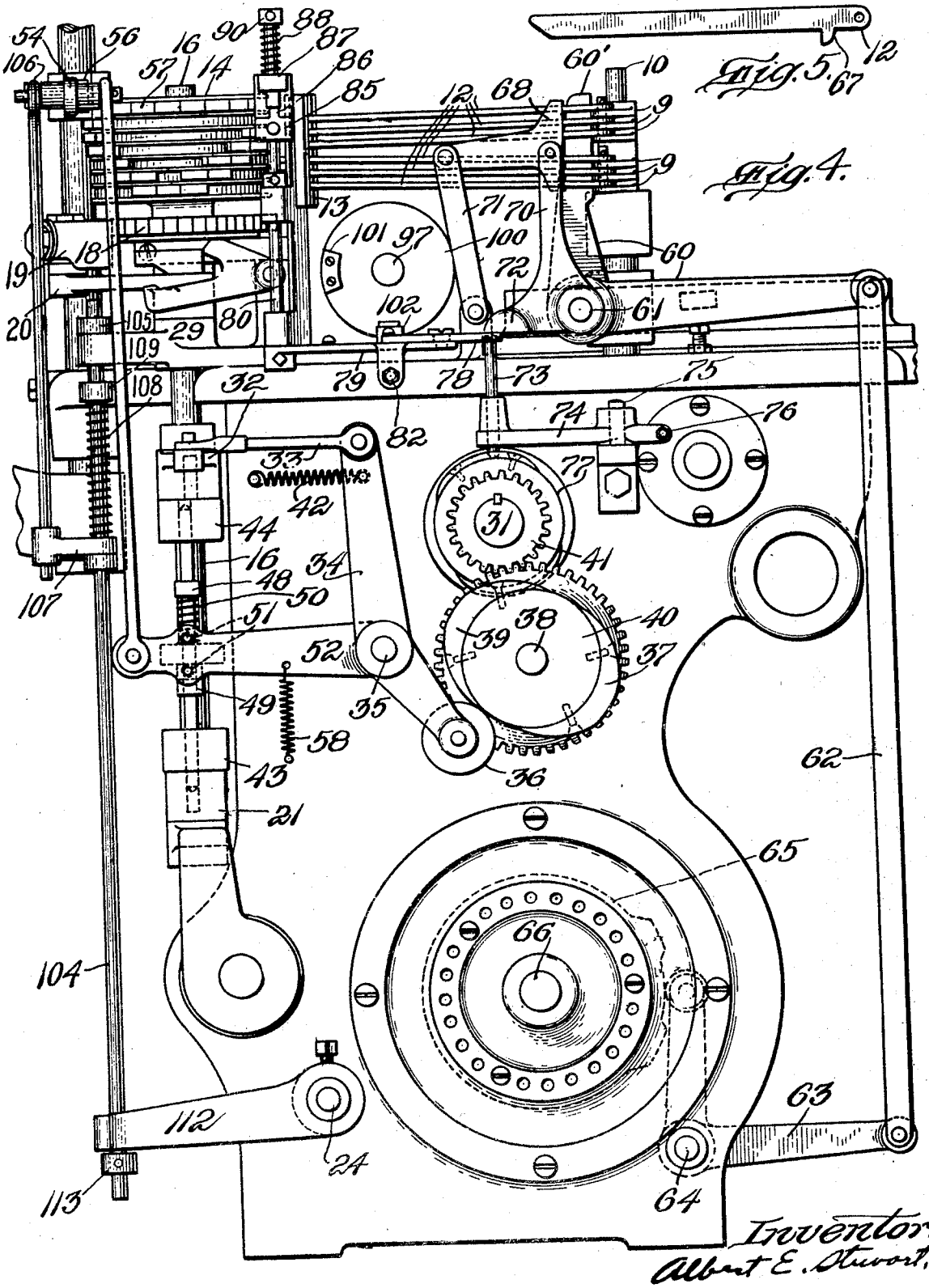
Fig. 3.

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KNITTING MACHINE

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KNITTING MACHINE

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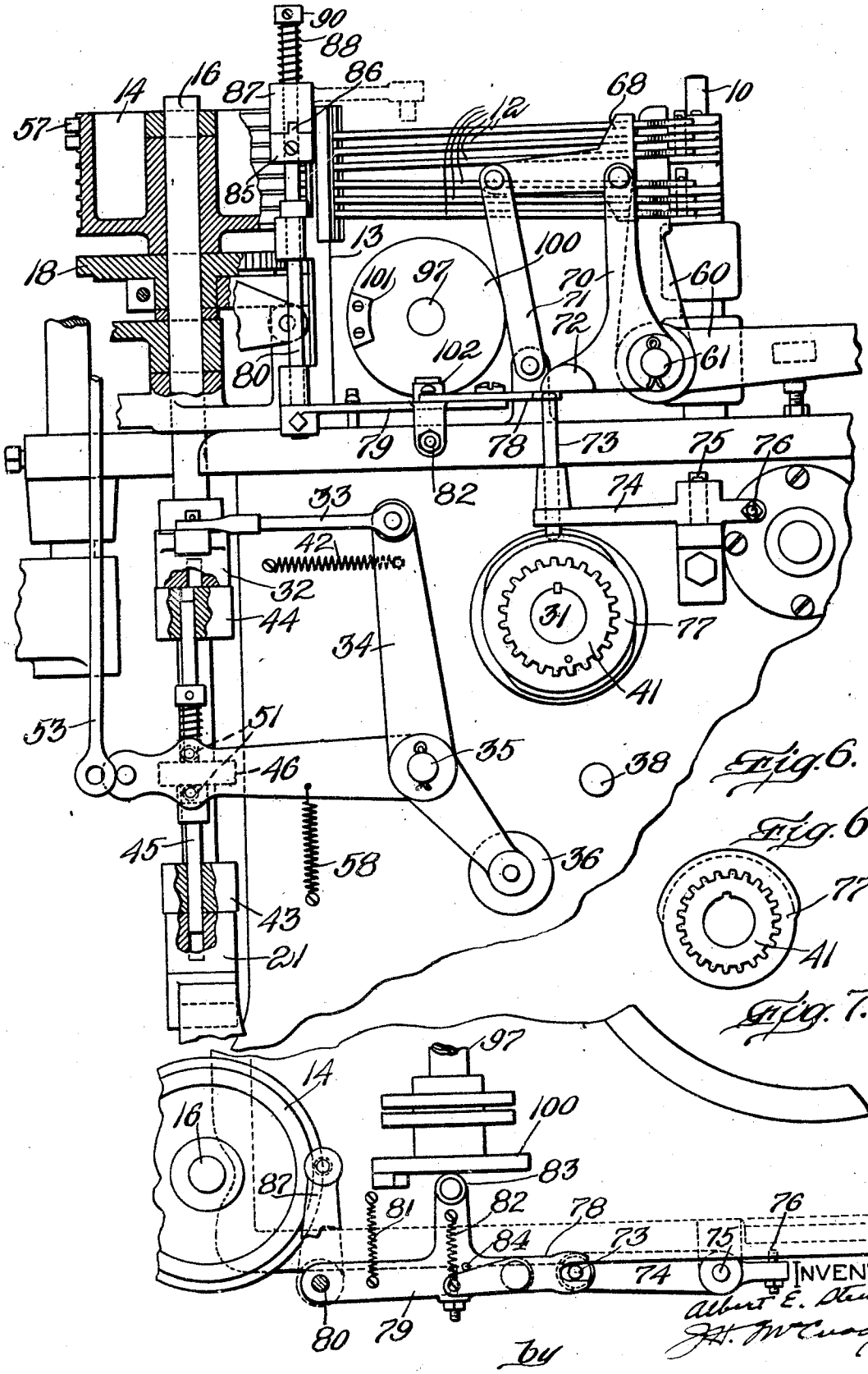


Fig. 6.

Fig. 6a

Fig. 7.

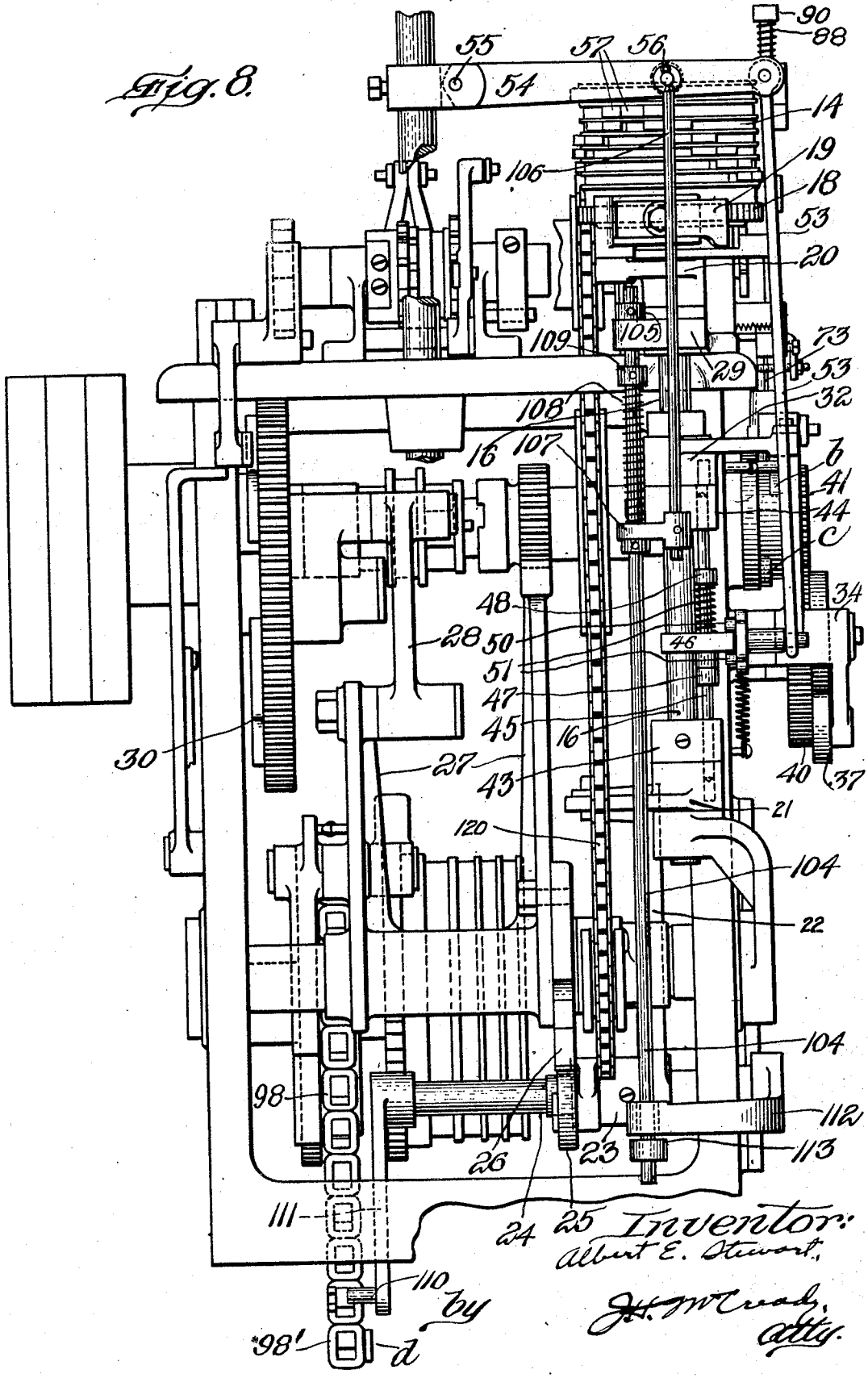
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Fig. 8.



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May 17, 1932. A. E. STEWART 1,859,256

KNITTING MACHINE

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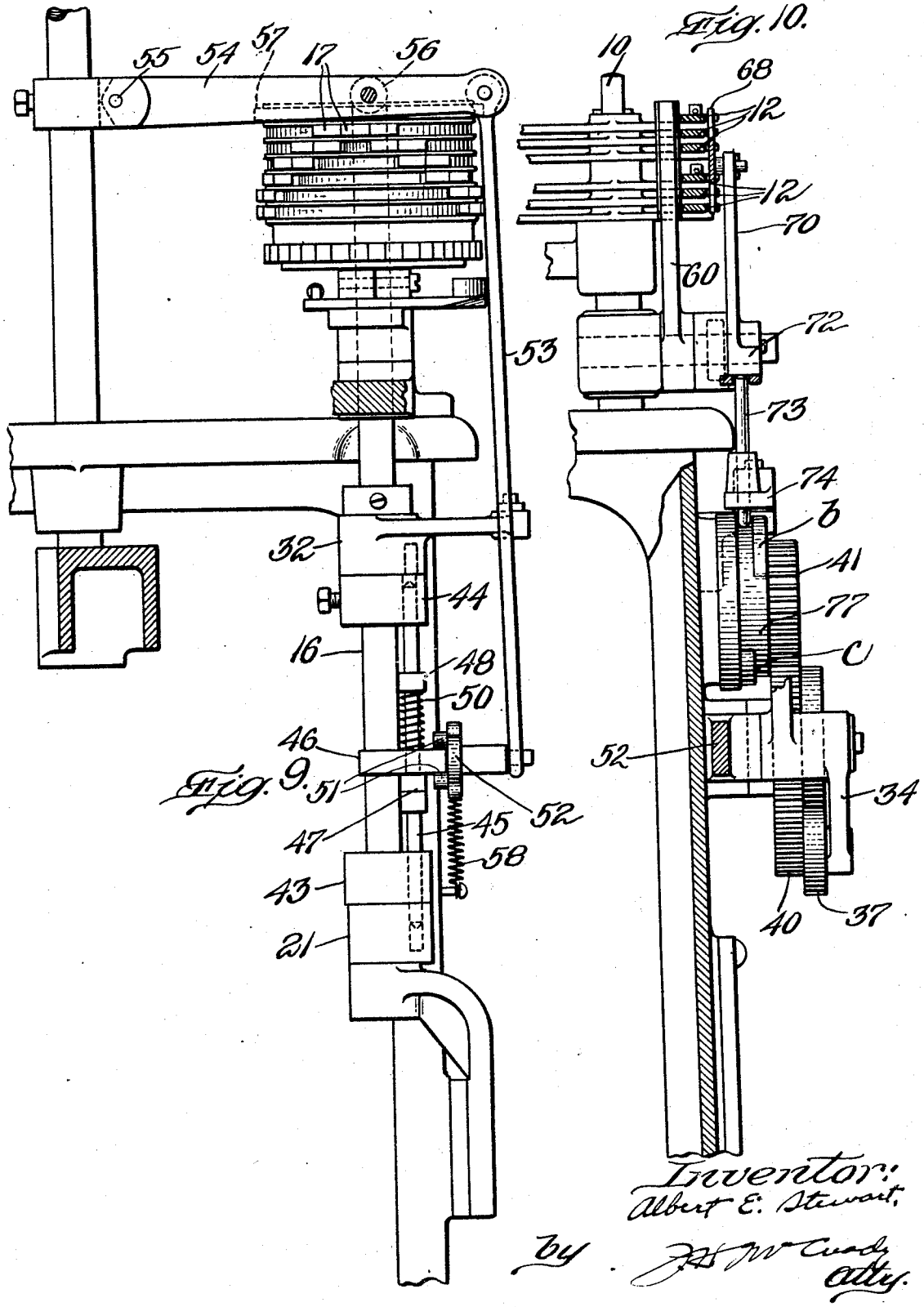


Fig. 9.

Fig. 10.

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KNITTING MACHINE

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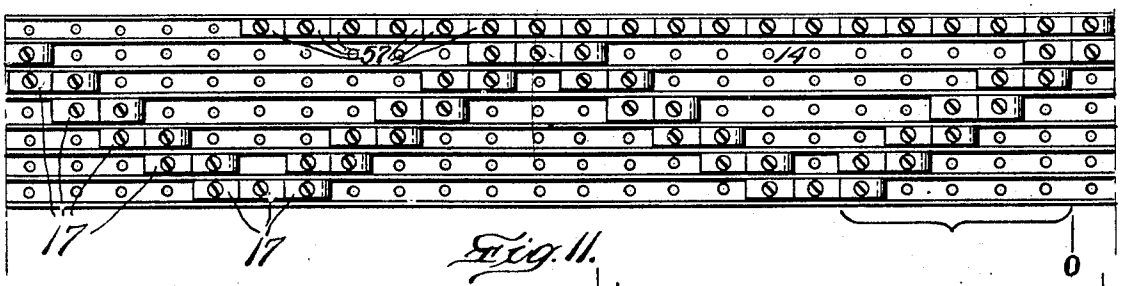


Fig. 11.

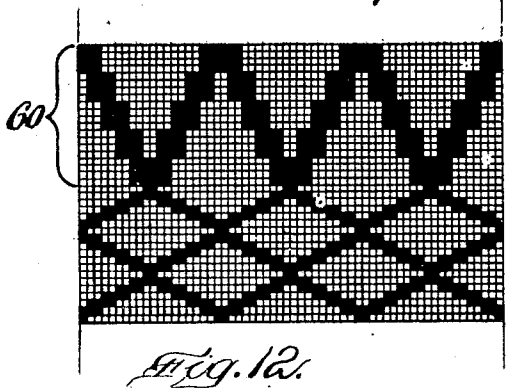


Fig. 12.

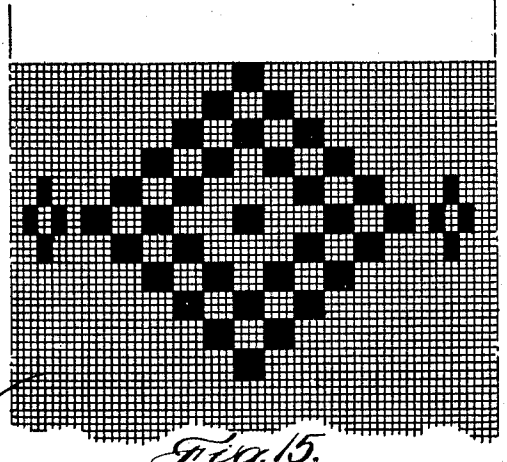


Fig. 15.

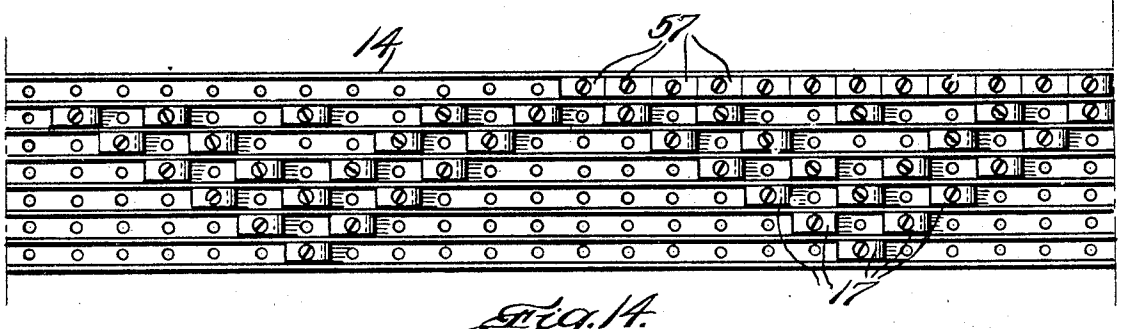
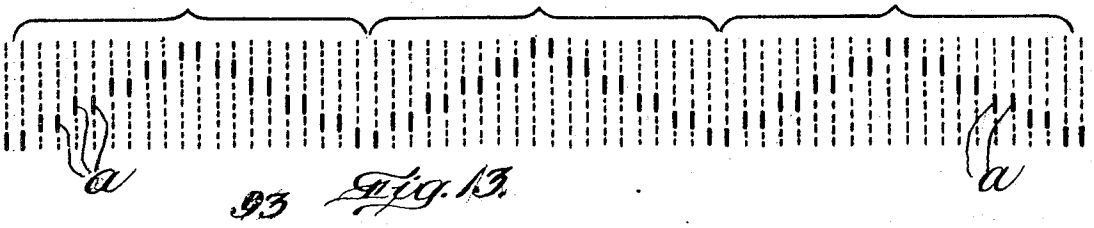


Fig. 14.



93

Fig. 13.

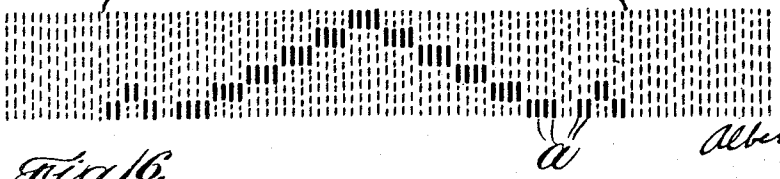


Fig. 16.

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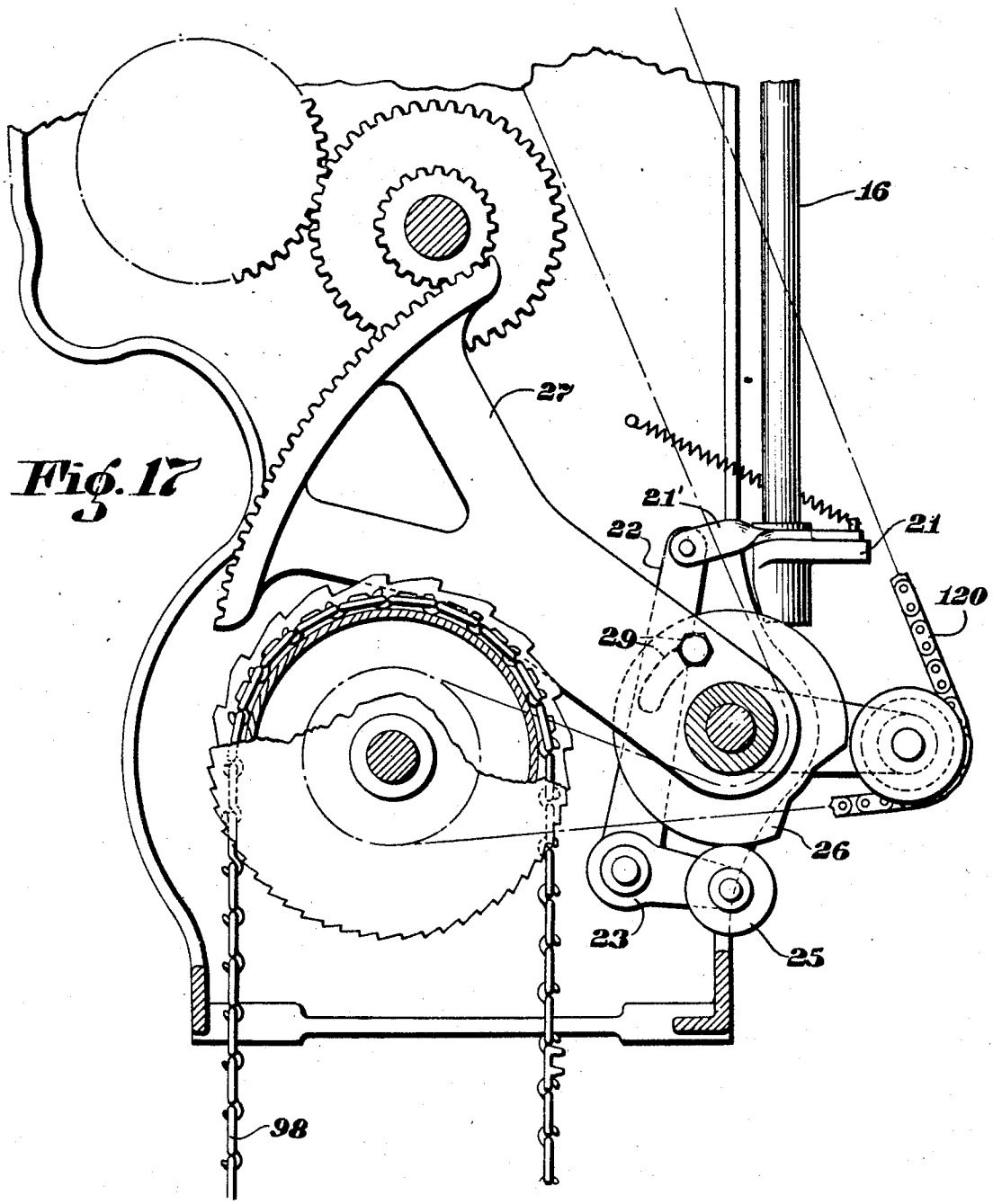
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KNITTING MACHINE

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Fig. 17



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Patented May 17, 1932 1,859,256

UNITED STATES PATENT OFFICE

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KNITTING MACHINE

Application filed October 5, 1928. Serial No. 310,523.

In my Patent No. 1,602,786 and in my pending application Serial No. 284,680 filed June 12, 1928, I have disclosed a knitting machine in which pattern effects are produced by knitting with two threads of different colors fed to the needles in plating relationship and reversing the threads at desired points. This produces a reverse plating at such points and the knitting instrumentalities are properly controlled to produce the desired pattern effects.

The present invention aims further to develop machines of this type with a view to adapting them to handle a greater variety of work and to producing automatically a wider range of patterns.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawings, and the novel features will be particularly pointed out in the appended claims.

In the drawings,

Figure 1 is a partial plan view of a knitting machine constructed in accordance with this invention;

Fig. 2 is a side view of a sinker which may be used in the machine;

Fig. 3 is a plan view on a somewhat larger scale showing particularly certain of the auxiliary or special sinker operating cams and their relationship to the sinkers;

Fig. 4 is a side elevation of the machine shown in Fig. 1;

Fig. 5 is a plan view of one of the thrust bars or levers used in the machine;

Fig. 6 is a side elevation, partly in section, illustrating certain of the operating and adjusting mechanisms;

Fig. 6ª is a detail view of one of the cams;

Fig. 7 is a plan view of certain of the parts shown in Fig. 6;

Fig. 8 is a rear elevation of the machine shown in Figs. 1 and 4;

Fig. 9 is a rear elevation showing separately some of the parts illustrated in Fig. 8;

Fig. 10 is a view partly in elevation and partly in section illustrating more clearly certain of the parts shown in Figs. 6 and 8;

Fig. 11 is a diagrammatic development of a pattern drum showing a typical arrangement of cams;

Fig. 12 illustrates a pattern figure which may be made by the arrangement of cams shown in Fig. 11;

Fig. 13 is a diagrammatic view illustrating the arrangement of the butts of the special sinkers employed in producing the figure or pattern shown in Fig. 12;

Fig. 14 is a diagrammatic development of a pattern drum constructed for the production of another pattern;

Fig. 15 illustrates the pattern produced by the drum shown in Fig. 14;

Fig. 16 is a diagrammatic view illustrating the arrangement of the sinker butts in producing the pattern shown in Fig. 15; and

Fig. 17 is a side elevation, partly in section, illustrating some of the mechanism shown in Fig. 8.

The drawings show the invention as embodied in a hosiery knitting machine of the rotary needle cylinder type, although it will be evident to those skilled in this art that the invention is equally applicable to a machine of the stationary cylinder type. The particular machine shown for purposes of explanation is that known commercially as the Acme Model D machine, but modified in accordance with the disclosure made in my pending application above identified.

In this machine, as explained more fully in my pending application, two threads or yarns are fed to the needles in plating relationship, a substantially greater tension being applied to one yarn than the other. In normal knitting this will result in the tensioned yarn appearing at the face of the fabric. This is ordinary plating. The machine, however, is equipped with sinkers which, in addition to being operated in the usual manner, are provided with special lugs located in different positions and arranged to be engaged by special or auxiliary sinker operating cams which are controlled by a pattern mechanism so that the sinkers can be operated selectively and independently of the regular sinker operating cam. As explained fully in my Patent No. 1,602,786, when one of these special sinkers is moved

into engagement with the plating threads at an abnormally early point in the stitch forming operation, it results in reversing the threads in that particular stitch. This selective and automatic operation of the sinkers is utilized to produce pattern effects in the fabric.

In the machine shown in my pending application above referred to, the special pattern mechanism which controls the operation of the auxiliary sinker operating cams is operated in a fixed ratio to the operation of the knitting mechanism of the machine. The fact that this ratio is fixed, limits, in some respects, the variety of patterns or designs which can be produced in the machine. It is, therefore, one of the objects of this invention to devise means for changing this ratio automatically at the desired point or points in the cycle of operations of the machine. It is a further object of the invention to devise means for suspending the operation of the pattern mechanism which controls the plating, at desired points, and to provide means for controlling the action of the auxiliary sinker operating cams at times independently of the pattern mechanism which normally controls their action.

Referring now to the drawings, the machine shown includes a revolving needle cylinder 2, Fig. 3, carrying a series of independent upright needles 3. Sinkers 4 are interposed between adjacent needles, and these sinkers may be of the form shown in Fig. 2. Each of these sinkers is provided with a butt having an upright cam lug 5 to run in the cam groove 6, Fig. 3, of the main cam. The sinker 4, as shown in Fig. 2, is provided with a series of lugs *a* which extend horizontally from the rearward edge of the butt. Usually all of these lugs, except one, are broken off, but the particular lug left may be any one of the six lugs shown. In some cases all of the lugs are left on the sinker, while in other cases all of them are removed or broken off. For some purposes, also, sinkers are employed having a different number of lugs from that shown, and situations occur in which a plurality of lugs *a* are left on an individual sinker. A series of auxiliary sinker operating cams 7 is associated with the cam ring, these cams corresponding in number to the lugs *a* and being located in different elevations so that each cam is positioned to engage a lug located in one only of the six positions which the lugs *a* may take. Springs 8, Fig. 3, act on these cams to hold them in an outward or inoperative position where they will not engage the lugs *a*, but the cams may be moved inwardly against the action of the springs by levers 9, Figs. 1 and 3, all mounted on an upright pivot stud 10, one lever being provided for each cam. Connected to the rearward ends of the levers 9 are thrust bars 12, Figs. 1 and 4, having end portions which are supported in a comb or guide 13, and the extremities of these thrust bars are bevelled to engage with cams on the upright pattern drum 14. Coiled springs 15, Fig. 1, act on the thrust bars 12 to hold them normally against the drum, and when permitted by the cams on the drum, these springs act to swing the levers 9 inwardly and thus force the auxiliary cams into their operative positions.

It will be observed from an inspection of Fig. 3 that when any cam 7 is held in its inner or operative position by its lever 9, it will engage the lugs *a* of certain of the sinkers 4 and force such sinkers in at an abnormally early point. That is, this cam will act on the sinkers to move them inwardly before the regular lugs 5 of the sinkers strike the cam surface 6', Fig. 3, of the regular sinker cam. This movement results in reversing the threads at the stitches or loops engaged by the sinkers. In other words, normal plating occurs so long as the auxiliary cams are held in their outward or inoperative positions, and reverse plating occurs at those sinkers which are moved in by their cams 7. The sinkers are arranged in groups or sets, depending upon the pattern desired, and each cam 7 acts on only the sinkers of its individual set.

It should also be noted that in this machine if the thrust bars 12 were controlled entirely by the springs 15 and all the sinkers were equipped with one or more lugs *a*, reverse plating would occur throughout the entire fabric. Consequently, if a single lug were used on the drum 14 to operate any individual thrust bar 12, normal plating would occur at the sinkers controlled by that bar so long as it remained in contact with the drum, and one or more stripes would be produced in the goods, the number of the stripes depending upon the number and arrangement of the sinkers operated by the auxiliary cam connected to the said thrust bar 12, and the length of the stripes depending upon the length of time that the cam on the pattern drum 14 remains in contact with the bar 12.

The construction so far described is substantially like that of the machine shown in my pending application, but the foregoing description will assist in an understanding of the operations which are performed by the mechanism provided by the present invention.

The pattern drum 14 is mounted to revolve loosely on the upright shaft 16, and it is provided with peripheral grooves to receive cams or cam lugs, such as those shown at 17, Fig. 11, for acting on the ends of the thrust bars 12. A ratchet wheel 18 is also mounted loosely on the shaft 16 but fast with the drum 14 and is arranged to be rotated step by step by a pawl 19 which is carried by an arm 20 secured fast on the shaft 16. During

the operation of the machine the shaft 16 is rocked or oscillated and acts through the pawl 19 to step the pattern drum 14 around in a counter clock-wise direction, Fig. 1.

Two mechanisms are provided for oscillating the shaft 16 and they may be thrown into and out of operative relationship to the shaft 16 selectively. Referring to Figs. 8 and 17 it will be seen that an arm 21 is mounted loosely on the shaft 16 and the upper end of this arm is connected by a link 21′ to an arm 22 of a bell crank lever 23 which is mounted to oscillate on the rod or shaft 24. One arm of this bell crank lever carries a roll 25 which is arranged to be acted upon by a cam 26 secured to the sector 27 of the machine. This sector is connected by a link 28, Fig. 8, to a wrist pin projecting from the gear 30 driven from the main shaft 31, Fig. 4, of the machine. The gear ratio is four to one so that the arm 21 is given one oscillation for each four revolutions of the needle cylinder, this part of the mechanism being substantially like that shown and described in my pending application above identified. The cam 26 is also made adjustable relatively to the sector 27 through the bolt and slot connection 29 so that the arm 21 may be oscillated twice for each oscillation of the sector, or in other words the arm may be oscillated once for each two revolutions of the needle cylinder. This will be clear from an inspection of Fig. 17, it being observed that when the cam 26 is in the position there shown it will oscillate the lever 23 and consequently the collar 21 once during each oscillation of the sector 27. This movement will be produced by the lower corner of the cam riding completely across the roll 25 and back again. If, however, the cam 26 is so adjusted that both corners ride over the roll 25 in each oscillation of the sector, then the lever 23 will be oscillated twice during each oscillation of the sector.

The other mechanism for oscillating the shaft 16 comprises a collar 32, Fig. 4, loosely mounted on said shaft and connected by a link 33 with the upper arm of a lever 34 which is fulcrumed on a stub shaft 35. The lower arm of this lever carries a roll 36 running on the surface of a double lobed cam 37 which revolves on a shaft 38. The cam rotates with a gear 40 which meshes with a pinion 41 fast on the main shaft 31 previously referred to. A spring 42 acts on the lever 34 to hold the roll 36 in contact with the cam. Both lobes of the cam 37 are removably secured by screws to the main body of the cam so that either lobe can be removed. The gear ratio is such that the collar 32 is given one oscillation for each revolution of the needle cylinder when two lobes are used on the cam 37, and is given one oscillation for each two revolutions of the needle cylinder when one lobe only is used.

In order to connect either of these oscillating mechanisms to the shaft 16, two clutch mechanisms are provided. Referring to Figs. 4 and 8 it will be seen that a collar 43 is mounted fast on the shaft 16 just above the arm 21, while a similar collar 44 is secured on the shaft just below the collar 32. A rod 45 is mounted immediately beside the shaft 16 with its ends extending into holes formed in said collars 43 and 44, holes also being formed in the parts 32 and 21 to receive, respectively, the upper and lower ends of this rod. The rod slides through a block 46 and collars 47 and 48 are secured fast on the rod below and above the block, respectively, a spring 50 being interposed between the block and the upper collar and tending to hold the block pressed downwardly against the lower collar. The block 46 is positioned between two pins 51—51 projecting laterally from one side of a lever arm 52 which is fulcrumed on the stud 35, and a link 53 connects this lever arm to a lever 54 fulcrumed at 55, Figs. 8 and 9, on the frame of the machine. This lever occupies a position immediately beside the upper edge of the pattern drum 14 and carries a roll 56 designed to be engaged by a row of cam lugs 57 mounted in the uppermost peripheral groove of the pattern drum. A spring 58, Figs. 4 and 9, holds the roll 56 in contact with the cam lugs 57.

So long as the parts remain in the position shown in Figs. 4, 8 and 9, with the lower end of the rod 45 positively connecting the collar 43 and arm 21, the shaft 16 will be oscillated with the arm, and the movement of this arm will have either a one to four or one to two ratio with reference to the rotation of the needle cylinder, depending upon the adjustment of the cam 26. When, however, as the pattern drum is rotated step by step the row of cam lugs 57 is brought into engagement with the roll 56, said cams or lugs will act through the lever 54, link 53, lever 52 and block 46 to raise the clutch rod 45 out of engagement with the arm 21 and force it into the socket provided for it in the collar 32, thus connecting the collars 44 and 32 positively together. The shaft 16 then will be oscillated by the cam 37. The ratio of this oscillating movement to the rotation of the needle cylinder will be either one to two or one to one, depending upon the number of lobes used on the cam 37.

This permits the automatic shifting of the operating ratio between the rotation of the needle cylinder and the step by step rotation of the pattern drum, so that the drum may at one time be fed one step for each four revolutions of the needle cylinder, and subsequently changed to a feed of either one step in each two revolutions, or one step in each revolution, as desired, or a shift may be made automatically from one step in each two revolutions to one step in each revolution.

The reverse shifts can also be made automatically.

A typical result obtainable with this arrangement is illustrated in Figs. 11 and 12. Fig. 11 shows a development of the pattern drum 14 with its seven circumferential grooves tapped to receive cams or cam lugs, such as those shown at 17 and 57, each cam or lug being secured in place by a screw. The six grooves below that in which the lugs 57 are located receive lugs for operating the thrust bars 12, as above explained. Each cam or lug has an angular length equal to the distance which the drum is moved by feeding it one tooth. Therefore each step movement of the drum will move one vertical row of cam lugs out of cooperative relationship to the thrust bars 12 and bring another vertical row of cam lugs into cooperative relationship to said bars.

Assuming that black and white threads are fed simultaneously to the needles, the arrangement of cams illustrated in Fig. 11 can be made to produce zig zag figures in the fabric. So long as the pattern drum 14 is fed one step in each four revolutions of the needle cylinder, the design or pattern will be like that in the upper part of Fig. 12. If the ratio is then changed automatically, as above described, to make the pattern drum feed one step in each revolution of the needle cylinder, but without making any other change in the machine, it will then produce the diamond pattern shown in the lower part of Fig. 12. The shift from one figuring to another can be made automatically at any desired point in the fabric. The arrangement of sinker lugs for producing this pattern is shown diagrammatically in Fig. 13, the dark lines *a* indicating the ends of the auxiliary lugs on the sinkers.

It is desirable to suspend the operation of the mechanism which produces the figuring or design in the fabric during the knitting of the heel and toe. For this purpose a bell crank lever 60, Fig. 4, is fulcrumed on the machine frame at 61 and is provided with an upright arm 60′, Figs. 1 and 4, which is positioned to bear against the short arms of the levers 9 that operate the auxiliary sinker cams 7. A link 62, Fig. 4, connects the horizontal arm of the lever 60 with a lever 63, fulcrumed at 64, and has an arm carrying a roll arranged to engage a cam 65 on the main cam or pattern shaft 66 of the machine. Consequently, during the knitting of the heel and toe the sinker cams 7 are taken out of the control of the pattern drum 14, but the control of the pattern drum is restored again as soon as the knitting of the heel and toe has been completed.

This machine also includes as a novel feature a mechanism for throwing the auxiliary sinker cams into and out of operation at other times than during the knitting of the heel and toe for the purpose of producing additional design effects. In this machine a single revolution of the pattern drum 14 produces one complete design section in the fabric, although this section may be repeated several times in the knitting of a single stocking. A special use for the automatic mechanism just mentioned is for the purpose of excluding the design or certain features of it from some parts of the fabric. For example, a design section may include one or more isolated figures, such as that shown in Fig. 15, which it is desired to produce at a certain place or places in one design section and to omit from corresponding parts of another design section.

To these ends the push bars 12 are each provided with a lateral projection 67, Figs. 4 and 5, these projections being alined with each other and positioned for simultaneous engagement with a bar 68, Fig. 4. This bar is supported jointly by a bell crank lever 70 and a link 71, the bar being pivoted to the upper ends of both of these members. The bell crank lever is fulcrumed on the pivot stud 61 and has a horizontal arm 72 which is flattened to bear on the upper end of a push rod 73. A lever 74 pivoted at 75 supports the push rod 73 and permits it to be swung toward or from the frame of the machine, this swinging movement being limited in one direction by a set screw 76 which is threaded through one arm of the lever 74. The lower end of the push rod 73 rests on the periphery of a cam 77 which rotates with the gear 41 previously referred to. Consequently, this cam makes one revolution during each revolution of the needle cylinder.

It will be seen from an inspection of Fig. 10 that the cam 77 is provided with two lobes, indicated at *b* and *c*, respectively. These lobes are removably secured to the cam by screws, and they are offset axially of the cam with reference to each other. Also, they are offset angularly of the cam by 180°. It will also be observed that if the push rod 73 is raised by either one of these cam lobes or "throws" it will operate through the bell crank lever 70, bar 68, and thrust bars 12 to throw all of the levers 9 outwardly, thus causing all of the auxiliary sinker cams 7 to move into their outer or inoperative positions. In other words, the auxiliary sinker operating cams are taken out of the control temporarily of the pattern drum 14.

It will thus be clear that with the push rod 73 occupying either of the two positions just referred to, it will be engaged once during each revolution of the needle cylinder by one or the other of the cam throws *b* or *c*, and that during the period it is so engaged no pattern or design will be produced in the fabric. In other words, the pattern which normally would be produced during these periods is excluded from the fabric.

In order to control the point in the production of the fabric at which this mechanism will be brought into action, the upper end of the push rod 73 is located in a slot in the end of a lever 78 which is fulcrumed on another lever 79, Figs. 1, 4 and 6. The latter lever is secured fast on the lower end of an upright rock shaft 80. A spring 81, Fig. 1, acts on the lever 79 to hold it in its innermost position, this position being determined by a set screw 82, while another spring 83 acts on the lever 78 to hold it normally against a stop pin 84 which is set into the lever 79. The lever 78 thus is simply a yielding tip for the main lever 79.

Secured fast on the rock shaft 80 is a collar 85, Figs. 4 and 6, which is provided with a key or fin 86 on its upper end. A lever 87 is mounted on this rock shaft just above the collar 85 and is provided with a slot to receive the key 86. Normally the lever is held in contact with the collar by a spring 88 backed up by a collar 90 on the end of the shaft. This arrangement permits the manual adjustment of the lever 87 into either an inoperative position as shown in Fig. 1, or a position directly opposite to that shown in said figure where a roll 91 mounted on the end of the lever will be located immediately beside the uppermost cam groove in the pattern drum 14 where it will be engaged by the cam lugs 57. It is rarely, if ever, necessary to use this mechanism and the automatic ratio changing mechanism above described at the same time, and consequently, when the lever arm 87 is in its operative position the link 53 of the ratio changing mechanism is unhooked from the lever 52.

It will be evident from an inspection of Figs. 1 and 4 that if the roll 91 on the lever 87 is engaged by one of the cams 57 it will rock the shaft 80 in a clockwise direction, Fig. 1, thus operating through the lever 79 and the yielding lever tip 78 to move the thrust pin 73 axially on the cam 77. This mechanism thus operates automatically to move the thrust pin 73 into engagement with either of the lobes *c* or *b* of the cam 77, as desired.

An effect which can be produced through the use of this mechanism will be explained by referring to Figs. 14, 15 and 16. Fig. 15 shows a figure which is produced by the group of sinkers 93, Fig. 16, when operated by cam lugs 17 arranged in the pattern drum 14 in the manner illustrated in Fig. 14. If it is desired to knit a stocking in which two vertical lines of these figures will be produced at the opposite sides of the leg, the figures in one line being staggered with reference to those in the other, then the sinkers at opposite sides of the sinker ring will be arranged as shown in Fig. 16. A single revolution of the pattern drum 14 produces a complete design section and the cams 17, therefore, arranged as shown in Fig. 14, would produce two of the figures shown in Fig. 15, one above the other, at each side of the stocking in each design section. In other words, four figures altogether. The lugs 57 in the uppermost cam groove of the drum cover 180° of the drum. The cam throw *c* on the cam 77 is timed to cause the auxiliary cams 7 to be thrown out of operation during the time that one of these groups of sinkers 93, Fig. 16, passes the auxiliary sinker cams. This prevents the production of the design in one side of the stocking but permits it in the other, and this action continues throughout the knitting of the upper half of one design section and while the figure is being produced at one side of the stocking. When this part of the design section has been completed the cams 57 come into contact with the roll 91 on the lever 87 and throw the thrust pin 73 over into alinement with the cam lobe or "throw" *b*, Fig. 10. Consequently, during the production of the next half of the design section the figure shown in Fig. 15 will be produced in the opposite side of the stocking from that in which it was formed during the knitting of the preceding half of the design, but it will be omitted from the latter section of the fabric.

Other design features can be knit into the goods between figures which are so staggered or which are omitted from predetermined parts of a given design section, the foregoing illustration simply explaining one use which can be made of this mechanism. Additional cams can also be substituted for the cam 77 to vary the effects produced in an appropriate manner. The mechanism does, however, permit the introduction of variations in the designs which otherwise would be made with a given arrangement of sinkers and a certain lay-out of cams on the pattern drum 14.

It will be understood that when the link 53 is removed or disconnected from the lever 52, as above described, the spring 58 will operate through the arm 52 to hold the clutch pin 45 in its lowermost position where it connects the collar 43 with the arm 21, the pattern drum at this time being fed one tooth for each two or each four revolutions of the needle cylinder, as desired.

It may here be noted, however, that the mechanism for automatically changing the ratio of the feeding movement of the pattern drum and the mechanism operated by the cam 77 could be used conjointly by using special lugs 57 since the vertical dimensions of these lugs are relied upon to operate the lever 54 while the width or horizontal dimensions of the lugs is used to operate the lever 87.

This machine also includes a yarn change drum 96, Fig. 1, mounted on the shaft 97, Fig. 4, and under the control of the main pattern chain 98, Fig. 8, of the machine due to its connection through the chain 120 with the main pattern shaft 66. This drum makes one complete revolution for each stocking and it

controls the thread fingers 99, as will be readily understood by those skilled in this art, and as explained more fully in my pending application above referred to.

It is desirable at times to throw the reverse plating mechanism out of action and to keep it out of operation during the knitting of the high splice, heel, the bottom of the foot, and the toe of the stocking. For this purpose a cam disk 100, Figs. 1, 4 and 6, is mounted on the end of the shaft 97, and a cam lug 101 is secured on the face of this disk in position to engage a roll 102 which is carried by a rearwardly extending arm of the lever 79, previously mentioned. It may also be necessary to replace the cam 77 with the cam 77ª, Fig. 6ª having a throw extending for 180° on the cam. When the cam lug 101 engages the roll 102 it operates through the lever 79 and lever tip 78 to throw the thrust pin 73 on to the portion of the cam having the rise or throw, and it will be maintained in this position during the knitting of the high splice, heel and toe. The result is to throw all of the auxiliary sinker operating cams 7 into their inoperative positions and to maintain them in this conditon during the knittng of the high splice, the heel, toe and bottom part of the foot. No design, therefore, will be produced in these portions of the stocking. This mechanism operates independently of the pattern drum but under the control of the main pattern mechanism of the machine. The length of the throw required on the cam 77 for this purpose will depend somewhat upon the nature of the design, and in some cases a cam such as that shown at 77ª is suitable for this purpose. At the completion of the toe the shaft 97 is adjusted as usual for the start of the leg of the next stocking and this movement carries the cam throw or lug 101 away from the roll 102, leaving the arm 79 again under the control of the top row of cam lugs 57 on the pattern drum 14.

It is desirable for some purposes, as for example in clocking, to suspend the rotation of the pattern drum 14 for a considerable period of time during the knitting of the stocking.

For this purpose an upright rod 104, Figs. 4 and 8, is mounted in vertical guides at the back of the machine and closely behind the rock shaft 16. Normally this rod is held by gravity in approximately the position shown in Fig. 4 by a collar 105 which is secured on the rod and rests on the bracket 29 through which the rod passes. Another rod 106 is connected to the lever 54, previously referred to, and when this lever is raised by one of the cam lugs 57 the movement so produced is transmitted to an arm 107 secured to the rod 106 and having an extension through which the rod 104 passes. A coiled spring 108 bears on the arm 107 and abuts at its upper end against a collar 109 secured to said rod. The movement of the lever 54 therefore raises the rod 104, and it is so positioned that its upper end is moved in behind the arm 20, Figs. 1 and 4, that carries the pawl 19 and prevents this arm from making its pawl feeding stroke. Therefore at this time the feeding movement of the pattern drum 14 will be interrupted. It should be understood that the link 53 is disconnected from the lever 52 at this time.

In order to cause a resumption of the feeding movement of the drum 14, one or more special links 98′, Fig. 8, are included in the main pattern chain 98 which controls the sequence of operations of the machine, this link being provided with a lug *d*, Fig. 8, designed to engage a pin 110 projecting laterally from the end of a lever 111 which is secured fast to the rock shaft 24, Figs. 4 and 8. The rod 104 extends through a hole in the end of another arm 112 which is secured fast on the outer end of the rock shaft 24 and a collar 113 is secured on the rod just below the rock shaft, as shown in Fig. 4. Consequently, when the lug *d* strikes the pin 110 it results in rocking the arm 112 in a counter clockwise direction, Fig. 4, and thus moves the rod 104 downwardly far enough to disengage it from the arm 20 and permit a resumption of the normal feeding movement of the pattern drum. A single lug 57 is sufficient to interrupt the feeding movement of the drum so that a single additional feeding step carries the lug out of contact with the roll 56 on the lever 54 and permits this lever to return again to its normal position.

In clocking, this mechanism may be used to prevent the production of any design in the upper part of the leg of the stocking, then to permit the feeding of the drum necessary to produce the design at the head of the clock, and then to interrupt said feeding movement again, the lugs on the pattern drum 14 being so placed that a vertical stripe leading from each design to the lower part of the stocking will be produced. A further design can be made at the lower end of the stripe if desired.

It will now be understood that the invention provides a knitting machine in which an exceptionally wide variety of patterns or designs can be produced and in which the matter of shifting from one design to another is relatively simple. The fact that the cam and sinker arrangement for a new design can be changed quickly for a new pattern when the pattern has once been laid out on paper is an important practical advantage.

While a preferred embodiment of the invention has been herein shown and described, it will be evident that the invention may be embodied in other forms without departing from the spirit or scope thereof.

Having thus described my invention, what I desire to claim as new is:

1. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating means for said cams including a pattern drum, mechanism for giving said drum a feeding movement, a pattern chain, means operative independently of said chain, for automatically interrupting said feeding movement at a predetermined point in the knitting operation, additional means for causing a resumption of said feeding movement, and automatic means for operating said pattern drum at a plurality of different speeds.

2. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating means for said cams including a pattern drum, mechanism for giving said drum a feeding movement, a cam on said drum, mechanism arranged to be operated by said cam for interrupting said feeding movement of the drum, and additional means for causing a resumption of said feeding movement.

3. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating means for said cams including a pattern drum, a pawl and ratchet mechanism for giving said drum a step by step feeding movement, a cam adjustable on said drum, means arranged to be operated by said cam for rendering said pawl and ratchet mechanism inoperative to feed the drum, and additional means operable automatically to cause a resumption of said feeding movement at any desired point in the knitting operation.

4. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles and having edges shaped to engage two threads fed to said needles in plating relationship, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers to cause reverse plating at the selected sinkers, and automatic means for operating the cams at a plurality of different speeds thereby to cause the sinkers to produce a certain design in one part of the fabric and to cause the same sinkers operating in the same manner on the threads to produce a different design in another part of the fabric while knitting with the same threads and maintaining the relationship between the needles and sinkers substantially unchanged during the production of both designs.

5. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles and having edges shaped to engage two threads fed to said needles in plating relationship, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers to cause reverse plating at the selected sinkers, pattern mechanism for selectively adjusting said cams in timed relationship to the operation of the knitting mechanism of the machine, actuating means for said pattern mechanism, and automatic means for operating the pattern mechanism at a plurality of different speeds thereby to change the operating ratio between said pattern mechanism and knitting mechanism at predetermined points in the cycle of operations of the machine.

6. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating means for said cams including a pattern drum, mechanism for feeding said drum in a definite time relationship to the operation of the machine, and means for automatically operating the pattern drum at a plurality of different speeds thereby to change the operating ratio between the feeding movement of said drum and machine speed at predetermined points in the cycle of operations of the machine.

7. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, pattern mechanism for selectively adjusting said cams, means for operating said pattern mechanism in different ratios to the operation of the knitting mechanism of the machine, and mechanism for automatically operating the pattern mechanism at a plurality of different speeds thereby to shift the pattern mechanism from one operating ratio to another at predetermined points in the knitting of the fabric.

8. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, pattern mechanism for selectively adjusting said cams, means for operating said pattern mechanism in a definite ratio to the operation of the knitting mechanism of the machine, and means for automatically operating

the pattern drum at a plurality of different speeds thereby to change from said ratio to a different ratio at a predetermined point in the knitting of the fabric.

9. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating means for said cams including a pattern drum, mechanism for giving said drum a feeding movement including two power driven devices operating in different time relationships to the knitting mechanism, and pattern controlled means for bringing said devices automatically and selectively into action to drive the drum.

10. A machine according to claim 9 in which the means for bringing said driven devices into action to drive said pattern drum is controlled by said drum.

11. A machine according to claim 9 in which said pattern controlled means includes two clutches for bringing either of said devices into action as desired, and connections controlled by said pattern drum for operating said clutches.

12. In a circular hosiery knitting machine, the combination of knitting instrumentalities constructed and arranged to produce design fabrics by reverse plating, pattern mechanism controlling the figuring so produced in each design section of the fabric and for causing the repetition of said design section in successive portions of a stocking, means for automatically suspending the action of the reverse plating mechanism during the knitting of a predetermined portion of a given design section, and subsequently restoring the action of said reverse plating mechanism during the knitting of a corresponding portion of another design section, and automatic means for operating the pattern mechanism at a plurality of different speeds.

13. A hosiery knitting machine of the character described having, in combination, a plurality of adjustable auxiliary sinker operating cams; a rotatable pattern drum; means for automatically rotating said drum step by step in timed relation to the operation of the knitting mechanism of the machine so as to impart one complete rotation to said drum for each complete design section of the fabric including a predetermined number of courses; means through which said drum acts to selectively adjust said auxiliary sinker cams to produce the figuring of the design in each design section of the fabric, and additional automatic means controlled by said drum for maintaining all of said auxiliary sinker operating cams out of their operative positions at a predetermined time during the production of certain predetermined consecutive courses of a design section of the fabric, whereby to omit the figuring from that portion of said design section.

14. A hosiery knitting machine having, in combination, a plurality of adjustable auxiliary sinker operating cams; a rotatable pattern drum; means for automatically rotating said drum step by step in timed relation to the operation of the knitting mechanism of the machine so as to impart one complete rotation to said drum for each complete design section of the fabric including a predetermined number of courses; means through which said drum acts to selectively adjust said auxiliary sinker cams to produce the figuring of the design in each design section of the fabric, and additional automatic means controlled by said drum for maintaining all of said auxiliary sinker operating cams out of their operative positions at predetermined times during the production of each design section so as to omit the figuring first at one place in said section and then at another place in said section that is angularly removed from the first place.

15. A hosiery knitting machine having, in combination, a plurality of adjustable auxiliary sinker operating cams; a rotatable pattern drum; means for automatically rotating said drum step by step in timed relation to the operation of the knitting mechanism of the machine so as to impart one complete rotation to said drum for each complete design section of the fabric including a predetermined number of courses; means through which said drum acts to selectively adjust said auxiliary sinker cams to produce the figuring of the design in each design section of the fabric, a driven cam, a normally inactive mechanism through which said cam acts at times to effect the simultaneous adjustment of all of said auxiliary sinker operating cams to omit the design figuring from a portion of the fabric, and means through which said pattern drum is operative to throw said normally inactive mechanism into and out of operation in timed relation with the operation of the knitting mechanism during the production of a design section of the fabric.

16. A machine according to claim 15 having means operative automatically to maintain said normally inoperative mechanism in action during the production of the high splice and foot to omit all of the figuring of the design from said high splice and from the bottom part of the foot.

17. A hosiery knitting machine having, in combination, a plurality of adjustable auxiliary sinker operating cams; a rotatable pattern drum; means for rotating said drum step by step in timed relation to the operation of the knitting mechanism of the machine; means through which said drum acts to selectively adjust said auxiliary sinker cams to produce the figuring of the design in each design section of the fabric, a main pattern mechanism,

and means through which the main pattern mechanism is operative to control said auxiliary sinker cams independently of said drum so as to omit the figuring of the design from the high splice portion of the stocking.

18. A hosiery knitting machine having, in combination, a plurality of adjustable auxiliary sinker operating cams; a rotatable pattern drum; means for rotating said drum step by step in timed relation to the operation of the knitting mechanism of the machine; means through which said drum acts to selectively adjust said auxiliary sinker cams to produce the figuring of the design in each design section of the fabric, a main pattern mechanism, and means through which said main pattern mechanism is operative to control said auxiliary sinker cams independently of said drum so as to omit the figuring of the design from the lower half of the foot while the machine operates to produce the figuring in the upper half of the foot.

19. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating mechanism for said cams including a pattern drum, mechanism for giving said drum a step by step feeding movement, a pattern chain controlling the sequence of operations of the machine, means adjustable to interrupt the feeding movement of said drum at any desired point in the knitting operation, said means being operative independently of said chain, and additional means arranged to be operated by the pattern chain for automatically causing a resumption of said feeding movement.

20. A machine according to claim 19 in which the means for automatically interrupting the feeding movement of the drum is arranged to be operated by the movement of said pattern drum.

21. In a rotary knitting machine of the character described, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations and cooperating with the needles and the threads fed to them to produce ordinary or reverse plating, a plurality of adjustable auxiliary cams for operating said sinkers, a rotatable pattern drum, means for automatically rotating said drum step by step in timed relation to the operation of the knitting mechanism in the machine, parts through which said drum is operative to adjust said auxiliary sinker cams selectively to produce the figuring of the design in each design section of the fabric, additional automatic means for maintaining all of said auxiliary sinker operating cams out of their operative positions at predetermined times during the operation of the machine, and automatic means for operating the pattern drum at a plurality of different speeds.

22. In a circular hosiery knitting machine equipped to produce design fabrics by reverse plating, the combination of pattern mechanism for controlling the figuring produced in each design section of the fabric, additional means for automatically modifying the action of said mechanism to exclude a feature of the design from one part of a design section of the fabric in which it otherwise would appear while permitting said mechanism to produce said feature in another part of said design section, and automatic means for operating the pattern mechanism at a plurality of different speeds.

23. In a circular hosiery knitting machine, the combination with knitting instrumentalities including a series of independent needles, sinkers interposed between said needles and arranged to engage two threads fed to said needles in plating relationship, said sinkers being arranged in sets having different butt formations, and cams for selectively operating said respective sets of sinkers to cause reverse plating at the selected sinkers; of pattern mechanism for selectively adjusting said cams automatically to control the production of the design in the fabric, and automatic means for operating the pattern mechanism at a plurality of different speeds to cause the production of a different design with the same sinkers and needles operating in the same manner on the same threads.

24. In a circular hosiery knitting machine, the combination with knitting instrumentalities including a series of independent needles, sinkers interposed between said needles and arranged to engage two threads fed to said needles in plating relationship, said sinkers being arranged in sets having different butt formations, and cams for selectively operating said respective sets of sinkers to cause reverse plating at the selected sinkers; of pattern mechanism for selectively adjusting said cams automatically to control the production of the design in the fabric, and means for automatically operating the pattern mechanism at a plurality of different speeds thereby to change the speed ratio between said pattern mechanism and said knitting instrumentalities while the knitting operation continues uninterruptedly.

25. In a rotary knitting machine, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations, cams for selectively operating said respective sets of sinkers, operating means for said cams including a pattern drum, mechanism for giving said drum a feeding movement, a pattern chain, means operative independently of said chain, for automatically interrupting said feeding

movement at a predetermined point in the knitting operation, and additional means for causing a resumption of said feeding movement, said means for automatically interrupting the feeding movement being arranged for operation by the movement of said pattern drum.

26. In a circular hosiery knitting machine, the combination of knitting instrumentalities constructed and arranged to produce design fabrics by reverse plating, pattern mechanism controlling the figuring so produced in each design section of the fabric and for causing the repetition of said design section in successive portions of a stocking, and means for automatically suspending the action of the reverse plating mechanism during the knitting of a predetermined portion of a given design section, and subsequently restoring the action of said reverse plating mechanism during the knitting of a corresponding portion of another design section, said means for automatically suspending the action of the reverse plating mechanism being controlled by said pattern mechanism.

27. In a rotary knitting machine of the character described, the combination of a series of independent needles, sinkers interposed between said needles, said sinkers being arranged in sets having different butt formations and cooperating with the needles and the threads fed to them to produce ordinary or reverse plating, a plurality of adjustable auxiliary cams for operating said sinkers, a rotatable pattern drum, means for automatically rotating said drum step by step in timed relation to the operating of the knitting mechanism in the machine, parts through which said drum is operative to adjust said auxiliary sinker cams selectively to produce the figuring of the design in each design section of the fabric, and additional automatic means for maintaining all of said auxiliary sinker operating cams out of their operative positions at predetermined times during the operation of the machine, said additional automatic means being under the control of said pattern drum.

ALBERT E. STEWART.

CERTIFICATE OF CORRECTION.

Patent No. 1,859,256. May 17, 1932.

ALBERT E. STEWART.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 8, line 1, claim 8, for "drum" read mechanism; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of September, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)