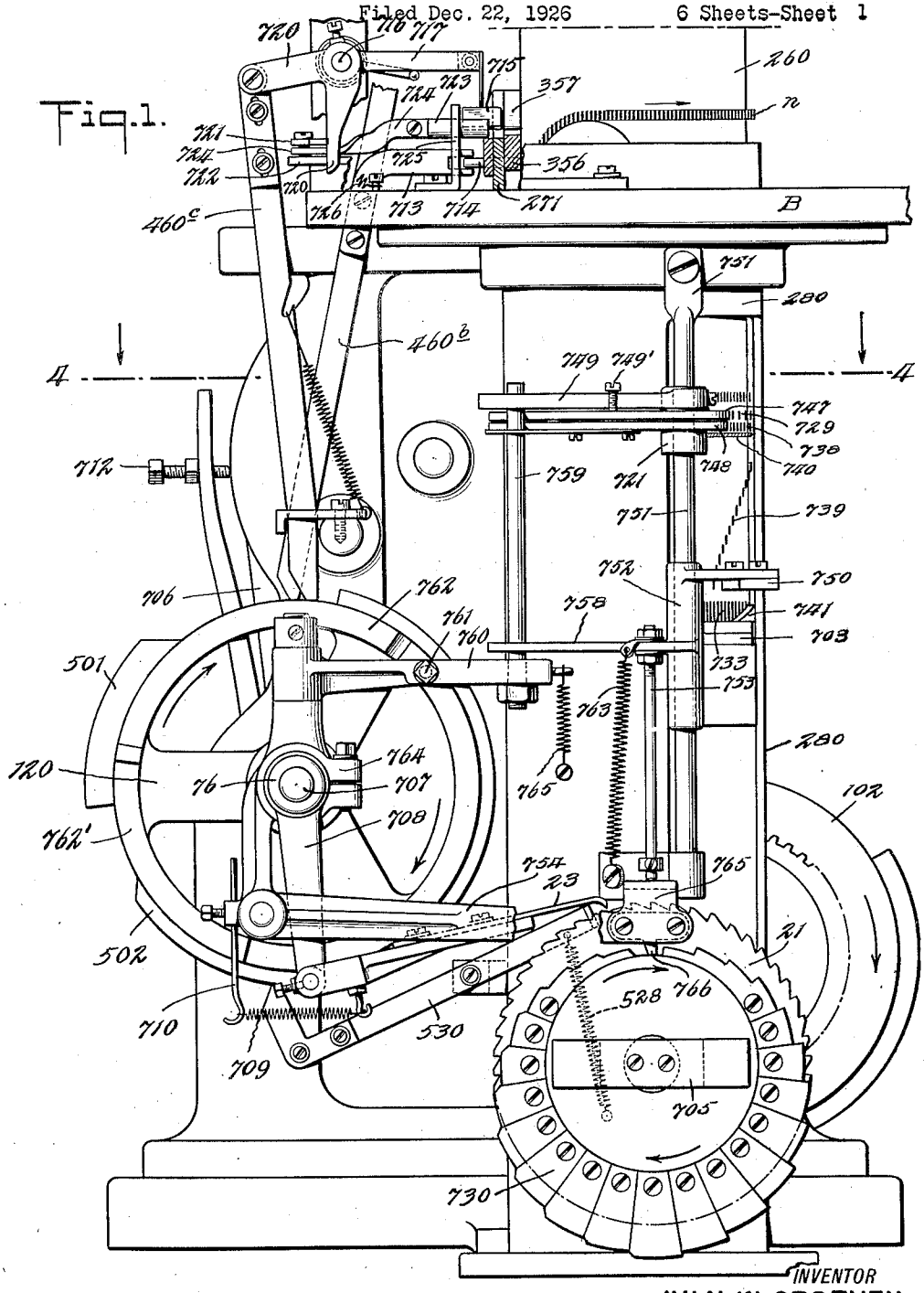
July 24, 1928. 1,678,385

I. W. GROTHEY

CIRCULAR KNITTING MACHINE

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Fig. 1.



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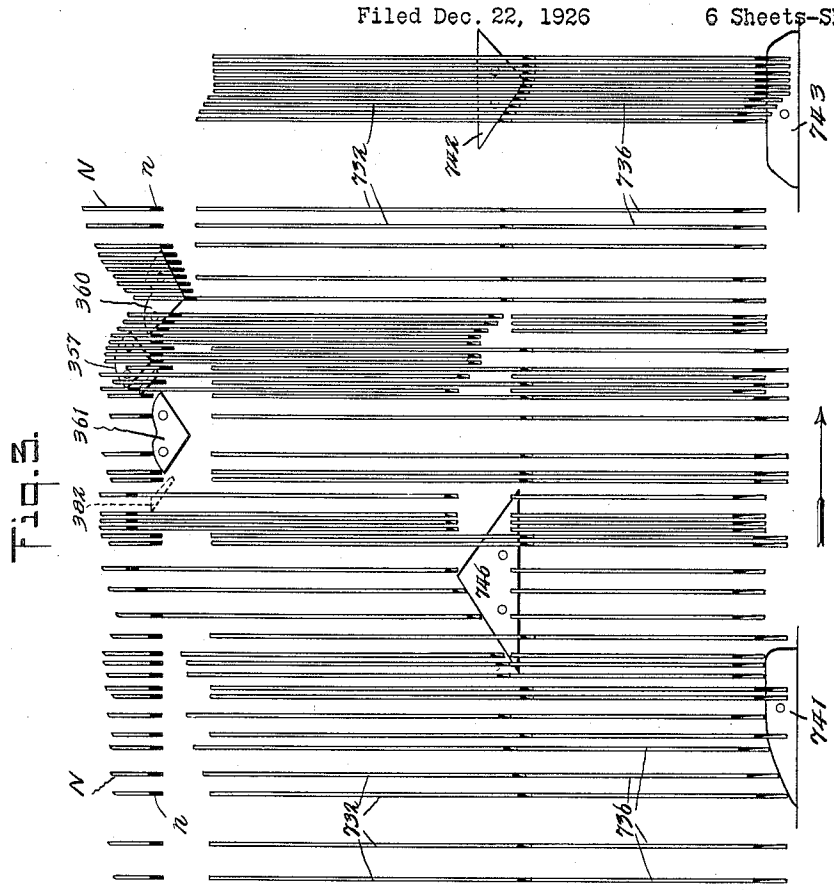


Fig. 3.

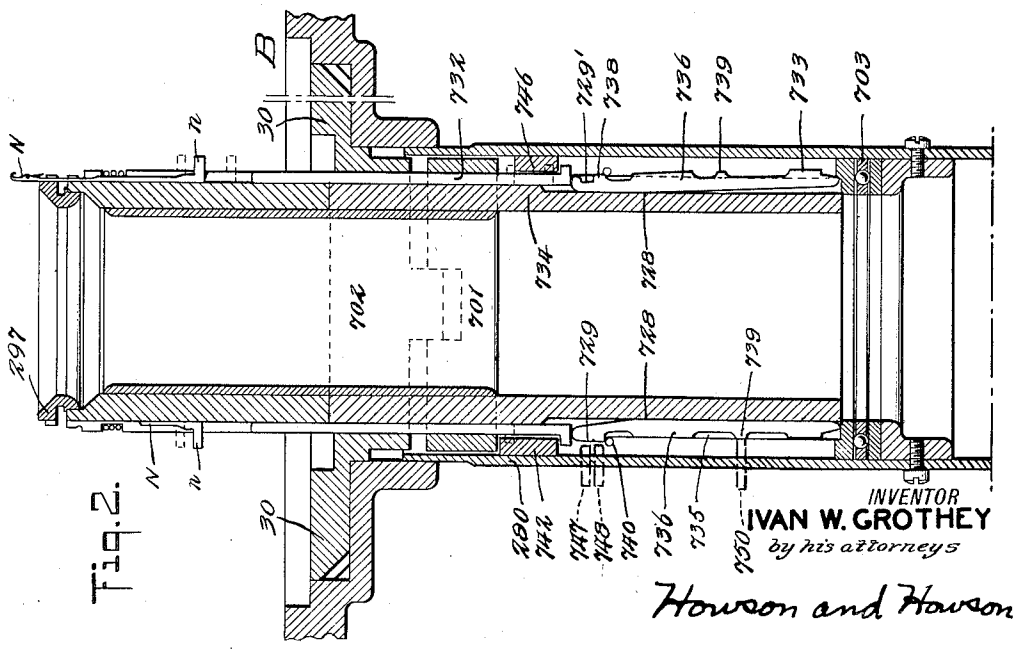


Fig. 2.

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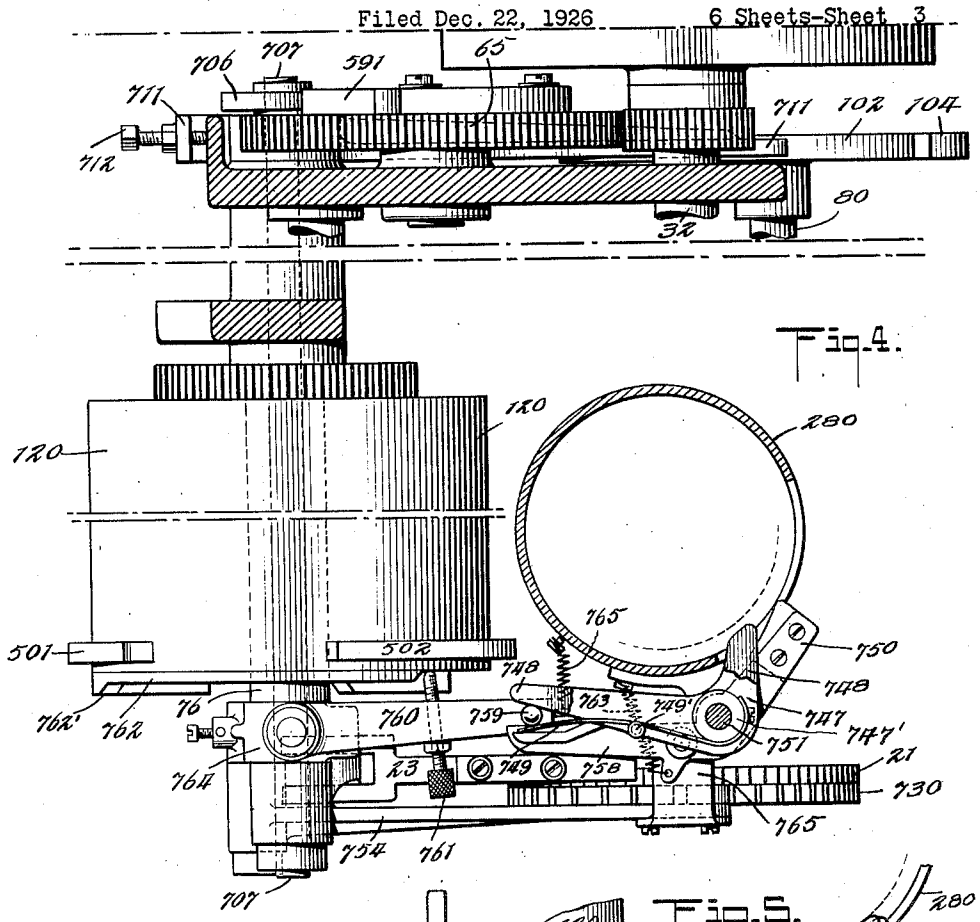


Fig. 4.

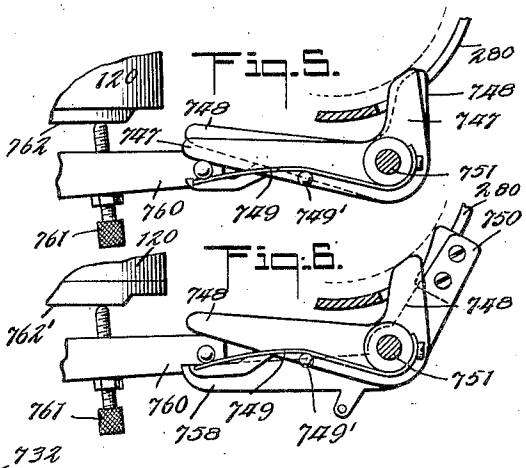


Fig. 5.

Fig. 6.

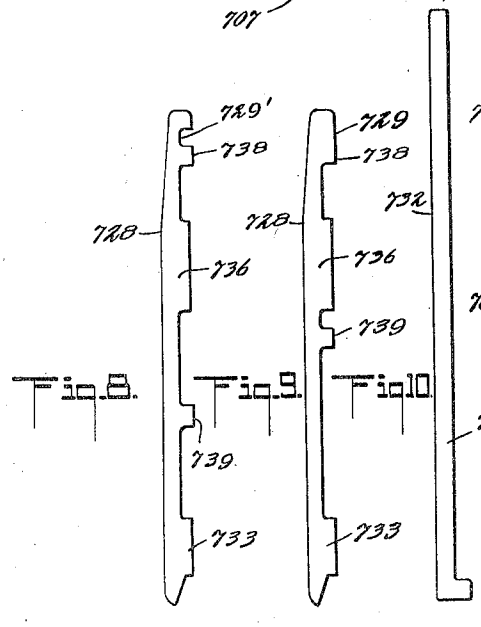


Fig. 8. Fig. 9. Fig. 10

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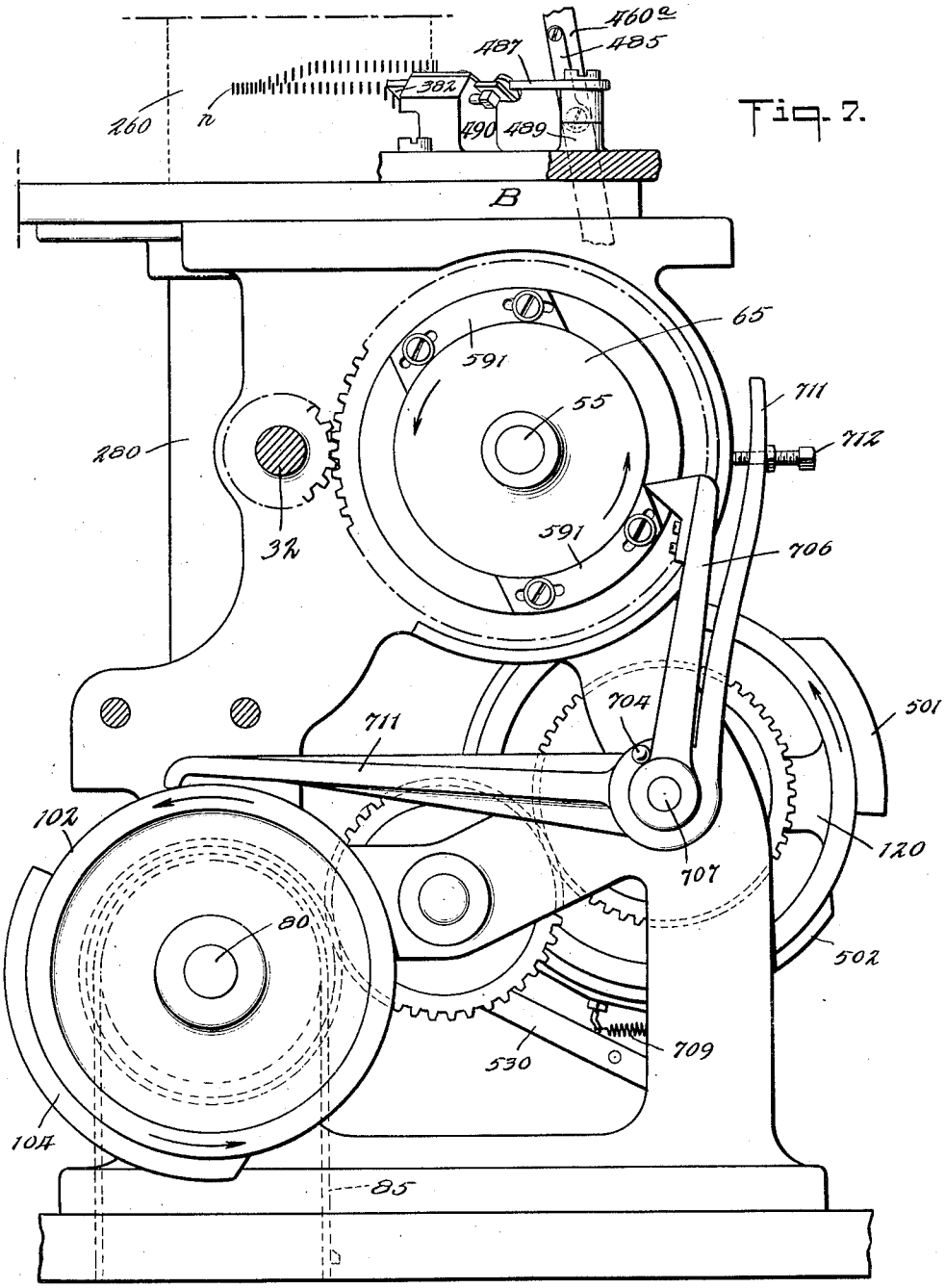


Fig. 7.

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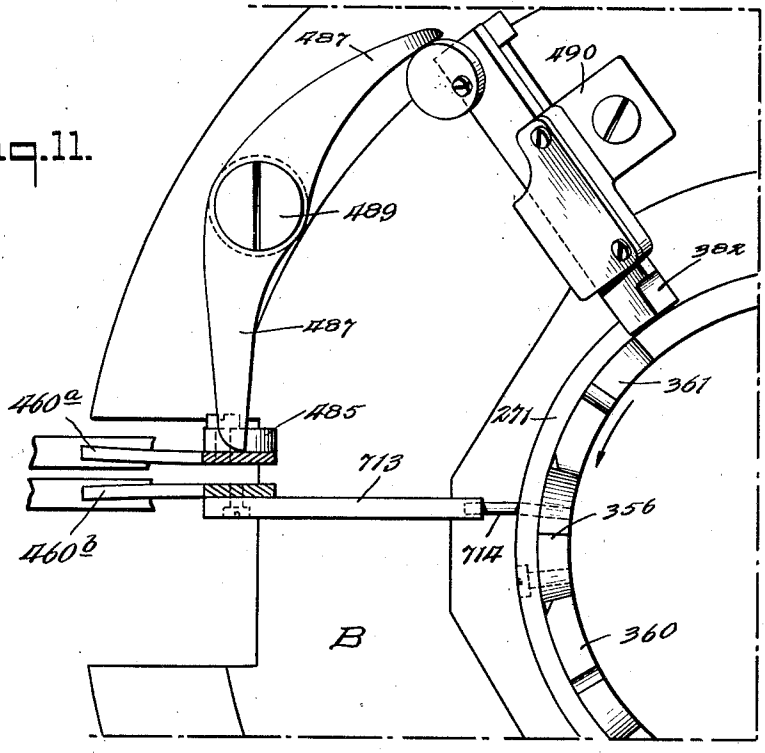
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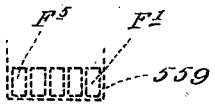
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CIRCULAR KNITTING MACHINE

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Fig.11.





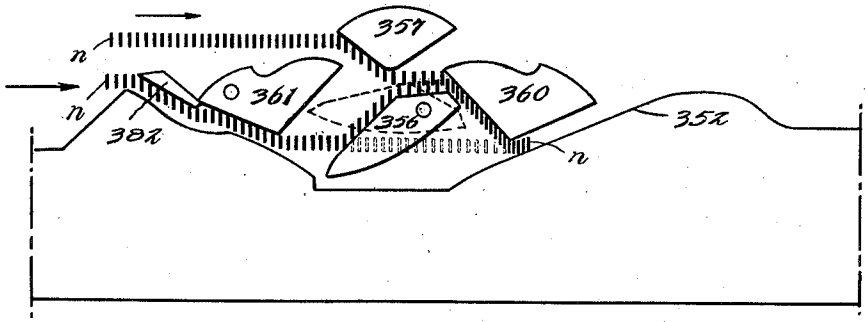


Fig.12.

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CIRCULAR KNITTING MACHINE

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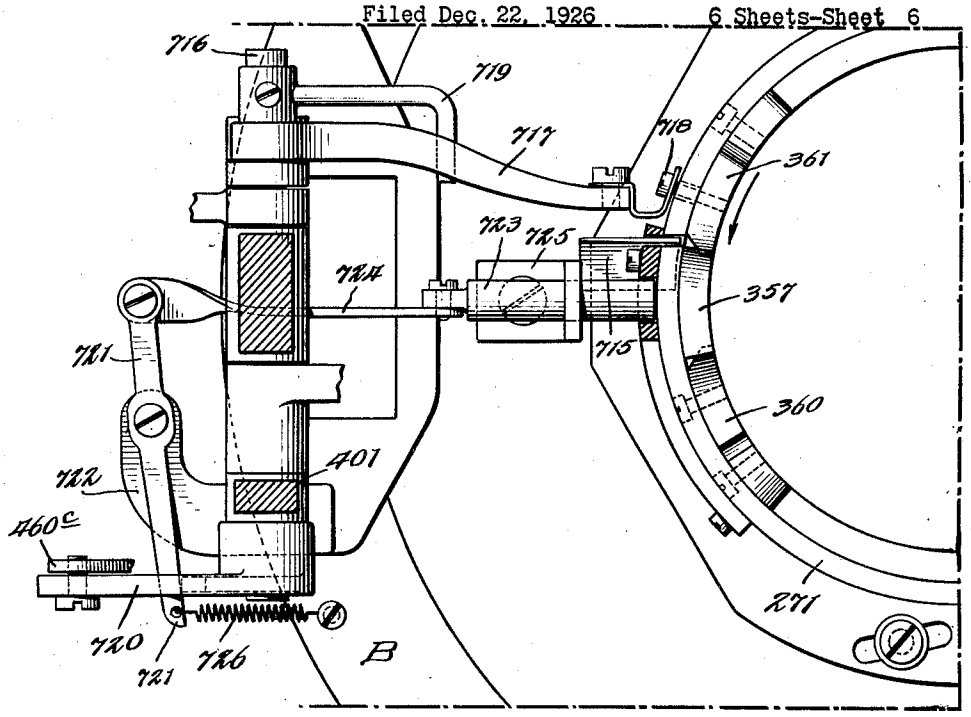


Fig. 13.

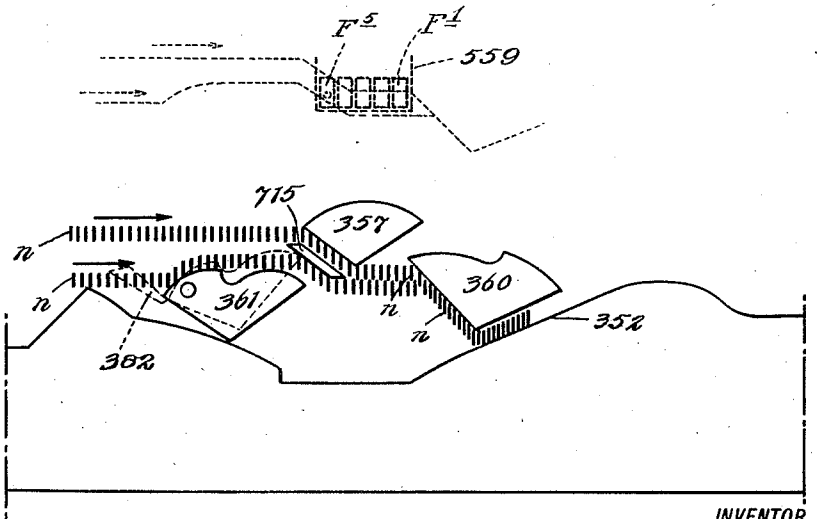


Fig. 14.

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Patented July 24, 1928. 1,678,385

UNITED STATES PATENT OFFICE.

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CIRCULAR-KNITTING MACHINE.

Application filed December 22, 1926. Serial No. 156,458.

This invention relates to circular knitting machines and more particularly to pattern mechanism for selectively controlling the individual knitting elements, that is to say the needles or cooperating elements such as the sinkers. A machine made according to the invention has pattern jacks each rocking on a point intermediate its ends, for the purpose of aiding in the selection of the knitting elements. These jacks are adapted to be rocked selectively in either direction.

One of the objects of the invention is the provision of a single control mechanism which can make totally independent selections or series of selections. Another object of the invention is the provision of an increased number of selections for each knitting element. Another object of the invention is the provision of a single mechanism which will give the manipulations of the knitting elements required in plain knitting and also those used in producing designs. Another object of the invention is the provision of an improved form of pattern jack. Thus, in the drawings where the selections are applied to the needles, they not only produce designs but also control the special manipulation of individual needles for the making of a starting-up course, an anti-run-back course and an automatic inturned welt. The selections for these regular fabric functions are wholly independent of the design selections.

The invention will be shown and described embodied in the well-known Scott & Williams type of revolving needle cylinder seamless hosiery machine, with the selections applied to the needles.

In the drawings,

Fig. 1 is an elevation taken from the left side of the central part of a Scott & Williams seamless hosiery machine, showing the novel mechanism controlling the needles;

Fig. 2 is a vertical cross section through the knitting head, showing the needles and jacks and the cams controlling the jacks;

Fig. 3 is a development of the circle of needles, long jacks, pattern jacks and some of their cams, showing the manipulation which causes a partial float stitch on certain needles;

Fig. 4 is a plan view of the machine on the line 4—4 of Fig. 1 showing the mechanism controlling the reader cams which select the pattern jacks, the reader cams all being out of operative position;

Fig. 5 is a plan view of the reader cams when the regular fabric reader cam is in operative position;

Fig. 6 is a view similar to Fig. 5 showing all the reader cams in operative position;

Fig. 7 is an elevation corresponding to Fig. 1 but taken from the right side of the machine, showing some of the mechanism driving the pattern wheel which moves the design reader cam vertically;

Figs. 8, 9 and 10 are views of the general types of jacks employed, Fig. 8 showing the pattern jack used under the needles which do not take the yarn in the setting-up course, Fig. 9 the pattern jack used under the needles which take the yarn in the setting-up course, and Fig. 10 the long jack used with every pattern jack;

Fig. 11 is a plan view of sufficient of the head of the machine to show the mechanism controlling the dividing cam and lower center cam when tuck stitches are desired, the top center cam being omitted;

Fig. 12 is a development of the knitting cams and needle butts showing in black the paths of the butts when making tuck and partial float or tuck stitches, and in dotted lines when making full float stitches;

Fig. 13 is a plan view of sufficient of the head of the machine to show the mechanism controlling the movable clearing cam and a special dividing cam; while

Fig. 14 is a development of the knitting cams and needle butts, showing the relation of the yarn fingers and paths of the needle butts when knitting partial float stitches.

In the example shown in the drawings the machine has needles N with butts *n* independently movable in the tricks of the needle cylinder 260. The needle cylinder is revolubly mounted in the bedplate B of the machine being driven from the horizontal gear ring 30 by means of two cooperating clutch rings 701, 702, one fixed on the gear ring 30 and the other shrunk on the outside of the needle cylinder. These two clutch rings slide in and out of each other, thus permitting the needle cylinder to move vertically with respect to the main head horizontal gear ring 30 for adjustment of the length of the stitch, and for other purposes. This vertical movement is given to the needle cylinder by cylinder raising tube 280 acting through bearing rings 703 on the inside of the cylinder raising tube. The usual inside sinker

ring 297 in the upper end of the needle cylinder is provided.

In a machine made according to this invention it is possible to select individual needles through mechanism which will now be described. There are rocking pattern jacks and long jacks mounted in tricks 735 of a jack cylinder 734 which forms a downward extension of the needle cylinder 260. In each trick are a pair of jacks, a rocking pattern jack 736 and a long jack 732, the long jack above the pattern jack with its butt resting on the upper end of the pattern jack. This pair of jacks is adapted to raise its associated needle in a manner to be described later. The pattern jacks 736 are held in their cylinder by spring bands 740.

In order to select the individual needles the pattern jacks are adapted to be rocked selectively in either direction, i. e. radially from either end. Each pattern jack is specially shaped intermediate its ends, this shape taking the form of a point 728 at its inner edge which rests against the bottom of the trick and provides a rocking point, permitting the two ends to move radially outward alternately. On the outer edge is an operating butt 733 located at one side of the rocking point—preferably at the bottom,—and selecting or pattern butts 739, 729, some on one side of the rocking point and some on the other. On the side opposite to the operating butt is a selecting, or specifically a resetting, butt 738. In the example shown in the drawings each of these butts project beyond the tricks of the jack cylinder when its end of the jack is rocked radially outward.

In addition to the resetting butts 738 there are other selecting butts on the jacks to assist in the selection of desired needles, some on one side of the rocking point and some on the other. In the drawings a single level of butts 729 is shown above the rocking point, one specific purpose of these butts being to provide the needle selections needed in knitting regular fabric. Alternate pattern jacks each have a notch 729′ in place of the butt 729. Below the rocking point of the jacks butts 739 may be provided at one or more levels, as required by the pattern. The selecting butts 739 below the rocking point assist in providing the selections for the design as will be described later. The various butts are acted upon by certain movable reader cams which will be described later.

When the operating butt 733 of a jack is rocked radially outward, the pattern jack, long jack and needle are raised by certain circumferentially stationary cams. The first of these stationary cams is a raising cam 741 (Fig. 3) in whose path lies the operating butt of each selected pattern jack. This raising cam 741 is screwed to the cylinder raising tube 280 just above the bearing ring 703 at a point which causes it to engage the operating butt of each selected jack shortly after the reader cams, and to raise both the pattern jack and its long jack a short distance. The lift thus given the long jack 732 places the butt of that jack in the path of a jack raising cam 746 on the cylinder raising tube 280 under which the butt would normally pass. This cam 746 raises the long jack till it contacts with the lower end of the needle and raises the latter a short distance. The resulting separation of needle butt levels is made use of in formation of special stitches as will be described later. When the needle is drawn down to the knocking over point by the stitch cam 360 it pushes the long jack 732 down till it touches the pattern jack 736. The butt of the long jack then comes in contact with a stationary lowering cam 742 on the tube 280 which pushes the pair of jacks down to normal level. Simultaneously, a bevel cam 743, which is inside the lower end of the cylinder raising tube 280 at the same level as the raising cam 741, pushes the lower end of the jack radially inward again to idle position.

The rocking of the pattern jacks to give the selections is accomplished by three reader cams, namely upper and lower selector cams 747, 750 and a resetting cam 748. All three cams are pivoted on a vertical rod 751 on the bedplate B and reach over the usual opening in the cylinder raising tube 280. By means of a bracket on the tube 280 the lower end of this rod 751 is given sliding support. The ends of these reader cams can be swung into and out of operative relation with the various selecting butts by a single element whose movements are controlled from a single cam path on the end of the main pattern drum 120. This single element is a vertical pin 759 mounted on the end of a lever 760 pivoted on a stationary bracket 764 on the main pattern drum shaft 76. On the lever 760 is a horizontal adjusting screw 761 adapted to lie against the end of the main pattern drum 120 or the cams 762, 762′ thereon. There is a tension spring 765 stretched between the lever 760 and the tube 280 tending to hold the screw 761 against the cams 762, 762′.

The horizontal reciprocations of this vertical pin 759 are transmitted to the reader cams by the following novel means. The lower reader cam 750 is mounted on the rod 751 by means of a sleeve 752 from which projects a horizontal arm 758 engaging against the outside of the vertical pin 759. There is a tension spring 763 stretched between the horizontal arm 758 and the cylinder raising tube 280 tending to keep the arm 758 against the vertical pin 759 and the reader cam 750 out of operative position with relation to the butts 739 of the pattern jacks. As already mentioned these selecting butts 739 are the

ones located below the rocking point. The adjustment of the parts is such that this selector cam 750 is put in operative position only by the high cam 762′ (Fig. 6). This cam 750 is movable vertically as will be described later. The resetting cam 748 has a forked tail which embraces the vertical pin 759 with considerable play between the two jaws of the fork. The cam is held on a level opposite the resetting butts 738 by a collar 747′. Like the lower selector cam 750 this resetting cam 748 is of such a shape that the pin 759 does not push it into engagement with the butts until the lever 760 is pushed out by the high drum cam 762′. However, the upper selector cam 747 is so connected to the vertical pin 759 that the low drum cam 762 moves the pin 759 a short distance which is sufficient to push the selector cam into engagement with the butts (Fig. 5). This movement of the pin is transmitted to the cam by a strip spring 749 lying against the outside of the pin 759 and the collar 747′ of the selector cam, but tensioned by taking around the inside of a screw 749′ on the tail of the cam. This tail is held against the vertical pin on the inside, thus enabling the pin to move the cam out of operative position when the adjustment screw 761 rides down onto the end of the main pattern drum 120.

By means of this spring connection and the adjustment of the parts the vertical pin is able to give the further movements necessary to put the lower selector cam and the resetting cam into operative position in spite of having put the upper selector cam into operative position by the previous movement. It is preferable that the upper selector cam be positioned to act on the jacks prior to the lower selector cam.

As previously mentioned, the lower selector cam 750 can be made vertically movable and by providing selecting butts on the pattern jacks at different levels below the rocking point it is possible to cause selections of different pattern jacks by this lower reader cam at different times. In the construction shown in the drawings butts are used at 13 levels and further variations in pattern can be obtained by varying the vertical width of the face of the lower selector cam 750 or by providing pattern jacks with selecting butts 739 which cover more than one level. Of course the pattern jack which has selecting butts at more than one level need not have the two butts at adjacent levels—they can be spaced apart if the pattern requires it. The lower selector cam 750 can be moved up and down through practically any desired sequence of positions. The mechanism to accomplish this includes lever means operated by a segmental cut pattern wheel 730. The connection between the lower selector cam 750 and this cut pattern wheel 730 is shown as consisting of a vertical link rod 753 projecting downwardly from the horizontal arm 758 and resting on top of the bracket 765 attached to the cam tooth 766 engaging the pattern wheel 730. This cam tooth 766 and the bracket 765 are mounted on the end of the lever 754 pivoted on the bracket 764. The spring 763 mentioned above not only tends to keep the selector cam 750 out of engagement with the butts on the pattern jacks, but also tends to hold that selector cam 750 down at such level that the lower end of the link rod 753 is against the surface of the bracket 765. It will now be apparent that the revolution of this pattern wheel 730 will cause the selector cam 750 to be moved directly from one position to another in accordance with the height of the successive segments of the pattern wheel. The level of the selector cam with relation to the whole range of butt levels 739 can be changed by adjusting the effective length of the vertical link rod 753.

Any suitable means can be employed to turn the pattern wheel but in the present application that wheel is shown mounted fast to a ratchet wheel 21 operated by a racking pawl 23. The pattern wheel and the ratchet wheel are revolubly mounted on the lower end of the cylinder raising tube 280, there being braking means 705 acting against the side of the pattern wheel to prevent that wheel from turning except under the action of the racking pawl 23. This racking pawl 23 is adapted to be reciprocated continuously by cams 591 on the gear wheel 65 on the right side of the machine on the shaft 55 (Fig. 7). This movement is given by cams 591 on wheel 65 moving the lever 706 and the motion of that lever 706 being transmitted to the racking pawl 23 by means of the shaft 707 and the arm 708 to which the pawl is pivoted. The pattern drum shaft 76 is made hollow and the shaft 707 passed therethrough since the gear wheel 65 is on the opposite side of the machine from the pattern wheel 730. The racking pawl 23 is held in engagement with the teeth of the ratchet wheel 21 by means of a tension spring 709 between the pawl and a pin 710 mounted on the bracket 764. This spring also holds the lever 706 against the cams 591. In the construction shown in the drawings the gear 65 is driven from the main drive shaft 32 of the machine at a speed equal to four revolutions of the knitting head. By having two cams 591 on the side of the gear wheel the pawl 23 is adapted to move the pattern wheel forward one tooth for every two revolutions of the knitting head.

Means are also provided which make it possible to stop the reciprocation of the pawl 23, these means include a bell crank idling lever 711 loosely mounted on the main

pattern drum shaft 76 just below the gear 65. The lower arm of this bell crank lever 711 rests on the circumference of the belt shifter drum 102 and the cam 104 thereon. By means of a pin 704 at the apex of the bell crank lever engaging against the arm 706, the raising of the lower arm of the bell crank lever 711 by the cam 104 pushes the arm 706 out of the path of the cams 591 and holds the pawl 23 motionless in its forward position (Fig. 7). This belt shifter drum 102 is mounted on the pattern chain shaft 80 and revolves in unison with the main pattern drum 120. The lugs on the pattern chain 85 control the racking of the shaft 80 as usual (see the patent to Robert W. Scott Number 1,152,850 dated September 7, 1915). The bell crank lever 711 has the additional function of adjusting the length of stroke of the pawl 23 by means of adjusting screw 712 on its upper arm, which screw is adapted to rest against the guard around the gear wheel 65.

Another means of stopping effective motion by the pawl 23 is provided by means which raise the pawl to idling position. These means may consist of an idling lever 530 pivoted near its mid-point on a bracket screwed to the cylinder raising tube 280. The forward end of this idling lever underlies the forward end of the pawl 23 and the rear end of the idling lever rests on one of the cam paths on the surface of the main pattern drum. On this cam path are a high cam 501 and a low cam 502, the high cam being adapted to tip the idling lever until the racking pawl 23 is lifted clear of all the teeth on the ratchet wheel 21. These idling means are employed to stop the rotation of the pattern wheel 730 when the machine is knitting parts of the stocking where vertical movement of the lower selector cam 750 is not desired. Thus, the high drum cam 501 is so positioned on the main pattern drum that it causes the pawl 23 to begin idling just as the needle cylinder begins reciprocating movement for the formation of the heel of the stocking. At the end of the heel the idling lever 530 rides off the high cam 501 and the racking pawl 23 is lowered to continue moving the pattern wheel 730 from the position where it left off. The result is that the pattern wheel and the jack butts 739 provide a pattern which is unbroken on the instep of the stocking in spite of the insertion of the heel at the back. It will be noted in Fig. 1 that one of the teeth on the ratchet wheel 21 is lower than the others. The difference in height of this tooth is made use of when coming to the end of the foot. As the process of knitting approaches the end of the pattern in the foot, the idling lever 530 rides up on to the low cam 502 on the main pattern drum 120. This cam 502 is not as high as cam 501, and the idling lever 530 is not lifted clear of all the teeth on the ratchet wheel but it engages all the teeth except the low tooth. The continued reciprocation of the pawl 23 therefore causes the ratchet wheel 21 to advance until it comes to the low tooth where it idles. The low tooth being cut on the ratchet wheel at a point which corresponds to the end of the pattern set up on the pattern wheel 730, this low tooth and low cam combination always insure that the pattern in the next stocking will begin at the same point as that in the previous stocking. This invention is broadly useful in obtaining selections of needles both in the making of the regular fabric of a stocking and in making designs in that fabric without necessarily using butts of different lengths on the needles.

The selection of needles according to this invention brings the butts of the needles to the knitting cams at two separate levels. By suitable arrangements of the knitting cams this separation into two levels is availed of to 1, miss the yarns entirely as in a setting up course; 2, make tuck stitches; 3, make a combination of tucked work and float stitches by missing one of the yarns; 4, miss one of the yarns in plated work.

The method of dividing the needles to make float or missed stitches will first be described. In order to obtain this effect a dividing cam 382 is provided just in front of the clearing or leading stitch cam 361. This dividing cam 382 is adapted to draw down under clearing cam 361 the butts of all needles which have not been raised above it. The butts of the needles not raised by their jacks pass under the clearing cam 361. If the needles are to miss the yarns entirely, the lower center cam 356 will be in its raised or dotted position (Fig. 12) and the butts will pass directly under this lower center cam 356 and will be raised by the side cam 352 once more to normal level. In this way the yarns are fed only to the needles passing above the clearing cam 361. This particular arrangement of needle butts and cams can be availed of to make a setting up course when knitting is commenced on the bare needles. This is accomplished by the formation of a selvaged structure, only every other needle taking the yarn on the first course. This same division of the needles into an alternate arrangement is also needed in making the transfer of the welt fastening loops to the cylinder needles involved in the formation of an automatic inturned welt, as described in the Scott Patent 1,189,744.

Tuck stitches can also be made with these cams by simply swinging the lower center cam 356 to its down position as shown in Fig. 12. If a partial float stitch is desired on the same needle with the tuck stitch the facing yarn is fed from the yarn finger F^5. The needles which are not raised by the jacks

are drawn down by cams 382 as shown in Fig. 12 and raised by the lower center cam 356. As they approach the throat plate 559 their hooks come up outside of the facing yarn fed from the yarn finger F^5 and consequently take only the backing yarn fed from the yarn finger F'. As these needles which are drawn down have not cleared their previous stitch they hold it and the partial float stitch until they are raised over cam 382 which may be in the next course, or they may accumulate other tucked float stitches before casting off, according to the pattern desired. The combination tuck and partial float stitch brings the backing yarn partly to the face of the tuck pattern making a contrasting color. If it is desired to have a tuck stitch without a partial float stitch, the facing yarn should be fed from one of the yarn fingers nearer the finger F'.

When the needles whose butts approach the knitting cams on the lower level are not to pass under the clearing cam 361 and regular knitting is to occur, the supplementary dividing cam 382 is withdrawn radially and the needles ride up the clearing cam and meet the butts of the other needles at the top center cam 357. The radial reciprocation of this dividing cam 382 is controlled from the main pattern drum acting through a thrust rod 460^a having a cam surface 485 on its upper end adapted to actuate a lever 487 pivoted on a post 489 on the bedplate. This lever 487 takes against the rear end of the cam 382 which is slidably mounted in a post 490 also mounted on the bedplate. Eccentric means can be provided on the cam for its radial adjustment.

A thrust rod 460^b may be employed to tilt the bottom center cam up and down by means of having a bent arm 713 on the thrust rod holding in its forked end a pin 714 passing through a slot in the cam ring 271 and mounted in the swinging end of the lower center cam. The vertical movement of the thrust rod 460^b will raise and lower the lower center cam 356.

When making plated fabric, it is sometimes desirable in addition to the full float stitches obtained by cam 382 to have one yarn floated on certain needles without a tuck stitch being made simultaneously. In such case, a dividing cam 715 is introduced between the clearing cam 361 and the upper center cam 357, (Fig. 14). This cam lies slightly below the level of the top center cam 357, its upper end being the height of a needle butt *n* below the corner of the top center cam and spaced therefrom sufficiently to allow a needle butt to pass between the two. When it is desired to employ this cam for the purpose of making a partial float stitch on certain needles, the clearing cam 361 is tipped downwardly or moved circumferentially counter to the direction of movement of the needles, and the dividing cam 715 is pushed radially inward. The butts of the needles which have been raised by the jacks will pass above the dividing cam 715 and ride under the top center cam in the usual manner, but the butts of the needles which have not been raised by the pattern jacks will ride up the clearing cam and will be drawn down by the dividing cam 715 sooner than would be the case if they were acted on by the top center cam 357. This early drawing down of these needles causes them to miss the facing yarn which is being fed from the yarn finger F^5 but they take the backing yarn which is being fed from the yarn finger F'. The tipping of the clearing cam downwardly is solely for the purpose of providing sufficient space between that cam and the special dividing cam 715 for the passage of needle butts. The needles unite into one wave as their butts come to the stitch cam 360.

The radial reciprocation of the special dividing cam 715 and the tipping of the clearing cam 361 can be accomplished by cams on the main pattern drum 120 actuated by single thrust rod 460^c, as shown in Fig. 13. The upper end of this thrust rod is linked to a horizontal shaft 716 mounted in the bracket 401 on the bedplate, this shaft being adapted to receive a turning movement when the thrust rod is raised. Clearing cam 361 is tipped up and down with the turning of this shaft by means of an arm 717 mounted loosely on the shaft 716, and connected to the clearing cam 361 by a pin 718 passing through the cam ring 271. The arm is lifted by a bracket 719 mounted fast on the shaft 716, and underlying the arm 717. The link connecting the upper end of the thrust rod 460^c to this shaft 716 is the upper arm of the bell crank lever 720, the movements of whose lower arm control the radial reciprocation of the special dividing cam 715. In order to accomplish this the lower arm of the bell crank lever 720 reciprocates a pivoted lever 721 mounted on the bracket 722. This lever 721 is attached to the pin 723 carrying the cam 715 by link 724, the pin 723 being reciprocably mounted in a bracket 725 on the bedplate. There is a spring 726 attached to the lever 721 tending to hold the dividing cam 715 withdrawn from contact with the butts of the needles. By the mechanism which has just been described the knitting cam changes necessary to change from the ordinary knitting wave to the condition in which the needles not raised by the jacks miss taking one of the two yarns being knitted, are all accomplished simultaneously by the movement of the single thrust rod 460^c.

Having described the machine, its operation as far as it affects the present invention will now be described. Assuming that the

machine is to make a stocking with an automatic inturned welt in which it is desired to produce a partial float stitch pattern in the leg and instep of the stocking, the machine commences knitting on the bare needles by making a selvage. As far as the needles are concerned this may consist in withdrawing every other needle from action during the first course and feeding the yarns to the remaining cylinder needles but knitting on every cylinder needle in subsequent courses. This is accomplished by having the cam 762 on the end of the main pattern drum 120 push the vertical pin 759 out to the position shown in Fig. 5 thus bringing the upper selector cam 747 into engagement with the butts 729, above the rocking points of the pattern jacks 736. As before mentioned, in the example shown in the drawings, these butts 729 are present on every other jack and the jack having such a butt 729 has its lower end pushed radially outward until it lies in the path of the raising cam 741. The jacks whose operating butts are thus placed in operative position are associated with the needles which are to take the yarn in the first course of knitting, those needles being raised to a level above that of the dividing cam 382 by the action of the raising cam 741 and the long jack raising cam 746. The pattern jacks associated with the needles which are not to take the yarns in this first course have notches 729′ at the level of the upper selector cam 747 which notches are so deep that after the stationary level cam 743 has pressed the lower ends of those pattern jacks inwardly, the bottoms of those notches 729′ do not project beyond the walls of the tricks. The selector cam 747 which is pressing against the tops of the walls of the tricks of the jack cylinder 734 therefore does not rock the notched jacks and bring the operating butts into line with the raising cam 741. These pattern jacks and long jacks are therefore not raised, the butts of the needles associated therewith pass under the dividing cam 382 and the clearing cam 361 and they ride up the side cam 352 without taking any yarns in their hooks. The dividing cam 382, which was pushed radially inward just before the beginning of the first course by means of the thrust rod 460ª, is released as that thrust rod reaches the end of its cam on the main pattern drum and is radially withdrawn. If desired, the withdrawal or introduction of this dividing cam 382 can be accomplished by means of two heights of cams on the main pattern drum 120 in order that with the aid of butts of different lengths on the needles, the functioning of the dividing cam 382 may become, or cease to be, effective at certain predetermined needles.

This dividing cam 382 having been withdrawn from action, the butts of the needles which were not raised by their jacks come in contact with clearing cam 361 at the normal level and are raised by that cam in the regular knitting wave. Regular knitting then proceeds in this manner for the next few courses. However the separation into alternate needles is still being caused by the upper selector cam 747 for the purpose of allowing the secondary needles or transfer jacks to be protruded between them in order that they may hand their retained loops over to the cylinder needles at the end of the welt. For making an antirunback or float stitch course it is necessary with certain types of machines that the cylinder needles which did not take the yarn in the first course be retired again for one course and in order to accomplish this it is merely necessary for another cam on the main pattern drum to raise the thrust rod 460ª and insert dividing cam 382. This has the effect of lowering underneath the clearing cam and the center cams the needles which were not raised by their jacks with the result that they do not take the yarn in that course. At the completion of that course cam 382 is withdrawn again and if plain fabric is to be made during the next portion of the stocking the upper selector cam 747 can be thrown out of operative relation with the butts 729. However, as already explained, regular knitting can proceed while this cam is still in an operative position and the cams shown in the drawings hold this reader cam in operative position until the completion of the float stitch pattern.

Assuming that the stocking is being knit with a plurality of yarns of different colors, i. e., plated work, and it is desired to make patterns by having certain of the needles miss the facing yarn, the necessary cams will be arranged as shown in Fig. 14. At the beginning of the design the vertical pin 759 will be pushed outwardly to the position shown in Fig. 6. This puts the lower selector cam 750 into engagement with the butts 739 on the pattern jacks and also puts the resetting cam 748 into contact with the resetting butts 738 which latter are above the rocking points of the jacks. It will be apparent that while the low cam 762 on the main pattern drum put the upper selector cam 747 into operative position under the influence of the spring 749, it merely took up the play between the jaws and the tail of the resetting cam 748 and did not move the lower selecting cam 750 far enough to bring it into contact with the butts 739. However, the higher movement caused by the high cam 762′ moves both the cams 748 and 750 into operative position and puts the spring 749 under greater tension. This movement of the vertical pin 759 assists in bringing into play the design selections of the pattern jacks 736.

Before the pattern jacks reach the reader cams 747 and 748, the operating butts 733 of the jacks have been pressed radially inward by the stationary cam 743 and the resetting butts 738 and the upper selecting butts 729 are in their radially outward position. These two reader cams 747 and 748 at once rock all the jacks having butts opposite either of them and since in the example given in the drawings each pattern jack has a butt 738, the operating butts of all the pattern jacks are put in the path of the stationary raising cam 741. However, almost immediately the jacks reach the lower selector cam 750 and that reader cam being in operative position the jacks with selecting butts at the same level as the cam have their operating butts pushed radially inward out of the path of the stationary raising cam 741. The jacks having butts opposite this reader cam 750 are the ones on which it is desired to float or miss the facing yarn. The pattern jacks whose operating butts still lie in the path of the stationary raising cam 741 after passing the lower selector cam 750 are then raised by that stationary cam 741, and they in turn lift the long jacks to a position at which the butts of the long jacks ride up the long jack raising cam 746. This raises the needles to a height at which their butts are above the cam 715. The needles which are not raised by their jacks remain at the normal level until they reach the clearing cam. By the time they reach the clearing cam the thrust rod 460^c has been raised by a cam on the main pattern drum 120, turning the shaft 716 and lowering the highest point of the clearing cam 361, while the special dividing cam 715 has been pushed radially inward. The needle butts therefore ride up the clearing cam 361 and are drawn down by this dividing cam 715 at such an early position with relation to the throat plate that they miss the facing yarn coming from finger F^5. The butts of the needles which were raised by their pattern jacks pass above the dividing cam 715 and remaining in their raised position until they meet the top center cam 357 get the facing yarn in their hooks. In Fig. 14 every other needle is shown raised by its jack. All the needle butts are drawn down by the stitch cam 360 as usual, the knitting wave being a normal one from this point forward. It will be obvious that by this means float stitches are obtained on the facing yarn on certain selected needles while the backing yarn is knit in as usual. With yarns of different colors this affords chance for design. If it is desired to make patterned work on the front of the stocking only, as in the foot of the stocking, cam 715 is inserted to take down the long butt needles only.

The vertical reciprocation of the lower selector cam 750 and the pattern possibilities of that reciprocation will now be described. When it is desired to begin the design in the leg of the stocking the bell crank lever 711 rides off the cam 104 on the belt shifter drum 102 and simultaneously the idling lever 530 rides off the low cam 502 on the main pattern drum. This drops the pawl 23 into active position in front of the low tooth on the ratchet wheel 21 and the pattern wheel 730 starts turning. The pawl racks the pattern wheel ahead every two revolutions of the needle cylinder. Each segment of the Dawson wheel is one step higher than the previous one and in this way the vertical elevation of the lower selector cam 750 is changed every two revolutions of the jack cylinder in regular progression. It should be noted that this lower selector cam stays in operative position throughout the making of the pattern. The upward movement of the reader cam 750 selects the butts at the different levels in one order but the second half of the pattern wheel selects them in the reverse order. This reciprocation can be availed of to great advantage in producing diamond or so-called "in and out" patterns, and of course the levels of the butts 739 can be changed or the butts lengthened to cover a plurality of levels if desired. In addition to the possibility of changing the height or level of the butts 739, the lower selector cam 750 can be varied with relation to the butt levels by adjusting the rod 753 until the cam partly overlies the butts of two adjacent levels. It is also possible to produce a third type of change in the design by varying the height or order of the segments of the pattern wheel. It should be noted that in making an "in and out" pattern the second half of the design need not be in line with the first half in its sequence although the same butts 739 are used for each half of the pattern.

If it is desired to use the butts 739 below the rocking point 728 of the jacks for the purpose of producing tuck stitches, the needle butts n are manipulated in the manner shown in Fig. 12. The dividing cam 382 draws below the clearing cam 361 the butts of all needles which have not been lifted by their pattern jacks, as when making the setting up course above mentioned, and the lower center cam 356 is tipped downwardly to raise the needles over it in time to take the yarn, the needles then being drawn down by the stitch cam 360 as usual. However, not having passed over the clearing cam 361, the needles have a tuck stitch on them. When making the foot of the stocking cam 382 is withdrawn half way to take down the long butt needles only, thus making tucked fabric on the instep and plain fabric in the sole. If it is desired to make float stitches

on the needles which have not been raised by their pattern jacks, it is merely necessary to tip the lower center cam 356 to its upper position as shown in dotted lines in Fig. 12 and as would be done in making the setting up course above described.

Many variations will occur to those skilled in the art which do not depart from the scope of this invention.

It will be observed that in a machine constructed according to this invention the setting up of the cut pattern wheel 730 and the location of the design butts 739 are entirely independent of the selections needed for the making of regular fabric. The mechanism is simple, accessible, easily adjustable and uses the minimum amount of space on the main pattern devices of the machine.

I do not claim in this application the control mechanism—except when combined with jacks rocking on points intermediate their ends. Generic claims on the control mechanism hereinabove disclosed form the subject matter of my patent application Ser. No. 105,805 filed April 30, 1926. Certain other applications of said control mechanism are disclosel and claimed in my application, Ser. No. 196,089, filed June 2, 1927 and my Patent Number 1,678,386 dated July 24, 1928.

I claim:

1. A circular knitting machine having a needle cylinder and a circle of knitting elements therewith, in combination with pattern jacks for said knitting elements adapted to be selected by rocking on a point intermediate their ends, each jack having a butt on either side of its rocking point, and cam means to operate on said butts.

2. A circular knitting machine having a needle cylinder, a circle of knitting elements therewith, rocking pattern jacks each associated with one of said knitting elements, and an operating butt on each jack on one side of the rocking point, in combination with selecting butts on said jacks, some butts on one side of the rocking point and some on the other, each jack having at least one butt, and cams adapted to rock said jacks selectively in either direction.

3. A circular knitting machine having a needle cylinder, a circle of knitting elements therewith, rocking pattern jacks each associated with one of said knitting elements, each jack having a resetting butt and an operating butt on opposite sides of the rocking point, in combination with selecting butts on said jacks, some butts on one side of the rocking point and some on the other, each jack having at least one butt, movable cams to act upon said resetting and selecting butts, and a cam adapted to raise such jacks as have their operating butts in its path.

4. A circular knitting machine having a revolving needle cylinder, a circle of knitting elements therewith, rocking pattern jacks each associated with one of said knitting elements and an operating butt on one side of the rocking point, a selecting butt on the other side and on a plurality of said jacks a selecting butt on the same side of the rocking point as the operating butt, in combination with a cam for said operating butts, and reader cams for the selecting butts on each side of the rocking point, one reader cam being positioned to act on the jacks prior to the other.

5. A circular knitting machine having a revolving needle cylinder, a circle of knitting elements therewith, pattern jacks each associated with one of said knitting elements and adapted to rock about a point on its inner edge intermediate its ends, each jack having butts on its outer edge including an operating butt and a resetting butt on opposite sides of the rocking point thereof, in combination with selecting butts on said jacks some on one side of the rocking points and some on the other, circumferentially stationary cams for said butts including a resetting cam and a selecting cam on one side of the rocking point, a selecting cam on the other side positioned to act subsequently to the cams on the first mentioned side of the rocking point; and pattern means moving said cams into and out of position.

6. A circular knitting machine having a revolving needle cylinder, a circle of independent needles therein, pattern jacks each associated with one of said needles and adapted to rock about a point intermediate its ends, butts on said jacks at a plurality of levels, both above and below said rocking points, and an operating butt on one side of said point, in combination with a plurality of cams on the side of the rocking point opposite to that of the operating butt, a reader cam on the same side as the operating butt, the butts on the side opposite to that of the operating butt being so arranged that the cams on that side of the rocking point rock outwardly on different selections of operating butts, and a circumferentially stationary cam adapted to raise the jacks whose operating butts remain rocked outward.

7. A circular knitting machine having a needle cylinder, a circle of knitting elements therewith, rocking pattern jacks each associated with one of said knitting elements, selecting butts on the jacks some on one side of the rocking point and some on the other, two cams above and one below the rocking point of the jacks adapted to rock said jacks, in combination with pattern means adapted to put said three cams into and out of operative relation with said selecting butts, one of the upper cams and the lower cam being moved simultaneously, an operating butt on each jack below the rocking point, and an

operating cam adapted to raise the jacks whose operating butts remain rocked outward.

8. A circular knitting machine having a revolving needle cylinder, a circle of independent needles therein, rocking pattern jacks each associated with one of said needles, each jack having an operating butt and a selecting butt on one side of said rocking point and a resetting butt on the other side, certain of the jacks having a selecting butt on the side of the resetting butt; a resetting cam and reader cams respectively for the resetting butts and the selecting butts above and below the rocking points of the jacks, in combination with a single element adapted to move the reader cam nearest the resetting cam into operative position with one movement, and to move the resetting cam and the other reader cam into action with another.

9. A circular knitting machine having a revolving needle cylinder, a circle of independent needles therein, rocking pattern jacks each associated with one of said needles, each jack having an operating butt below and a resetting butt above said rocking point and selecting butts on said jacks, some on one side of the rocking points and some on the other, a resetting cam for said resetting butts and an upper reader cam for the selecting butts above the rocking points, in combination with a lower reader cam positioned to act on the selecting butts below the rocking points prior to the upper reader cam, a single element controlling the movements of said three cams, and connected to said upper reader cam by spring means, and means giving said single element a short and a long movement, the short movement putting the upper reader cam in operative position and the long movement putting all three cams in operative position.

10. A circular knitting machine having a revolving needle cylinder and a jack cylinder revolving therewith, a circle of independent needles in the needle cylinder, a clearing cam therefor, pattern jacks and long jacks in said jack cylinder, an operating cam for raising said pattern jacks thereby raising said long jacks, a long jack cam adapted to raise further such long jacks as are raised by their pattern jacks, this further raising of the long jacks being adapted to raise the needle butts above the normal position of the clearing cam, in combination with an operating butt on each jack adapted when rocked outwardly to lie in the path of said operating cam, selecting butts on said jacks, some on one side of the rocking point and some on the other, each jack having at least one butt, and cams adapted to press said selecting butts inwardly.

11. A circular knitting machine having a revolving needle cylinder, a circle of knitting elements therewith, a jack cylinder revolving with the needle cylinder, rocking pattern jacks and long jacks in said jack cylinder, each pair being associated with one of said knitting elements, an operating butt on each pattern jack, and an operating cam for raising said pattern jacks, butts on one selection of pattern jacks adapted when pressed inwardly to put the operating butts of said jacks in the path of the operating cam and other butts on another selection of jacks adapted when pressed inwardly to move the operating butts of those jacks out of the path of the operating cam.

12. A circular knitting machine having a revolving needle cylinder, circle of independent needles therein, a dividing cam therefor, a jack cylinder revolving with the needle cylinder, rocking pattern jacks and long jacks in said jack cylinder, each pair being associated with one of said needles, an operating butt on each pattern jack and an operating cam for raising said pattern jacks and thereby raise their long jacks, a long jack cam adapted to raise further such long jacks as are raised by their pattern jacks, this further raising of the long jacks being adapted to raise the needle butts above the dividing cam, a selecting butt on every alternate pattern jack adapted when pressed inwardly to put the operating butt of that jack in the path of the operating cam, a circumferentially stationary cam to press said selecting butts inwardly and a like cam adjacent thereto adapted to act on adjacent butts on every pattern jack, in combination with a series of butts at different levels for said pattern jacks each adapted when pressed radially inward to put the operating butt out of line with the operating cam, and a vertically movable selector cam adapted to press said last-mentioned series of butts inward subsequently to the jacks being acted on by said stationary cams.

13. A knitting machine jack adapted to slide in a trick, the inner edge of said jack being shaped intermediate its ends to permit rocking of said ends outwardly, in combination with a butt on either side of the rocking point on the outer edge of the jack adapted to be acted upon by cams outside said trick, for the purposes described.

14. A knitting machine pattern jack adapted to slide in a trick, said jack having a point on its inner edge located intermediate its ends and adapted to permit rocking of said ends outwardly, in combination with butts on the outer edge of said jack including an operating butt on one side of the rocking point, a resetting butt on the opposite side of said point, and a selecting butt on one side of said rocking point.

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

IVAN W. GROTHEY.