Nov. 12, 1940. H. McADAMS 2,221,713

KNITTING MACHINE

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Fig. 1.

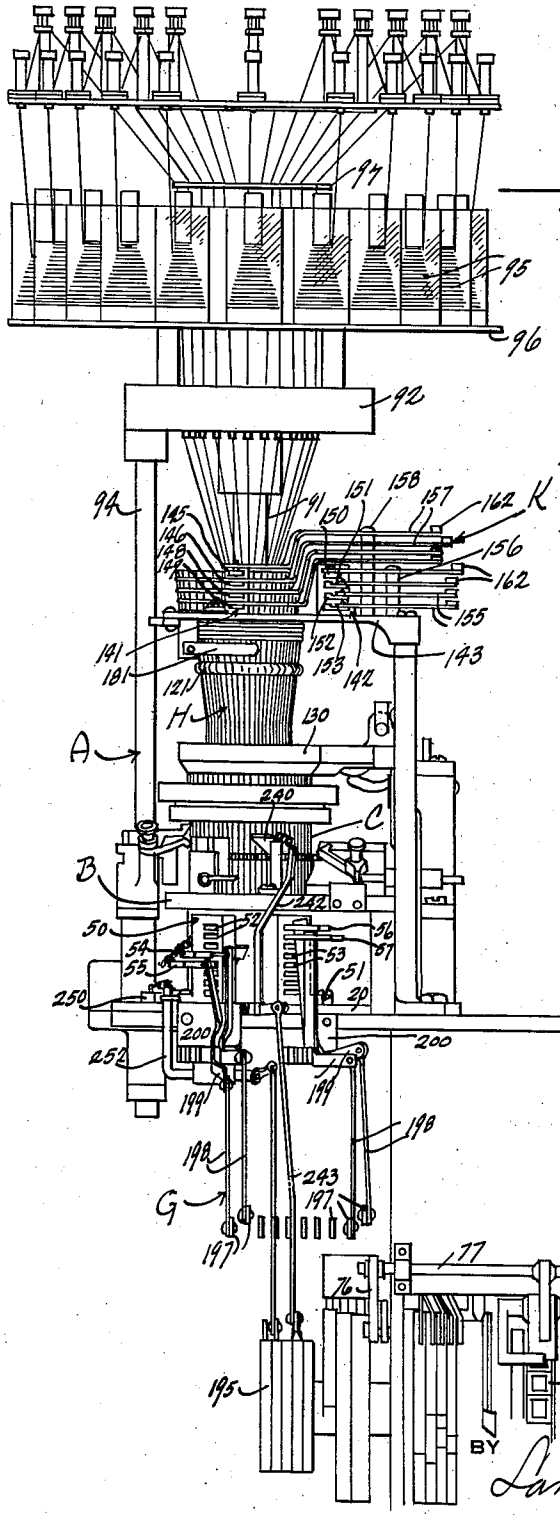
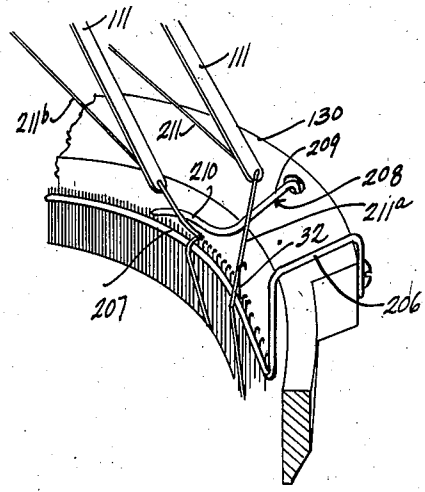


Fig. 3.



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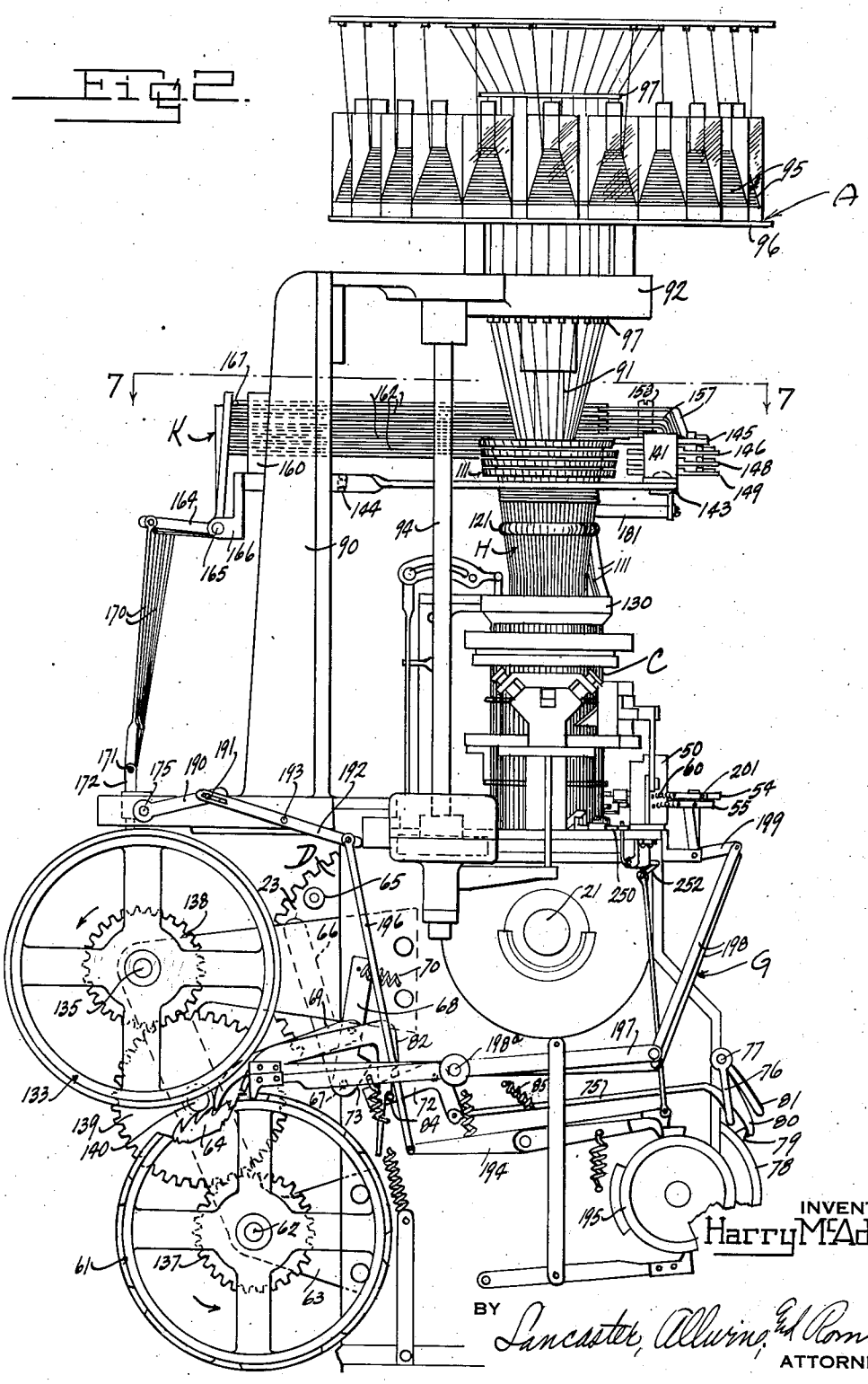
BY Lancaster, Allwine and Rommel
ATTORNEYS.

Nov. 12, 1940. H. McADAMS 2,221,713

KNITTING MACHINE

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Fig. 2.



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KNITTING MACHINE

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Fig. 4.

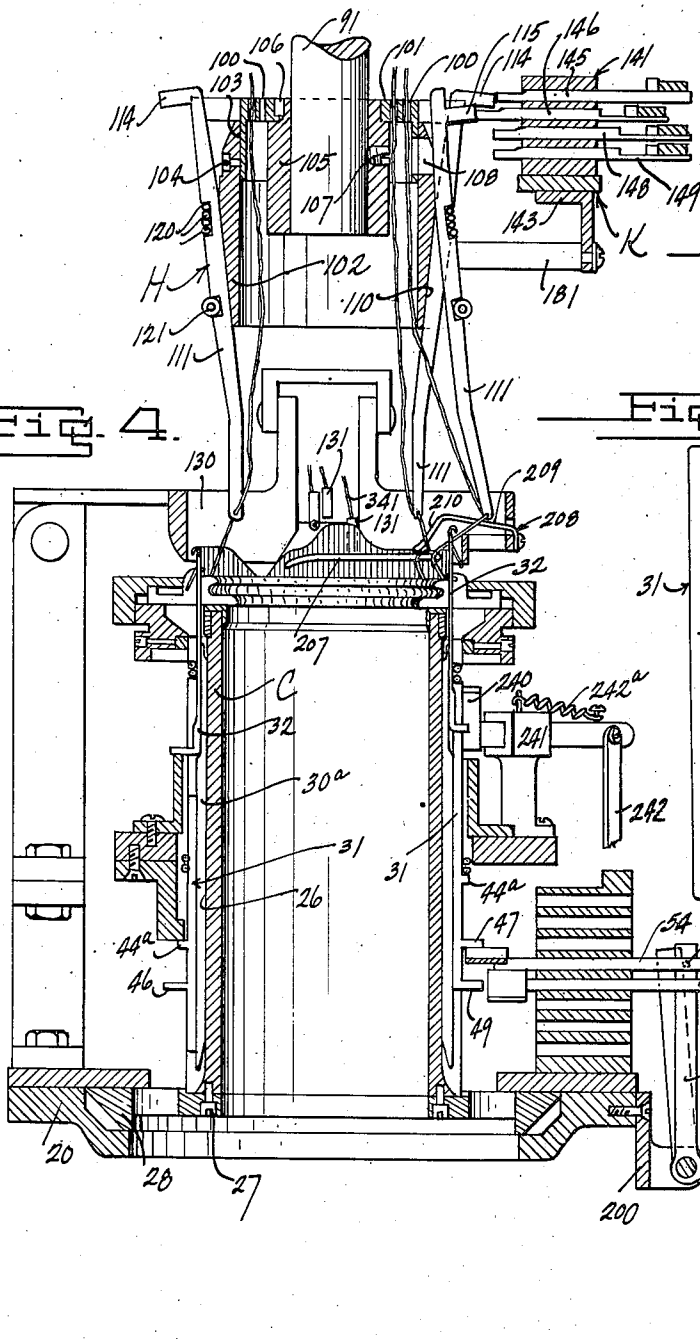


Fig. 5.

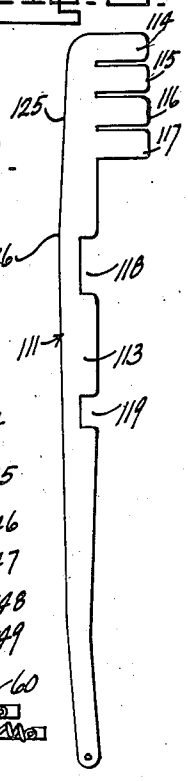
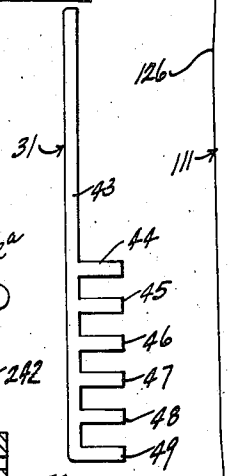


Fig. 6.



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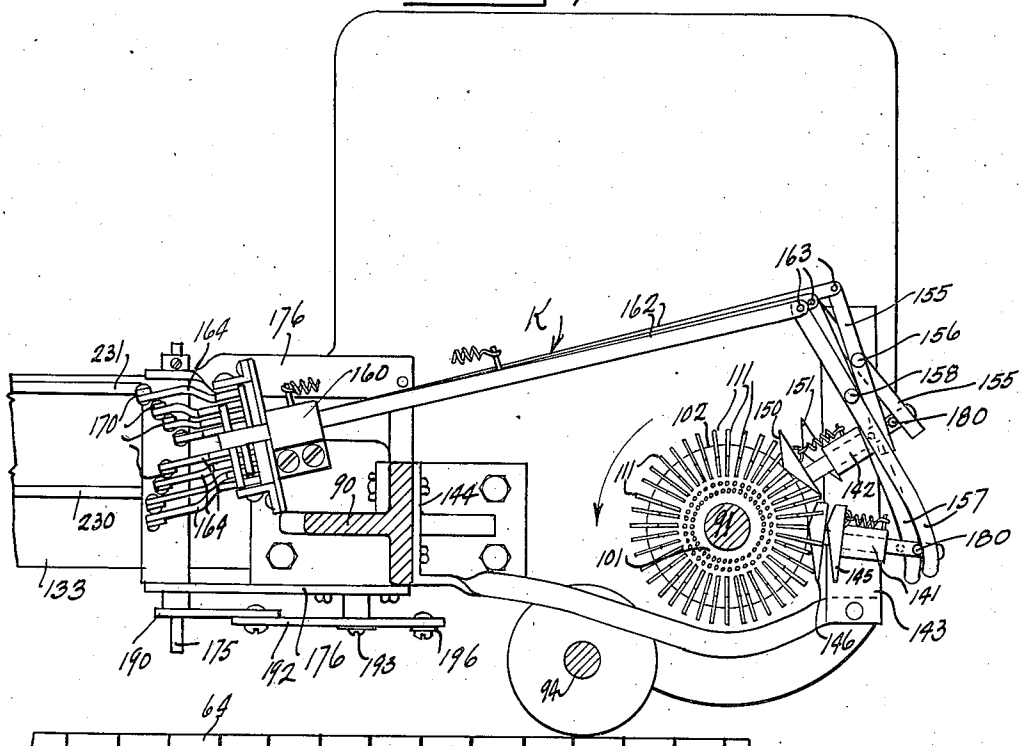
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KNITTING MACHINE

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Fig. 7



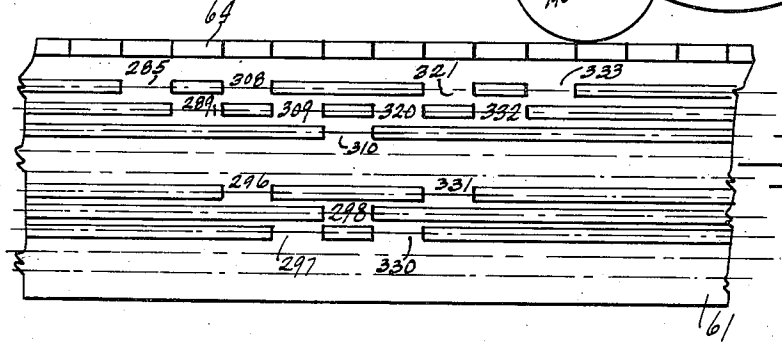


Fig. 15.

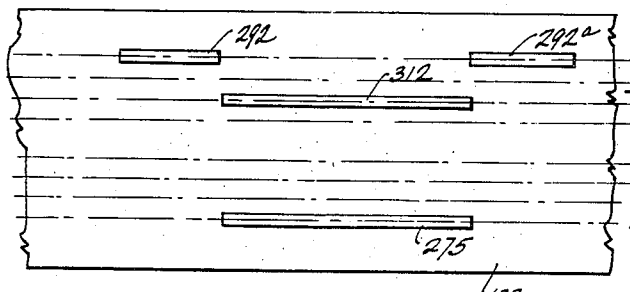


Fig. 16.

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KNITTING MACHINE

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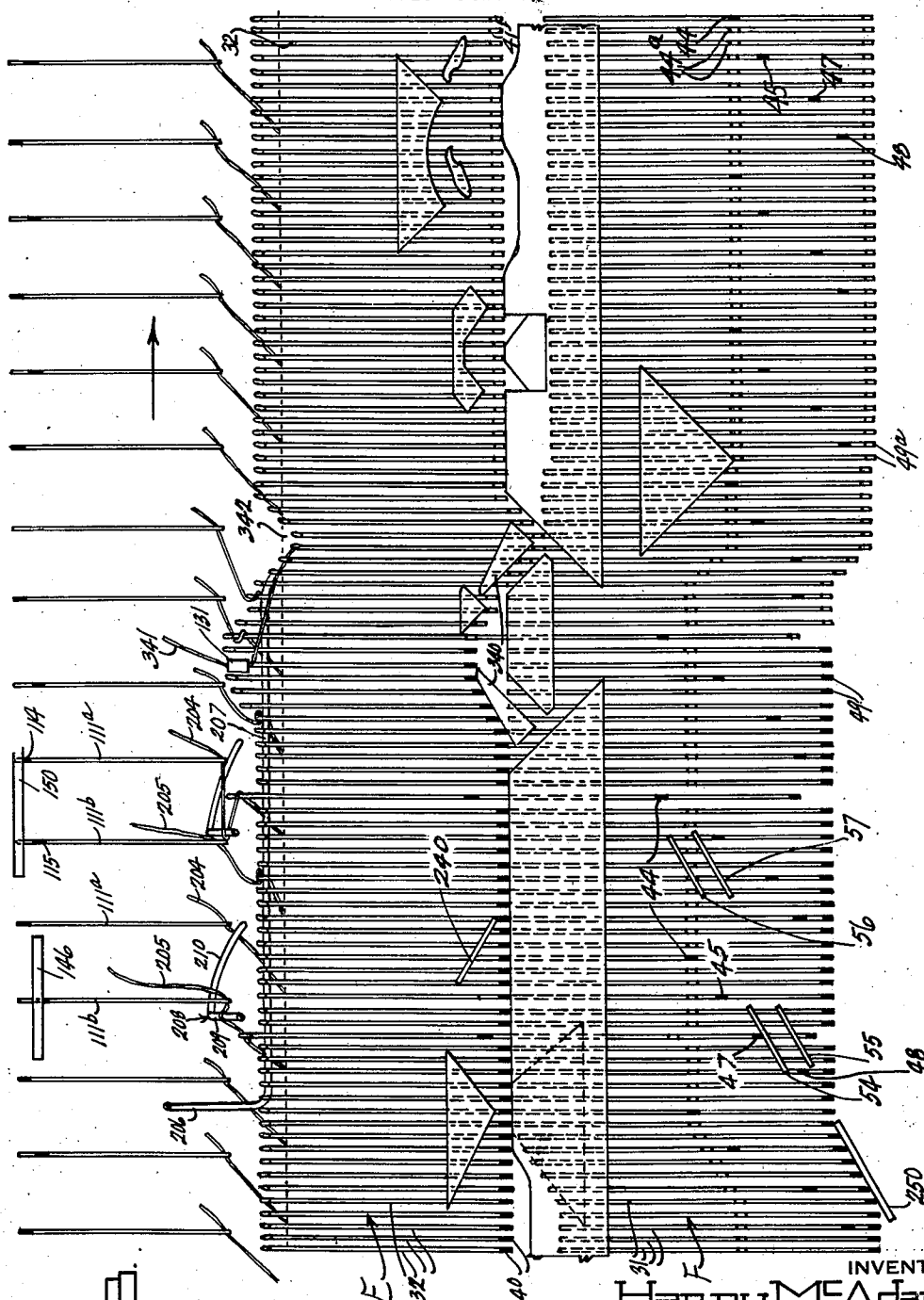


FIG. 5.

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Fig. 9

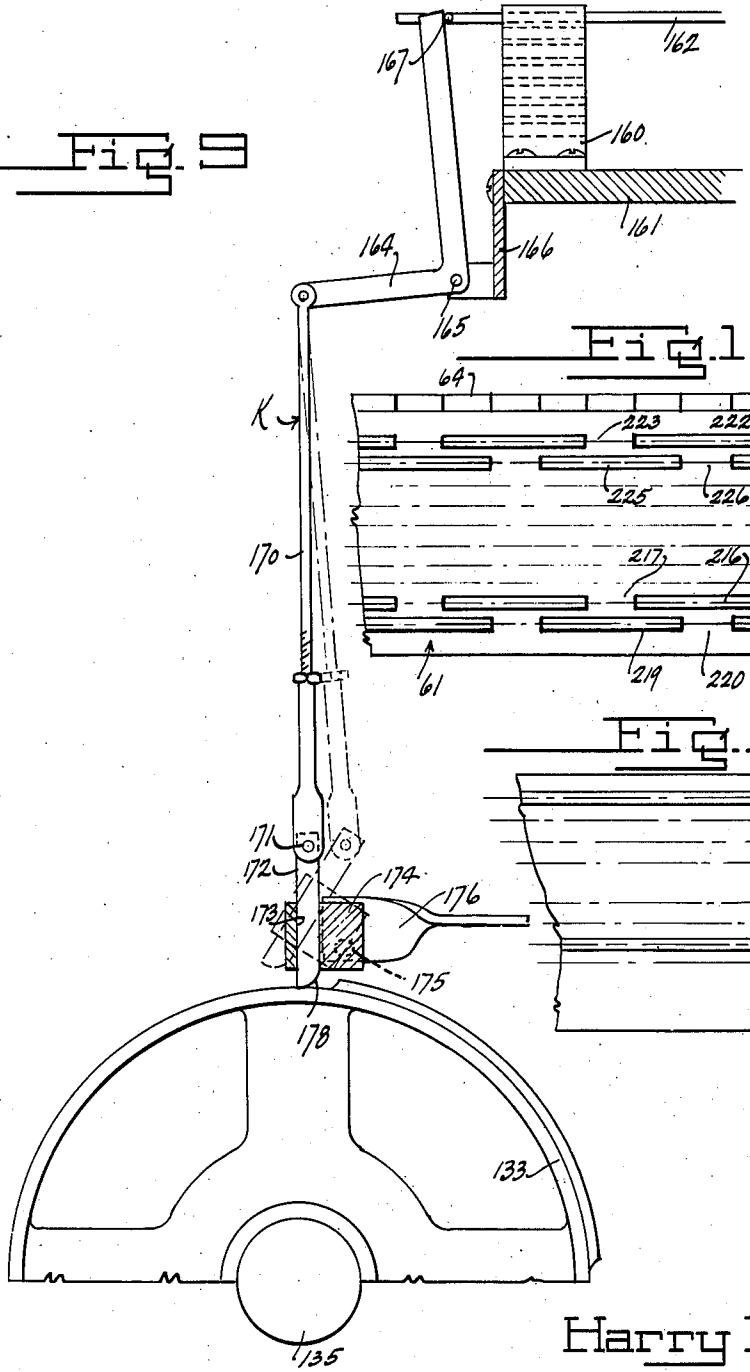


Fig. 10.

Fig. 11.

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KNITTING MACHINE

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FIG. 13.

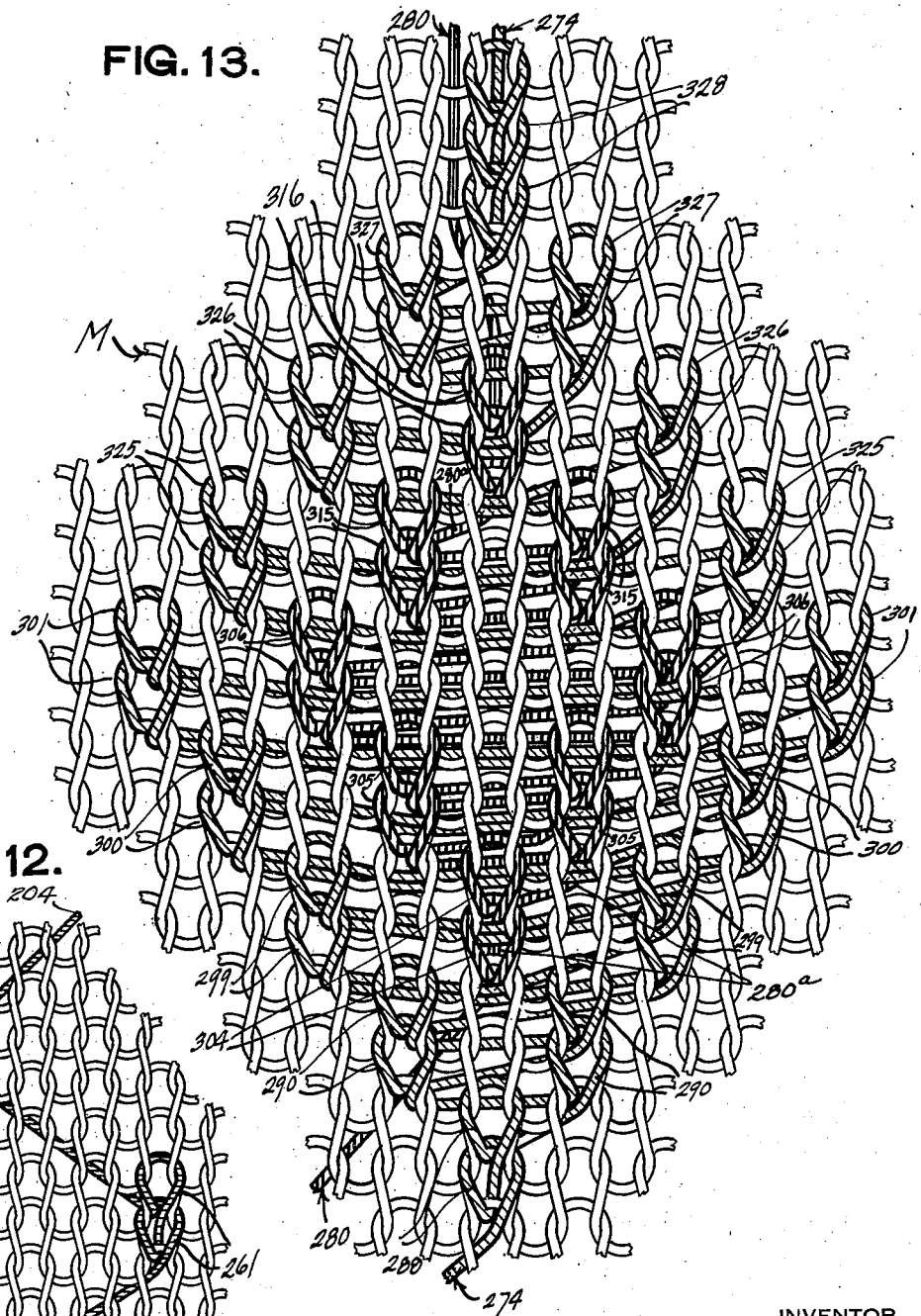


FIG. 12.

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KNITTING MACHINE

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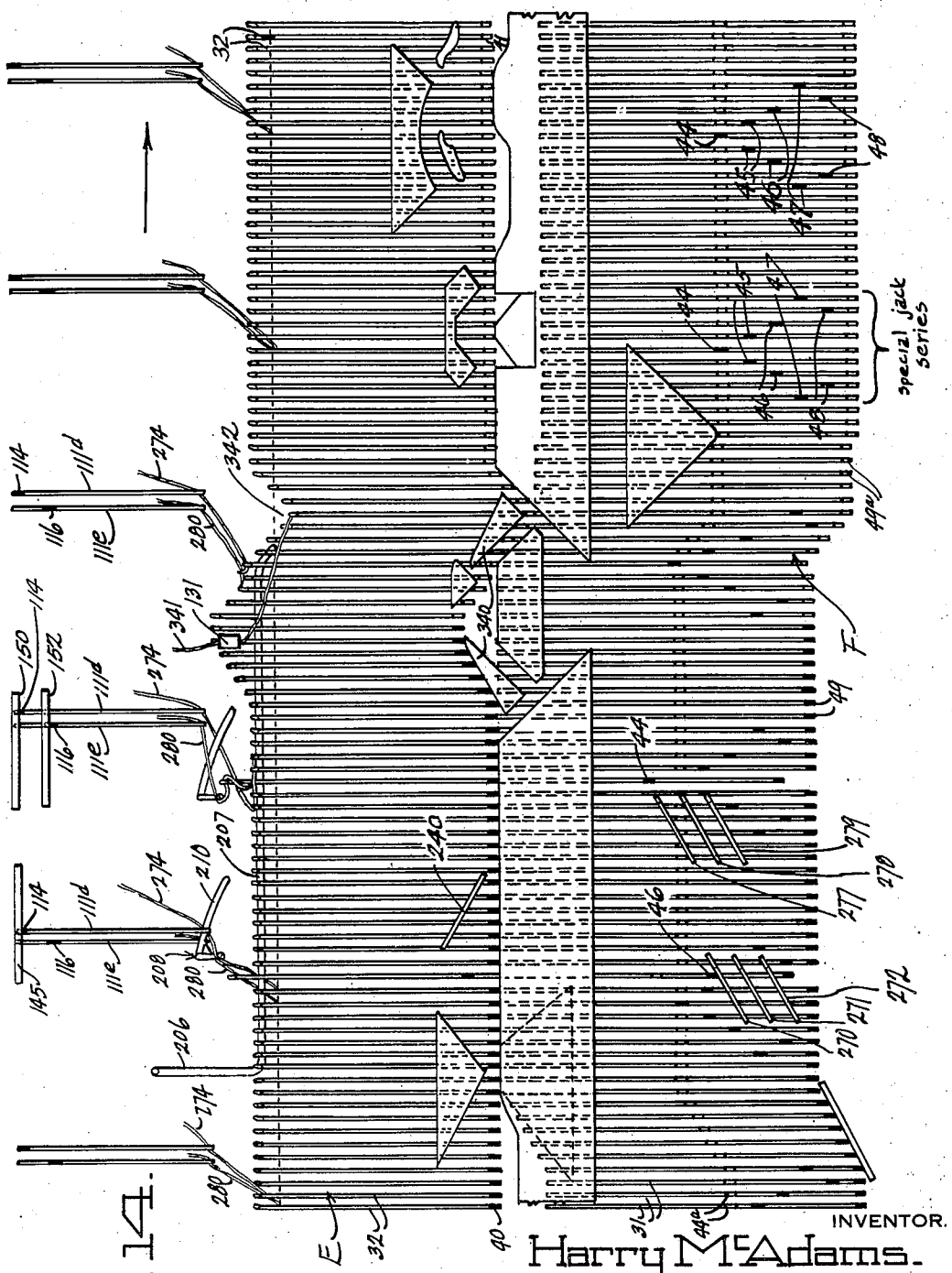


Fig. 14.

Patented Nov. 12, 1940

2,221,713

UNITED STATES PATENT OFFICE

2,221,713

KNITTING MACHINE

Harry McAdams, Reading, Pa., assignor to Nolde and Horst Company, Reading, Pa., a corporation

Application February 8, 1932, Serial No. 591,689

12 Claims. (Cl. 66—135)

This invention relates to improvements in knitting machines.

The primary object of this invention is the provision of an improved knitting machine whereon knitted fabric may be produced with incorporated plated designs having interspersed contrastingly colored yarns.

A further object of the invention is the provision of an improved knitting machine whereon fabric may be produced with plated designs formed of supplementary yarns of desired color or colors, incorporated with the stitches of the main yarn during production by wrapping the same about the needles in such manner that complicated and ornamental designs may be plated in the fabric.

A further object of this invention is the provision of an improved knitting machine for the production of plated fabrics, having improved needle controlling jack and jack operating cam constructions.

A further object of this invention is the provision of improved means for the selective utilization of a large number of wrapping yarns upon a conventional independent needle knitting machine.

A further object of this invention is the provision of an improved method for the production of plated fabrics.

A further object of this invention is the provision of an improved plated fabric.

A further object of this invention is the provision of improved synchronized cam controlling means for cooperatively actuating needles for the reception of a plurality of different plating yarns in wrapped relation upon the needles of an independent needle machine.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In the accompanying drawings, forming a part of this specification, and wherein similar reference characters designate corresponding parts throughout the several views,

Figure 1 is a front elevation of the improved knitting machine.

Figure 2 is a side elevation of the improved knitting machine.

Figure 3 is a fragmentary perspective view showing the manner in which a plurality of plating yarns may be manipulated for reception upon predetermined needles of the needle set.

Figure 4 is a vertical cross sectional view taken through the cylinder of the improved knitting machine, showing the association therewith of a series of selectively operated jack actuating cams and a series of selectively operated yarn finger controlling cams.

Figure 5 is a side elevation of an improved yarn finger which is used upon the machine for manipulation of yarns into wrapping relation upon the needles of the machine.

Figure 6 is a side elevation of a jack used upon the machine.

Figure 7 is a horizontal sectional view taken through the improved machine, substantially on the line 7—7 of Figure 2, and more particularly showing means for selectively operating the cams which manipulate the yarn control fingers.

Figure 8 is a view on a developed plane of the needle set and cooperating series of jacks in associated relation with a series of yarn guide and controlling fingers, and the operating cams for knitting the fabric shown in Figure 12.

Figure 9 is a fragmentary view, partly in section, showing part of the means for actuating the yarn controlling finger cams of the machine.

Figure 10 is a fragmentary view, showing on a developed plane, the arrangement of pattern control lugs which, through a lever and cam mechanism, control actuation of the jacks and needles of the machine for the knitting of the plated fabric shown in Figure 12.

Figure 11 is a fragmentary view showing on a developed plane the pattern control lugs which, through a lever and cam mechanism, control actuation of the yarn fingers, by means of which the yarns are wrapped upon the needles of the machine prior to the knitting operation, for the production of the fabric shown in Figure 12.

Figure 12 shows a piece of fabric with an incorporated plated design interknitted with the main yarn after the so-called wrap stripe method.

Figure 13 is a view of another piece of fabric with a different and more complicated color design which is plated in the fabric after the wrap stripe method, showing the float portions of the threads at the inside of the fabric.

Figure 14 is a view on a developed plane of the needle set and cooperating series of jacks in associated relation with a series of yarn guide or controlling fingers, and the jack, needle, and yarn finger operating cams for the knitting of the fabric shown in Figure 13.

Figure 15 is a fragmentary view showing on a developed plane the arrangement of pattern control lugs which, through a lever and cam mechanism, control actuation of the jacks and needles of the machine for the knitting of the type of plated fabric shown in Figure 13.

Figure 16 is a fragmentary view showing on a developed plane the pattern control lugs which, through a lever and cam mechanism, control actuation of the yarn fingers by means of which the yarns are wrapped upon the needles of the machine prior to the knitting operation, for the production of the fabric shown in Figure 13.

In the drawings, wherein for the purpose of illustration are shown preferred and modified forms of the invention, the letter A may gen-

erally designate the improved knitting machine which may include a frame B, cylinder C; means D for operating the cylinder and driving the machine; a set of needles E; a set of jacks F to actuate the needles E; means G to actuate the jacks; a yarn controlling device H for wrapping the yarns upon the needles of the machine; and means K for actuating the yarn guide fingers of the means H. By way of example pieces of fabric L and M are shown respectively in Figures 12 and 13, but it is to be understood that a wide variety of designs and fabrics may be knitted upon the improved machine.

The knitting machine generally partakes of characteristics of the Banner type disclosed in U. S. Patent #933,443. The frame B has a supporting bed 20 upon which the cylinder C is rotatably mounted, as shown in Figure 4. The means for rotating and oscillating the cylinder C are of the usual type, preferably similar to those shown in the patent above mentioned. The cylinder is driven off the main shaft 21 shown in Figure 2, whereon are positioned the usual pulleys and gearing, including a pinion (not shown) for driving a larger gear 23 (see Figure 2) known conventionally as the "104" gear.

The cylinder C is preferably of special construction, in that it is longer than the usual knitting machine cylinder. It is of the type described in my co-pending application Serial No. 586,635, filed Jan. 14, 1932, and has needle grooves 26 therein. At its lower end the cylinder is anchored, as shown at 27 in Figure 4 of the drawings, upon the gear 28 which forms part of the cylinder driving means D, as will be well understood by those skilled in the art. The grooves 26 are relatively deep, since it is contemplated that the machine may be utilized as set forth in my above mentioned application for the feeding of a plurality of body yarns in plating relation, although in the example shown in the drawings only one main yarn is used to produce the knitting of the main web of the fabric. The needles 32 of the set E are each of the usual latch type; half of them having long butts 40 and the remaining having short butts 41; the former being shown in full black in Figures 8 and 14 of the drawings. The jacks 31 forming the set F have individual characteristics similar to that shown in Figure 6. Each of them includes a stem or body portion 43 which at the lower end thereof is provided with a plurality of frangible butts 44, 45, 46, 47, 48 and 49, more or less. Any or all of these butts may be snapped off at its juncture with the jack shank, or at any place along its length so that it may be made into a short butt or a butt of intermediate length. Thus it can readily be seen that each jack may be provided with any arrangement of butts desired. This enables the selected actuation of predetermined needles as will be subsequently described.

The jack actuating means G preferably includes a pair of supporting blocks 50 and 51, each of which is provided with a vertical series of slots therethrough, preferably radial to the cylinder. These blocks are attached upon the bed 20 of the machine. In the slots 52 of the block 50, and in the slots 53 of the block 51 flat elongated horizontally positioned cams are slidable into and out of butt actuating relation upon the jacks 31 of the set F. Any desired number of slots 52 and 53 may be provided in the blocks 50 and 51, but in the preferred instance eight of such slots are provided in each block. For the knitting of the fabric L shown in Figure 12 the block 50 is provided with upper and lower cams 54 and 55, positioned in the two centrally positioned slots 52 of the block, as shown in Figures 1 and 4 of the drawings. These slidable cams 54 and 55 are provided with angularly positioned cam heads thereon, as shown in Figure 4, which are respectively positioned to engage butts at the level of the jack butts 47 and 48 respectively, in order to elevate the jacks which have butts at these levels, and for cooperatively elevating the respective needles associatd therewith into position where the yarn controlling device H may wrap particular yarns thereon. In the blocks 51 there are positioned upper and lower cams 56 and 57 in the two uppermost slots 53, which have cam heads thereon for actuating jacks which have butts at the levels 44 and 45 respectively. The upper cam 56 is positioned so that it will actuate only upon the long jack butts 44. All such long jack butts are indicated in solid black in Figure 8 of the drawings, and short jack butts are indicated by the rectangular blank spaces.

The cams of the blocks 50 and 51 are similarly actuated, wherever positioned in either of said blocks. They are each provided with springs 60 which normally urge the cam heads into position for engaging the butts and actuating the jacks during cylinder revolution. The jack actuating means G further includes a pattern control wheel or drum 61, best shown in Figure 2 of the drawings, which is rotatably mounted upon the machine frame at 62, preferably upon a bracket arm 63 attached to the usual frame of the machine. This drum 61 supports a plurality of lugs intended to actuate the system of levers for selective control of the various cams mounted in the blocks 50 and 51. The drum 61 is actuated in a step by step movement off the cylinder driving mechanism of the machine. Normally the drum has an externally smooth surface, and the lugs may be applied on the drum in selected manner to accord with any desired pattern.

Adjacent the frame of the machine the drum is provided with a rigid ratchet wheel 64 which has sixty teeth about the circumference thereof. In the above mentioned type of machine upon which the improvement is applicable, but which is not to be limited thereto, the conventional "104" gear wheel 23 rotates once for each four revolutions of the cylinder C. Since it is intended to advance the drum 61 for the length of one tooth for two revolutions of the cylinder C, the gear wheel 23 is provided with diametrically opposed pins or lugs 65 positioned to engage a pivoted lever 66, shown in dotted lines in Figure 2 of the drawings. The lever 66 is keyed upon a shaft 67 mounted upon the machine frame, and this shaft also has an arm 68 keyed therewith. A pawl 69 is pivoted on the arm 68, between the ends thereof, the actuating end of which rests by gravity upon the teeth of the ratchet wheel 64. A spring 70 normally draws the lever 68 into a position so that the arm 66 will be engaged by the two lugs 65 during rotation of the gear 23. Such engagement will throw the pawl 69 rearwardly for advancing the ratchet wheel and also the drum 61.

Since at times it will be desirable to cut out the pattern mechanism, means is provided to hold the pawl actuating lever out of the path of movement of the lugs 65. It includes a bell crank lever 72 pivoted on the machine frame, one end of which is in position for abutment against a

surface 73 of the arm 68 in order to hold the lever arm 66 out of the path of engagement by the lugs 65. The bell crank lever 72 is provided with a rod 75 which is pivoted at one end thereto. The opposite end of the connecting rod is pivoted to the free end of an arm 76. The latter is keyed upon a shaft 77, shown best in Figure 1 of the drawings. The pattern chain 78 of the machine is provided with appropriate lugs 79, shown in Figure 2 of the drawings, adapted to operate against an arm 80 pivoted on the front of the machine, which is in position to act against another arm 81 keyed upon the shaft 77 for rocking the latter in order to trip the bell crank lever 72 into the position shown in Figure 2 of the drawings. The bell crank lever 72 is normally held in an inoperative relation by means of a second bell crank lever 82 shown in Figure 2 of the drawings, which has one end thereof in position to be engaged by suitable pins on the drum 61, selectively placed to operate the lever 82 at the desired time. The other arm portion of the bell crank lever 82 is suitably notched in a stepped relation to receive a pin 84 carried upon the bell crank lever 72. During step by step advance of the drum 61 the bell crank lever 82 is in the position shown in Figure 2, and holding the bell crank lever 72 inoperative. However, as soon as a drum pin trips the bell crank lever 82 the pin 84 will be released and the spring 85 will throw the bell crank lever 72 into position against the arm 68, at the surface 73, to hold the arm 66 out of the path of travel of the lugs 65, so that the drum cannot be advanced until a lug 79 on the pattern chain 78 trips the bell crank lever 72, as has been above described.

Referring to the yarn controlling device by means of which the plating or design providing yarns are wrapped upon predetermined needles, a bracket or standard 90 is mounted upon the bed or on the frame portion of the machine for carrying the bobbin stand and gears for driving the same. This bobbin stand comprises a rotary spindle 91 rotatably supported off the upper frame portion 92 of the standard, and having gears connected therewith and driven off the shaft 94, in a manner which is well known. The spindle 91 is preferably concentrically arranged above the cylinder C; the bobbins 95 being supported upon a rotary platform 96; the threads or yarns therefrom being extended upwardly through suitable guide and tensioning devices shown in Fig. 1, and then extending downwardly through suitable concentrating discs 97; finally converging into guide passageways 100 provided in the upper plate 101 of the device H, as shown in Figure 4 of the drawings. The device H includes a cylindrical hollow body 102, which at its upper end has the depending sleeve or skirt 103 of the plate 101 telescoped therein and keyed as at 104. A spindle attaching hub or sleeve 105 is fixedly keyed at 106 to the central portion of the plate 101; depending within the hollow body 102, in annnularly spaced relation with the inner peripheral surface thereof. The spindle 91 extends through the hub 105 and is secured thereto as by set screws 107; the latter being accessible through an opening 108 provided in the body 102, as shown in Figure 4, through which the bit of a screw driver may be inserted. The body 102 externally is provided with parallel vertical slots 110 wherein the individual yarn guide fingers 111 are mounted in such manner that they may be rocked to move their lower ends for swinging the yarn into needle wrapping relation. The additional yarns or threads extend downwardly through the openings 100 and through the passageway between the body 102 and the hub 105 and are threaded through the lower apertured ends of the fingers 111, as shown in Figure 4.

The yarn controlling fingers 111 are of improved construction, each including a shank 113 which at the upper end thereof may be provided with a plurality of frangible butts 114, 115, 116 and 117, each of which may be readily snapped off at its connection with the shank 113, or at any location along its length, to either eliminate the same or make it into a short butt. The shanks 113 along the butt projecting edge thereof are provided with an upper recess 118 and a lower recess 119. The upper recess 118 is adapted to receive a plurality of retaining springs 120 therein which are under tension and suitably retained in an annular groove (not shown) in the body 102, in order to hold the fingers 111 in place upon the body 102, as shown in Figure 4. The lower recess 119 is provided to receive a spring or elastic device 121. The slots 110 have the bottoms thereof shaped to converge downwardly; the upper ends of the slots 110 of the body 102 being widest and at this location it is noted that the shanks 113 of the figers 111 are sloped, along the edge 125 in Figure 5 of the drawings, so as to provide a fulcrum point 126 on the shank 113. Cams are adapted to actuate upon the butts at the upper ends of the fingers 111 for the purpose of moving the said upper ends of the fingers inwardly towards the spindle 91, which throws the lower ends of the fingers radially outward in order to wrap the yarns controlled thereby upon predetermined needles of the machine, as can quite readily be understood from Figure 4 of the drawings.

The latch ring 130 of the improved machine is of usual construction, with certain minor additions in the way of guide wires and rods, shown in Figure 3, for the purpose of assisting the additional yarns to be wrapped upon the needles. The conventional yarn controlling fingers 131 may be provided upon the latch ring, for manipulating the body yarns, or indeed additional yarns if desired, for the knitting of a fabric having the knitted web of the fabric shown in Figures 12 and 13, or a plated web if so desired.

Referring to the means K for actuating the fingers of the device H, it is to be noted that the same comprises a series of cams mounted above the cylinder and in an out of the way relation of conventional knitting machine actuating parts. These cams are operated off of a pattern control drum 133, best shown in Figure 2 of the drawings, which is of the same effective diameter as the pattern drum 61 above described. The drum 133 is rotatably mounted upon a shaft 135 carried by the bracket arms 63. The drum 133 is intermittently driven in synchronized relation with the drum 61 and in the same direction and at the same rate of speed. This is accomplished by keying gears 137 and 138 upon the drums 61 and 133. They have the same pitch diameter and mesh with an intermediate gear 139 which is rotatably mounted upon a shaft 140 provided upon the bracket 63, as shown in Figure 2 of the drawings. Indeed it would be possible to actuate the yarn control finger actuating cams off of the drum 61, although for compactness the additional drum 133 is preferred.

A pair of cam blocks 141 and 142 are mounted upon a suitable supporting shelf 143 which is attached, as shown at 144 in Figure 7, to the

standard 90. Each of these blocks 141 and 142 supports four cams; the cams of the block 141 being intended to actuate predetermined yarn control fingers for throwing the yarns thereof into needle wrapping relation with those needles which are raised by the cams of the block 50. On the other hand the cams of the block 142 are intended to actuate predetermined yarn control fingers of the device H for the wrapping of the yarns thereof onto those predetermined needles of the cylinder C which are raised by the cams of the block 51 above described.

The cam block 141, as shown in Figures 1 and 4 of the drawings, is provided with four cams 145, 146, 148 and 149, which are respectively intended to actuate those fingers 111 of the device H, for the wrapping of yarns upon certain needles of the cylinder C, which respectively have butts at the levels of the butts 114, 115, 116 and 117. The cam block 142 is similarly provided with four cams 150, 151, 152 and 153 in position to swing the fingers of the device H into yarn wrapping relation with predetermined needles raised by the cams of the block 51; the cams 150 to 153 inclusive respectively actuating those fingers 111 which have butts at the levels of the butts 114 to 117 inclusive. The cam heads upon the cams 145 to 153 inclusive have their butt engaging surfaces sloped so as to gradually rock the yarn controlling fingers of the device H, as can well be understood from Figure 7 of the drawings. As to the manner of pushing the yarn finger swinging cam into butt engaging relation with the fingers 111, it will be noted that the cams of the block 142 are actuated by means of levers 155 which are pivoted at 156 on the frame 143, as shown in Figures 1 and 7 of the drawings. On the other hand the cams of the block 141 are actuated by means of levers 157 which are pivoted at 158 upon the support 143. These levers, as to the length, and the location of their pivot axes are arranged so that the cams of the two blocks 141 and 142 may be moved for only the required distance.

Referring to Figures 2, 7 and 9 of the drawings, it will be noted that a guide block or support 160 is mounted upon a support 161 attached to the upright 90. This support 160 is provided with a plurality of passageways therethrough for slidably receiving connecting rods 162. These connecting rods 162 are pivotally connected at 163, one to each of the levers 155 and 157. Bell crank levers 164 are pivoted at 165 upon a bracket arm 166 attached to the support 161. Their upper ends are offset at various distances and actuate against pins 167 which are mounted normal to the connecting rods 162, and upon each of them, as shown in the drawings. The other ends of the bell crank levers 164 are each provided with a depending length adjustable rod 170. The lower ends of the rods 170 are pivotally connected at 171 to suitable drum lug engaging portions 172 reciprocably mounted within suitable passageways 173 of a supporting block 174. The latter is eccentrically mounted at 175 upon suitable bracket arms 176. The drum facing ends of the portions 172 are convex, as shown at 178 in Figure 9 of the drawings, so that when the lugs of the drum 133 engage the same there will be no hindrance to rotation of the drum, and the lugs will push the portions 172 upwardly in the passageways of the support 174; rocking the bell crank levers 164 upon their pivots. In turn the connecting rods 162 are moved longitudinally for rocking the levers 155 and 157. The latter at their free ends engage pins 180 on the various cams of the blocks 141 and 142, for actuating said cams into yarn control finger rocking relation.

In order to prevent the yarn control fingers from rebounding after the fingers have completed a yarn wrapping operation upon predetermined needles, I have provided a leaf spring 181, shown in Figures 1 and 2 of the drawings, which may be associated beneath each of the cam blocks 141 and 142; the same being under considerable tension for normally holding the yarn control fingers in their inoperative positions. It is shown in Figure 4 that the yarn control fingers 111 when moved to a yarn wrapping relation with a needle will further tension the rebound preventing spring 181.

In order to prevent the additional yarns from being knitted into the fabric, which is necessary under certain circumstances when it is desired to accomplish normal knitting without plating or design effects, means has been provided to cut the device H, and indeed its operating means K, out of operation notwithstanding that the drum 133 may be intermittently rotated. To that end the shaft 175 has a lever arm 190 keyed therewith, as shown in Figure 2 of the drawings, which has a pin and slot connection at 191 with a lever 192 pivoted at 193. The lever 192 is actuated off a lever 194; the latter being actuated by the usual pattern wheel 195 of the knitting machine, and said lever having a rod 196 connecting it with the lever 192. It is readily apparent that lug operation of the lever 194 off the pattern wheel 195 will throw the lever arm 190 for rotating the shaft 175. Inasmuch as the supporting block 174 is eccentrically mounted by the shaft 175 it is readily apparent that the portions 172 will be thrown to the dotted positions shown in Figure 9 of the drawings and out of the path of travel of the lugs of the drum 133. It will be noted that there is no positive connection of the bell crank levers 164 with the connecting rods 162, but that said bell crank levers merely actuate against the projections 167 when moved in the proper direction.

The jack actuating cams mounted in the blocks 50 and 51 are actuated much in the same manner off the drum 61 as set forth in my co-pending application above referred to. That is, a number of levers 197, shown in Figure 2 of the drawings, are pivoted at 198[a] upon a side of the machine. One end of each of these levers is actuated off the drum 61; the opposite end is connected by a suitable rod 199 to a bell crank lever 199. The latter are pivoted upon suitable brackets 200 and actuate against suitable pins 201 upon the cams of the blocks 50 and 51. Suitable springs 60 normally urge the cams in the blocks 50 and 51 into butt actuating relation with the jacks of the set F. The lugs of the drum 61 actuate the levers 197 for withdrawing the cams of the blocks 50 and 51 from jack butt actuation, as can readily be understood.

Two typical set-ups are shown in Figures 8 and 14 of the drawings for production of the types of fabric L and M respectively illustrated in Figures 12 and 13 of the drawings.

Referring to the set-up shown in Figure 8 for the production of the fabric L, it will be noted that half of the jacks of the set F are provided with long lower butts 49 and half with shorter lower butts 49[a] at the same level. Every fourth needle is intended to take one of the additional yarns wrapped thereon by the device H. To that end every thirteenth jack is provided with a long butt 44, and at the same level the remaining

jacks are provided with shorter butts 44a. Every fourth jack starting with those having the long butts 44 in a direction counter to cylinder rotation is provided with a long butt 45. Every fourth jack starting with those having the long butts 45 measured in a direction counter to rotation of the cylinder is provided with a long butt 47, and every fourth jack starting with those having the long butts 47 and measured in a direction counter to cylinder rotation is provided with a long butt 48. Thus, the jacks which are intended to raise predetermined needles for taking wrapping yarns are adjacently positioned with a pair of inactive jacks therebetween. The pair of cams 56 and 57 carried by the block 51 are effective to respectively elevate those jacks having long butts 44 and 45 for the purpose of elevating the respective needles associated in the same slots therewith to a position where they may receive yarns which are wrapped thereon by the fingers of the means H to be described. On the other hand the cams 54 and 55 of the block 50 are at respective levels to engage the long butts 47 and 48 in order to elevate the jacks upon which said long butts are positioned and the respective needles associated therewith to a position where they may receive yarns in cooperative relation with the device H. In view of the slotted body 102 of the device H it can well be understood that a yarn controlling finger 111 may be provided thereon for each needle of the knitting machine. Preferably the arrangement is such that half as many yarn controlling fingers 111 are provided as needles, although it can well be understood that such arrangement may be variable. In the set-up shown in Figure 8 the device H is provided with certain fingers 111a having only the long top butts 114 for the feeding of a spotting or design providing or contrasting yarn 204 to needles controlled by the adjacent jacks having the long butts 44 and 45. On the other hand yarn guide fingers 111b are provided, having only long butts 115 for controlling the feed of a spotting or design providing contrasting yarn 205 to those needles which are controlled by each pair of adjacent jacks having the long butts 47 and 48. Another way of expressing the arrangement is to say that the jacks are divided into series; each series including four of the effective needle raising jacks in stepped relation at the levels 44, 45, 47 and 48. In each of these series one of the yarn fingers 111a controls the feeding of yarn to those needles elevated by the jacks having long butts 44 and 45 in that series, and the finger 111b controls the feeding of the other yarn in wrapped relation upon those needles elevated by the jacks having butts 47 and 48 in the series.

Referring at this time to Figure 3 for an understanding as to the manner in which the yarns are wrapped upon the needles, it will be noted that a needle 32 has been elevated in advance of the swinging of a yarn controlling finger 111 into position for the feeding of a yarn 211 thereto. This needle 32 is of course elevated by any of the jack actuating cams. The latch ring 130 is provided with a guide wire 206 having a curved bar portion 207 extending closely along the inside of the line of needles at a location just below the hook ends of the needles when the latter are lowered, for the purpose of preventing the yarns controlled by the guide fingers 111 from becoming entangled with sinkers and other needles than those intended. Each series of yarn finger actuating cams is provided on the latch ring with a cooperative yarn guide bar or member 208, shown in Figure 3, which has a bar portion 209 preferably extending radially to the cylinder and at a location above the hook ends of the needles, which slopes upwardly from the outer end of the latch ring to a location at the inner side of cylinder needles; the same then being turned arcuately inwardly and downwardly to the inside of the line of needles, as shown at 210. As the yarn finger 111 is swung outwardly by one of the cams, either in the series mounted in the block 141 or the series mounted in the block 142, it will be noted that the same swings the yarn 211 into taut position over the bar 207 and between the raised needle 32 and the bar portion 209 of the guide 208. As the cylinder and device H rotate the yarn at the location 211a will engage against the bar portion 209 and be held temporarily thereagainst until the raised needle 32 engages this portion 211a of the yarn 211 and wraps the same thereon; the yarn then riding off the bar 210 as shown for the yarn 211b in Figure 3, and at which time the finger moves inwardly to its normal position.

Referring now to the set-up shown in Figure 8 it will be noted that the cam block 142 is provided with only one effective cam 150 which, as before mentioned, is at a level to actuate only those yarn fingers having long top butts 114. On the other hand the other cam block 141 is provided with only one effective cam 146 which, as above mentioned, actuates only those jacks having long butts 115. The yarn fingers 111a, as can readily be understood, throw the additional yarn 204 in position for wrapping upon the needles controlled by the jacks which have the long butts 44 and 45 in each series. Correspondingly the fingers 111b are actuated by the cam 146 to throw the yarn 205 into position for wrapping upon those needles whose jacks in each special series of jacks are actuated by the cams 54 and 55.

As to the manner in which the cams 54 to 57 inclusive are actuated off the drum 61, it will be noted from Figure 10 of the drawings in conjunction with Figures 1 and 8 of the drawings that the cam 54 is controlled off one of the levers 197 whose end rides along the line indicated by the dot and dash lines 215 in Figure 10 of the drawings. Along this line 215 there are provided uniformly spaced lugs 216 with spaces 217 therebetween. As the lever 197 controlling the cam 54 drops into these spaces 217 the cam 54 is thrown into position for engaging the long butts 47 in order to elevate the predetermined needles associated therewith to take the yarn 205, as indicated in Figure 8. Similarly the cam 55 is actuated off a lever 197 which rides in the path shown by the dot and dash line 218 in Figure 10 of the drawings. Along this line 218 there are also provided lugs 219 which have spaces 220 therebetween uniformly spaced and staggered with respect to the spaces 217. As the lever 197 controlling with other lever mechanism the cam 55 drops into the spaces 220, the cam 55 will be thrown into position for engaging the long butts 48 of the jacks and elevating the needles associated in the slots therewith to take the yarn 205. In like manner the cam 56 is controlled off a lever mechanism 197 whose end rides along a line indicated by the dot and dash line 221 in Figure 10 of the drawings. Along this line 221 there are provided lugs 222 with spaces 223 therebetween in the same relation on the drum as the spaces 217 above mentioned. This throws the cam 56 into position for engaging the long butts 44 of the jacks and elevating the needles asso-

ciated therewith at the same time that the cam 54 is in position for elevating the jacks intended therefor. The cam 57 is controlled off a lever mechanism 197 which travels along a line indicated by the dot and dash line 224 in Figure 10. Along said line there are lugs 225 with spaces 226 located in the same relation on the drum as the spaces 220 above described. This throws the cam 57 into jack actuating position at the same time as the cam 55, but the cam 57 is in position for actuating the long butts 45.

In the set-up shown in Figure 8 the yarn controlling finger cams 146 and 150 remain in actuating position at all times. To that end the drum 133 is provided with circumferential ribs or lugs 230 and 231 which through the mechanism above described maintains the cams 146 and 150 in finger operating position at all times.

One of the most important features of the invention is the provision of a needle leveling cam 240, shown in various views of the drawings, and particularly in Figure 4, slidably mounted in a block 241 and normally spring urged at 242a into position to engage the butts of those needles which have been elevated by the cams operating in the block 50 to lower them in advance of the series of cams which operate in the block 51. Thus, after the additional yarns have been fed to those predetermined needles which have been elevated by the cams operating in the block 50 they are lowered in order not to interfere with the feeding of other yarns to those needles which are subsequently elevated by the cams operating in the block 51.

The cam 240 is actuated off the pattern control wheel 195 through a bell crank lever 242 and a connecting rod 243.

A leveling cam 250 is provided to bring the jacks into position for proper actuation by the two series of jack actuating cams. This cam 250 is actuated off the pattern control wheel 195 thru a suitable lever mechanism including the bell crank lever 252.

Referring to Figure 12 wherein the additional yarn 204 is shown interknitted in design producing relation with the main body yarn of the fabric, it will be noted that in one wale of the fabric the stitches 260 are knitted in two successive courses and from thence the additional yarn 240 is floated on the inside of the fabric diagonally across the next two successive courses and in the following two successive courses the stitches 261 are produced of said yarn in the fourth wale removed from that wherein the stitches 260 appear. The additional yarn 204 is then floated on the inside of the fabric back to the wale having the stitches 260 placed therein and the plating is reproduced in like manner along the fabric. The plating stitches 260 are produced on those needles which are controlled by the cam 57 through actuation of the jacks having butts 45, and the stitches 261 are produced off of those needles actuated off the jack actuating cam 56, as can quite readily be understood.

Merely by way of illustrating the extreme versatility of the improved knitting machine, which may knit in the fabric one or more contrastingly colored additional yarns within a boundary closed design knitted after the wrap needle method, I have shown another set-up in Figure 14, for the production of the fabric shown in Figure 13. In this fabric M the body yarn has a diamond shaped design knitted therein in a plated relation, using the wrap needle method, with an additional yarn of green color, and within this green diamond design there is also knitted a plated diamond design, after the wrap needle method, with a contrastingly colored yarn, such as red. Indeed, in the center of the design and within the design knitted by the red additional yarn there may also be interknitted other contrastingly colored yarns.

Nine consecutive jacks are provided in each special series of jacks, see Figure 14, for knitting the design shown in the fabric M. The center jack has merely one long butt 44; the jacks at each side of the central jack are provided with the long butts 45. The next outermost jacks in the series are provided with the special long butts 46; the next outermost jacks in the series are provided with the long butts 48, and the extreme end jacks in the series are provided with the long butts 47. Of course, the series of jacks may have their lowermost butts 49 divided, half into short butts and half into long butts, so that the design may be cut out when knitting certain parts of the fabric, as will be well understood. These bottom butts are not actuated by any of the design producing cams. Also each jack of the set F except the center one in each special series has a short butt 44a.

In the cam block 50 there are provided cams 270, 271 and 272 at levels for respectively actuating those jacks which have long butts 46, 47 and 48 in order to elevate the respective needles associated therewith for taking the green plating yarn 274 which is controlled by a finger 111d for each of the special series of jacks; this finger 111d having a top butt 114 actuated off the cam 145, which is the only effective cam in the block 141. This cam 145 is actuated off the pattern control drum 133 by means of a lug 275 shown in Figure 16 of the drawings in order to hold the finger 111d in position for wrapping of the green yarn 274 upon the needles which are raised through successive actuation of the cams 270, 272, and 271, in a manner which will be subsequently described.

The jack cam block 51 is provided with three cams 277, 278, and 279 which are intended to actuate the long jack butts of the special jack series at the levels 44, 45, and 46. For those needles which are raised by the last three mentioned cams the corresponding series of yarn controlling finger actuating cams include a cam 150 and a cam 152, which will act upon the butts 114 and 116 respectively of the fingers. Each special series of jacks is provided with two yarn controlling fingers, one of them the yarn controlling finger 111d above mentioned which controls the green yarn 274, and the other the yarn controlling finger 111e which controls a red yarn 280.

Referring to the sequence for the knitting of the design in the fabric M, and referring to the lug arrangement shown in Figure 15 for jack cam actuation, the cam 277 will first be thrown in by dropping of a lever mechanism 197 into the notch 285 of the drum 61, which knits the plating stitches 288 shown in the fabric M of Figure 13. Thereafter the cam 278 is thrown into jack actuating position by dropping of its lever mechanism into the notch 289, which elevates the two needles having jacks with butts 45 for the taking of green yarn and the knitting of the stitches 290 shown in the fabric. During the knitting of these four courses having the stitches 288 and 290 appearing therein the cam 150 is in position for actuating the finger 111d to wrap the

green yarn 274 upon the appropriate needles; a lug 292 on the drum 133, shown in Figure 16, actuating the cam 150 in this manner. Thereafter the cams 270, 272, and 271 are successively thrown into jack actuating position by the respective dropping of their lever mechanisms into the spaces 296, 297, and 298 for the knitting of the plated stitches 299, 300, and 301 respectively. It is of course understood that during the time that these cams 270, 271 and 272 are in jack actuated position the yarn finger 111d is held in needle wrapping position by the cam 145; the latter being held in position by the lug 275 on the drum 133. Simultaneous with the throwing of the jack cams 270, 272 and 271 into position the cams 277, 278, and 279 are respectively thrown into successive jack actuating positions for elevating the needles to take the other contrasting (red) yarn 280 in order to knit the stitches 304, 305, and 306, which are respectively in the same courses as the stitches of the contrasting yarn. These cams 277, 278, and 279 are actuated to produce the stitches 304, 305, and 306 by the dropping of their lever mechanisms respectively into the spaces 308, 309, and 310, as shown in Figure 15 of the drawings. The red yarn 280 is of course fed to the needles actuated at this time by the yarn finger 111e which is held in position by the cam 152; the latter being actuated through its lever mechanism off the lug 312, shown on the drum 133 in Figure 16 of the drawings. Thereafter the stitches 315 and 316 of the contrasting yarn 280 completing the inner portion of the design are knitted upon the needles actuated by the jack actuating cams 278 and 277 respectively, whose lever mechanisms are actuated off the drum spaces 320 and 321 shown in Figure 15 of the drawings. The green plated portion of the design is completed as to the stitches 325, 326, 327, and 328 by successive actuation of the cams 272, 270, 278 and 277, whose respective lever mechanisms successively are actuated off the pattern controlling drum spaces 330, 331, 332, and 333. At this time the green yarn 274 is fed to those needles actuated off the cams 272 and 270 by finger cam 145 actuated off the drum lug 275 and to the needles actuated off cams 278 and 277 by finger cam 150 actuated off the drum lug 292a. Of course the cam 240 is employed in the same manner as above described for lowering the needles after they have received yarn from the cam series in the block 141.

The yarn 274 is of course floated between successively knitted stitches and from course to course across the inside of the fabric. The yarn 280 is similarly floated, but the float portions at the inside of the fabric between successive stitches in different courses will cross over and float behind the float portions of the yarn 274. These "crossing over" float portions of the yarn 280 are designated at 280a in Figure 13. It is characteristic of them that they tend in to bind the float portions of the yarn 274 and prevent them from hanging too loosely.

Many and varied complicated patterns, designs, stripes, and contrasting figures may be knitted in plated relation after the wrap needle method with my improved machine, as can readily be understood from the foregoing typical examples; it being quite obvious that through manipulation of the two series of jack actuating cams and two series of yarn finger controlling cams in combination with the varied lug arrangement of the two pattern controlling drums therefor, that practically any plated design may be produced with a large variety of contrasting yarns.

In the improved machine the cylinder C is of the type adapted to support 224 needles, although not limited to such number. For this cylinder the yarn finger supporting cone has slots for accommodating 112 fingers, and of course the bobbin stand is provided with means for supporting 112 bobbins. The variety of contrastingly colored designs utilizing color within color which can be produced with this machine will be readily apparent from the foregoing.

It is readily understandable that any number of pattern drum actuating lugs may be provided on the gear 23, so that the wrap needle plating may be effected in any desired number of consecutive courses in the fabric. In the examples shown each tooth movement of the drum permits the cylinder to revolve twice.

The usual set of needle actuating cams is provided, including the stitch cams 340. The body or main yarn 341, fed by one of the conventional yarn guides 131 is knitted into fabric at the knitting point 342, in a manner which is well understood in this art. Other cams shown in Figures 8 and 14 of the drawings not described are of conventional order.

I claim:

1. A circular knitting machine comprising in combination a circular series of needles, means for introducing a main knitting yarn to said needles, means for feeding a wrap yarn to selected nonadjacent needles in wrapped relation thereon, and means for feeding a second and contrasting wrap yarn to other selected needles between the said nonadjacent needles for producing a fabric having the contrasting yarns appearing in adjacent design producing relation in the same knitted courses.

2. In a knitting machine the combination of a series of independent needles, means to feed a main body yarn thereto, means to actuate the needles for knitting said body yarn into fabric, means to actuate selected needles for wrapping thereupon a contrasting additional yarn to produce in the fabric a boundary closed design, and means to actuate said needles to interknit in said fabric and in the area within said boundary design a contrastingly colored yarn.

3. The method of producing plated fabric which comprises feeding a main yarn to a course of needles in knitting relation, selectively elevating recurrent predetermined needles, wrapping an additional yarn thereon and then lowering said needles, thereafter and in the same knitting course selectively elevating other predetermined needles lying between the first mentioned predetermined needles and wrapping another yarn thereon, and manipulating the needles with said yarns to complete the knitting of the fabric controlling means for cooperatively feeding selective contrasting yarns to different predetermined needles raised into position by said cams.

4. In a knitting machine the combination of a cylinder having a needle set movable therein consisting of independent needles, a cam set for actuating the needles for the knitting of fabric, means for feeding a main knitting yarn to the needles, a set of jacks having a special series therein with butts at different levels, a selectively operated series of cams for selectively actuating the jacks thru engagement of the butts at the different levels for raising the needles co-

operating with said jacks into yarn receiving position, a second series of selectively operated cams for similarly raising said needles, pattern control means for selective actuation of the cams of said two series, a rotary yarn supporting stand including a member having a plurality of yarn controlling fingers thereon, said yarn controlling fingers having butts thereon at different levels, a set of cams in position to actuate against the butts for moving the fingers into cooperative needle yarn wrapping relation upon the needles which are raised by the first mentioned series of jack actuating cams, a second series of yarn controlling finger actuating cams for actuating said fingers into yarn wrapping relation with the needles which are raised by the second mentioned series of jack actuating cams, and pattern controlling means for selectively actuating the cams of the two series of yarn controlling finger actuating cams and for synchronizing their action with the series of jack-actuating cams.

5. In a knitting machine for producing fabrics with plated designs appearing therein, the combination of a cylinder having an independent needle set thereon, a cam set for actuating said needles, a set of jacks for the individual needles, a series of cams for actuating the jacks and moving the needles into yarn receiving position, a pattern control drum, means actuated off the pattern control drum for operating said series of cams, a yarn controlling device including a support having a plurality of independently movable yarn controlling fingers, a set of cams for selective actuation of the yarn controlling fingers for moving the latter into yarn applying position with the needles which are brought into position by the series of jack actuated cams above mentioned, a second pattern control drum, and means actuated off the second pattern control drum for selective actuation of the cams of the series which operate said yarn controlling fingers.

6. In a knitting machine for producing fabrics with plated designs appearing therein the combination of a cylinder having an independent needle set thereon, a cam set for actuating said needles, a set of jacks for the individual needles, a series of cams for actuating the jacks and moving the needles into yarn receiving position, a pattern control drum, means actuated off the pattern control drum for operating said series of cams, a yarn controlling device including a support having a plurality of independently movable yarn controlling fingers, a set of cams for selective actuation of the yarn controlling fingers for moving the latter into yarn applying position with the needles which are brought into position by the series of jack actuated cams above mentioned, a second pattern control drum, means actuated off the second pattern control drum for selective actuation of the cams of the series which operates said yarn controlling fingers, and means for throwing the last mentioned means entirely out of operation during the knitting of certain parts of the main web.

7. In a knitting machine the combination of a cylinder having a set of independently movable needles thereon, means for feeding a body yarn thereto to knit fabric, means for feeding a wrap thread to non-adjacent needles of the set of needles with floats extending across the backs of the intermediate needles between said non-adjacent needles, and means for feeding a second wrap thread to a selected arrangement of said intermediate needles in the same knitting course with said first mentioned wrap thread.

8. In a knitting machine the combination of a set of independently movable needles, means to feed a body yarn thereto to knit fabric, means to manipulate non-adjacent needles of a certain group of needles to receive a wrap thread with floats of the wrap thread extending across the back of the intermediate needles, and means to feed upon some or all of the needles of the same group which did not receive the first wrap thread and in the same knitted courses with the latter a second wrap thread with floats extending across the back of any intermediate needles.

9. In a knitting machine a set of independent needles, a needle actuating cam set, means for feeding a main yarn to the needles, a series of jacks co-acting individually with a certain group of said needles, said jacks having butts thereon at different levels, a series of cams for operating upon selected butts of said series of jacks in pattern controlled relation, a second series of cams for operating upon the butts of said series of jacks to elevate them in pattern controlled relation, means for feeding an additional yarn to the needles as elevated by the first mentioned series of cams with float portions of said yarn extending back of any intermediate needles not raised by said cams, means to lower the needles thereafter upon which said additional yarn has been fed, means to feed another yarn to the needles raised by the second series of cams subsequent to lowering of the needles which receives said first additional yarn and in the same course of knitting therewith, and pattern control means for synchronously actuating all of said cams.

10. In a rotary knitting machine the combination of a rotary cylinder, independently movable needles therein, means to feed a body yarn to the needles of the cylinder to knit fabric, means to wrap a patterning yarn upon needles of a predetermined group of needles so that the floats of said wrap yarn extend across the backs of any intermediate needles in said group, and means to feed upon the said intermediate needles of the said group and in the same knitted courses with the first mentioned wrap yarn, a second wrap yarn of contrasting color with respect to the first mentioned wrap yarn.

11. In a rotary knitting machine the combination of a rotary cylinder, independently movable needles therein, means to feed a body yarn to the needles of the cylinder to knit fabric, means to wrap a patterning yarn upon needles of a predetermined group of needles so that the floats of said wrap yarn extend across the backs of any intermediate needles in said group, and means to feed upon one of said intermediate needles of the said group and in the same knitted courses with the first mentioned wrap yarn, a second wrap yarn of contrasting color with respect to the first mentioned wrap yarn.

12. In a knitting machine the combination of a series of independent needles, means to feed a main body yarn thereto, means to actuate the needles for knitting said body yarn into fabric, means to selectively actuate certain needles for wrapping thereon a single wrapping yarn to produce in the fabric a boundary closed wrapped design, and means to further selectively actuate said needles and to interknit in said fabric and inside of the area bounded by said boundary closed design a second wrapping yarn.

HARRY McADAMS.

CERTIFICATE OF CORRECTION.

Patent No. 2,221,713. November 12, 1940.

HARRY McADAMS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 7, second column, lines 62 to 65 inclusive, claim 3, strike out the words "controlling means for cooperatively feeding selective contrasting yarns to different predetermined needles raised into position by said cams"; 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 14th day of January, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)