

(No Model.)

3 Sheets—Sheet 1.

A. McMICHAEL & F. B. WILDMAN.
CIRCULAR KNITTING MACHINE.

No. 508,965.

Patented Nov. 21, 1893.

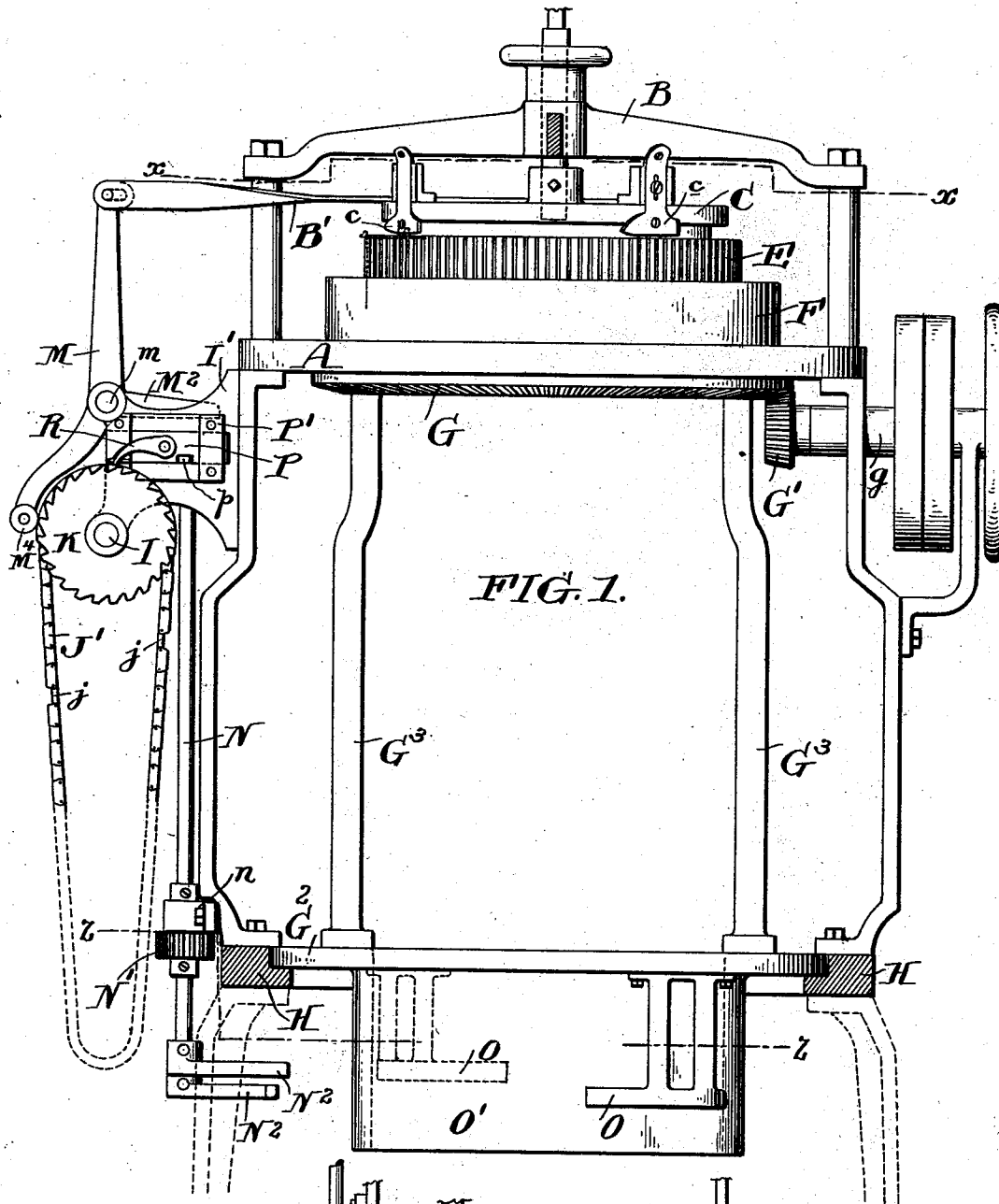


FIG. 1.

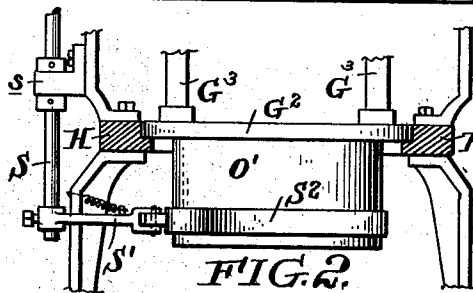


FIG. 2.

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By their Atty.

[Signature]

3 Sheets—Sheet 2.

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FIG. 3.

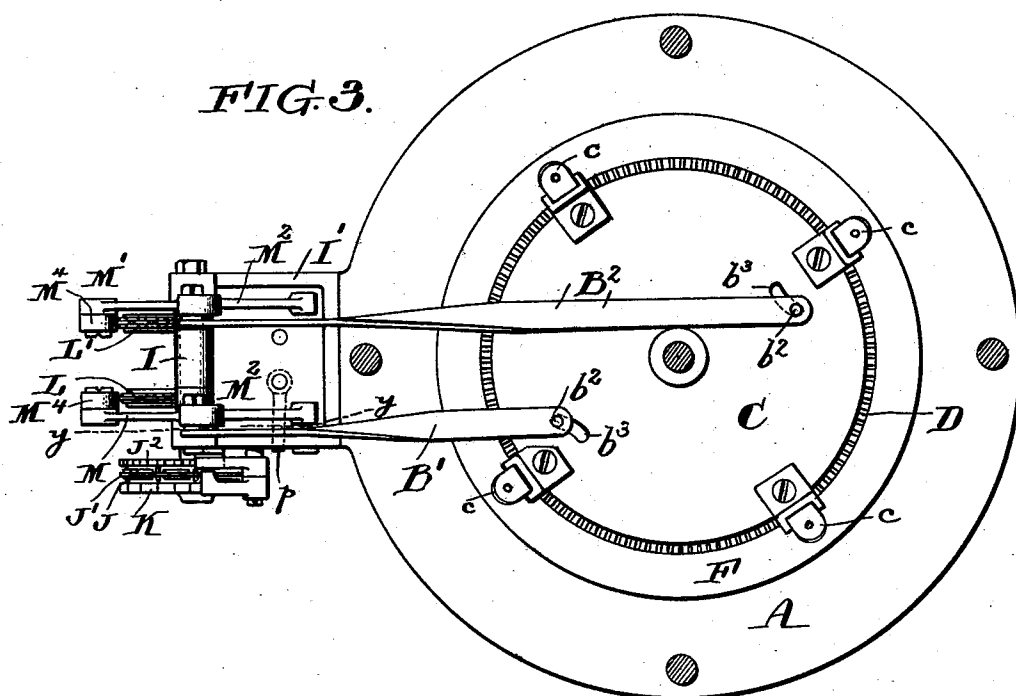
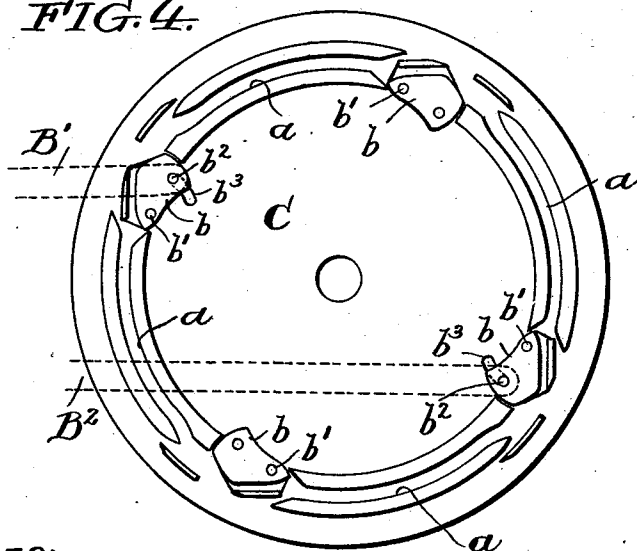


FIG. 4.



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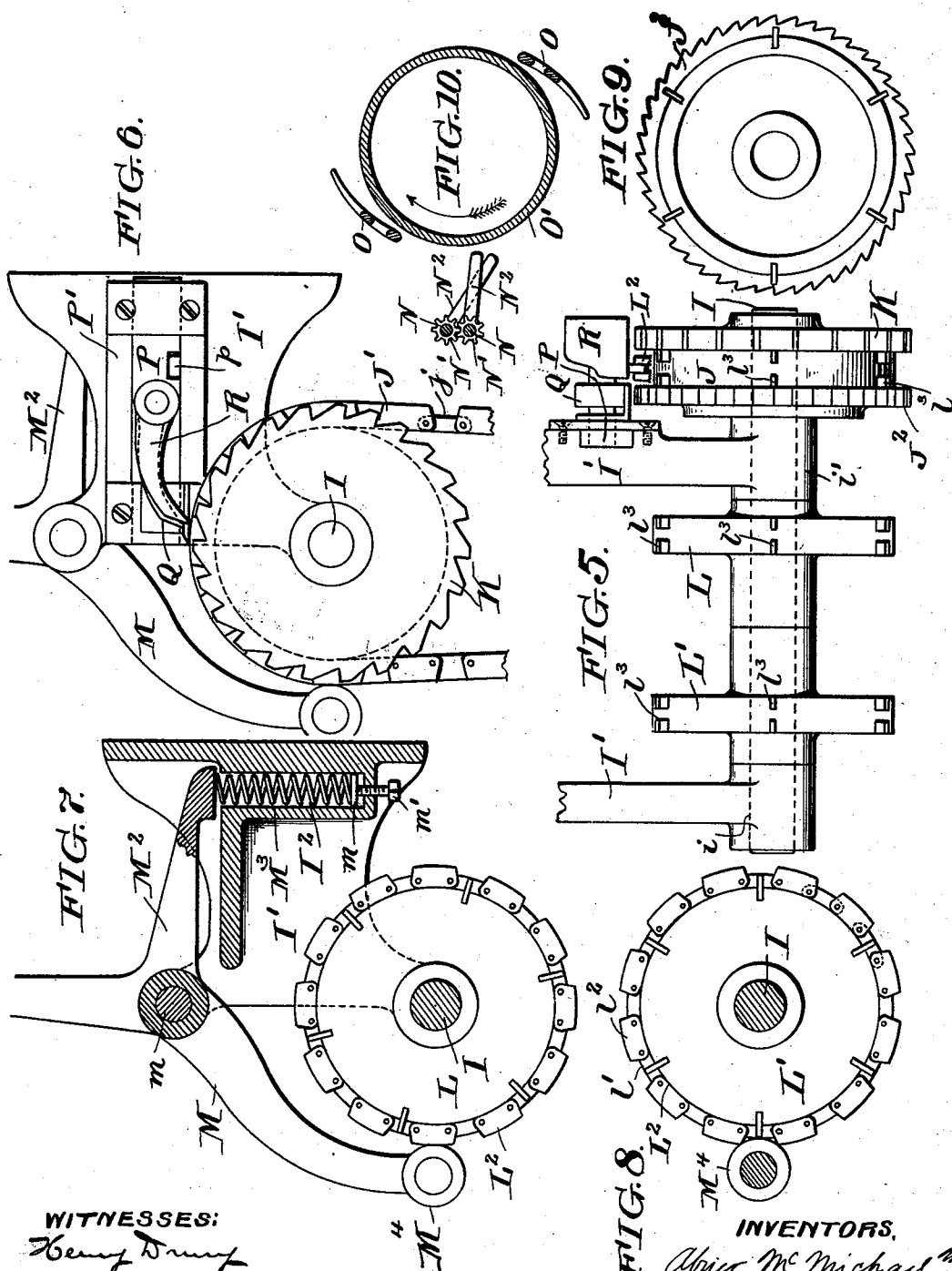
(No Model.)

3 Sheets—Sheet 3.

A. McMICHAEL & F. B. WILDMAN.
CIRCULAR KNITTING MACHINE.

No. 508,965.

Patented Nov. 21, 1893.



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UNITED STATES PATENT OFFICE.

ABNER McMICHAEL AND FRANK B. WILDMAN, OF NORRISTOWN,
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CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 508,965, dated November 21, 1893.

Application filed May 4, 1893. Serial No. 472,931. (No model.)

To all whom it may concern:

Be it known that we, ABNER McMICHAEL and FRANK B. WILDMAN, of the city of Norristown, Montgomery county, State of Pennsylvania, have invented an Improvement in Circular-Knitting Machines, of which the following is a specification.

Our invention relates to circular knitting machines, and consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings.

More particularly our invention relates to automatic knitting machines, in which the needles are controlled by movable needle directing cams which are automatically actuated by a pattern chain.

Our improvements relate particularly to the devices for automatically operating the needle directing cams of the horizontal needle dial, for the purpose of drawing the needles in or moving them farther out, in the manner well known in the art of knitting.

Our invention is not concerned with the particular construction of the knitting machine itself or of the movable needle directing cams but relates wholly to the devices for automatically moving such cams in a circular knitting machine.

Our improvements are designed to accomplish greater efficiency in operation with simplicity in the construction of the mechanism employed.

We shall now refer to the accompanying drawings for the purpose of particularly explaining the construction and mode of operation of our improved devices.

In the drawings: Figure 1 is a side elevation of a circular knitting machine having our improvements applied to it with the base frame in section. Fig. 2 is a similar view of the lower portion of the machine illustrating a modification of our invention. Fig. 3 is a sectional plan view of the machine on the line $x-x$ of Fig. 1. Fig. 4 is an inverted plan view of the cam dial. Fig. 5 is a front elevation of a portion of the cam controlling mechanism on an enlarged scale. Fig. 6 is an enlarged end elevation of the same. Fig. 7 is a vertical sectional view of the same on the line $y-y$ of Fig. 3 also on an enlarged

scale. Fig. 8 is a detail view of one of the toothed wheels for controlling the cam actuating levers. Fig. 9 is a detail view of the pattern ratchet for driving the pattern chain; and Fig. 10 is a horizontal sectional view on a reduced scale of the lower portion of the machine taken on the line $z-z$ of Fig. 1.

As has been previously stated our invention relates particularly to the devices for operating the movable cams of the cam dial to control the horizontal needles and the particular construction of the knitting machine in other respects is immaterial to our invention.

In the drawings for the purposes of illustration, we have shown a knitting machine of well known construction having our improvements applied to it.

A is the ordinary stationary bed plate.

B is the cross head from which the stationary cam dial C and the rotary needle dial D are suspended.

E is the rotary needle cylinder which carries the vertical needles.

The horizontal needle dial D and vertical needle cylinder E constitute the rotary knitting head of the machine.

F is the stationary cam ring which contains the usual cams for operating the vertical needles.

G is the annular bevel gear which carries the needle cylinder and is operated by a bevel pinion G' on the counter shaft g in the usual manner.

G^2 is an annular base plate carried by the depending frames G^3 of the rotary gear plate G and guided in the annular base frame H.

O' is the annular guide frame for the finished fabric carried by the plate G^2 .

The dial C is provided with appropriate stationary and movable cams to act upon the heels of the horizontal needles and move the needles in or out as the character of the knitting may require. Such cams are particularly shown in the plan view of the inverted dial Fig. 4. In that figure, a are the stationary cam grooves or guides for the needles and b are the movable directing cams which are shown as grooved cams pivoted as at b' adjacent to the grooves a and movable in and out. These cams b receive the needles as they pass

from the grooves *a* and carry them in or out. In the drawings four of such movable cams *b* are shown, two of which are operatively connected with the mechanism for moving them, 5 but it is immaterial to our invention whether one or more of such movable cams are used, as it is applicable equally to two or more feeds.

As shown in the drawings the invention is 10 applied to a four feed machine, the alternate cams *b* being operated. If desired two adjacent cams may be operated, instead of two opposite or alternate ones, by connecting the operating mechanism with two adjacent cams 15 instead of with the alternate cams. Each cam which is to be operated is connected by a pin *b*² through a slot *b*³ with the operating rod *B*¹ or *B*².

c are the thread guides upon the dial *C* located adjacent to the cams *b* so as to feed the thread at the points where the horizontal needles are operated by the cams.

So far as we have described the machine it is of well known construction.

25 We shall now particularly describe our improvements, which for purposes of illustration we have shown applied to the machine described.

I is a shaft journaled in suitable bearings 30 in a bracket *I*¹ carried by the main frame of the machine.

J is a pattern chain wheel loosely journaled on the shaft *I*.

35 J¹ is the pattern chain carried by the pattern chain wheel *J*.

J² is a ratchet wheel secured to the sprocket wheel *J*.

K is a second ratchet wheel fast upon the shaft *I* and adjacent to the sprocket wheel *J*.

40 L and L¹ are toothed wheels or disks fast upon the shaft *J* so as to rotate with it.

M, M¹ are bell cranks fulcrumed as at *m* on the bracket *I*¹. One end of each bell crank bears upon one of the toothed wheels L, L¹ so as to be rocked by the teeth thereof, and the other end is connected (preferably by a pin and slot connection) with one of the cam operating rods B¹, B². Each toothed wheel L or L¹ acting upon its appropriate bell crank M or M¹ operates the corresponding rod B¹ or B² and moves the cam *b* to which that rod is connected. 50

With the construction shown the teeth of the wheels L, L¹ are so disposed relatively to one another, that the two bell cranks are simultaneously operated in opposite directions, a tooth of one wheel acting upon the free end of the bell crank to move it out, while the free end of the other bell crank sinks into a recess 60 between a pair of teeth on the other wheel and is moved in. This opposite operation of the two bell cranks produces a corresponding opposite simultaneous shifting of the rods B¹, B² and causes them to operate the two cams *b*, *b* similarly with reference to the dial and needles by reason of their location at opposite sides of the dial, as is shown in Fig. 4. The 65

needles controlled by the two cams *b*, *b* are thus acting at any time in the same manner.

To maintain the free ends of the bell cranks 70 M, M¹ in close contact with the toothed peripheries of the wheels L, L¹ so as to be always actuated, they may be provided with springs acting to press them in contact with the wheels. In Fig. 7 we have shown our preferred construction for applying this spring pressure to the bell cranks. Each bell crank is provided with a projecting arm M² which is acted upon by a spring M³ contained in a recess I² in the bracket or frame I¹. These springs acting 80 upon the arms M² of the bell cranks hold their free ends in contact with the toothed peripheries of the wheels L, L¹. To permit the adjustment of the springs M³ to regulate their tension their lower ends may be supported 85 upon movable blocks *m* which may be adjusted by screws *m*¹.

While it is not material to our invention in what manner the toothed wheels L, L¹ are constructed we prefer to employ the construction shown in which the toothed peripheries are composed of chains L² composed of high and low links L¹, L². These links are also preferably arranged alternately single and in pairs, the single links L¹ fitting between lugs 95 L³ on the peripheries of the disks of the wheels, which thus serve to hold the chains in place. The pattern chain J¹ may be similarly constructed of links arranged alternately single and in pairs, with the single links lying between the lugs L³ on the periphery of the wheel *J*. The links of the pattern chain are however all of the same height except at such points as it is desired to operate the cams *b*, *b* to change the positions of the needles, at 105 which points the pattern chain is formed with a low link *j* which thus constitutes a notch in the chain for the purpose herein-after explained. The free ends of the bell cranks M may be provided with antifric tion 110 rollers or idlers M⁴ which run in contact with the peripheries of the wheels L, L¹.

We shall now describe the mechanism for operating the shaft *I* and toothed wheels L, L¹ for the purpose of moving the cams *b*, *b*. 115 N, N are two shafts journaled vertically in suitable bearings *n* carried by the frame of the machine and having their upper ends extending up into or near the bracket I¹. The lower ends of these shafts are provided with 120 pinions N¹, N¹ which are geared together so that the shafts will rock together and in opposite directions. The lower ends of the shafts are provided each with a projecting arm N², arranged one slightly above the other. 125 O, O are cams carried by the frame of the machine as by the base plate G² and rotating with it. The cams O, O are arranged at slightly different heights one above the other, the upper one being adapted to strike the upper arm N² and the lower one the lower arm. P is a slide carried in a suitable guide P¹ in the bracket I¹ and located adjacent to the sprocket wheel *J* and the ratchets J² and K. 130

This slide is operatively connected with a small crank arm *p* (dotted lines in Fig. 3) carried by one of the shafts *N*, so that upon each rocking movement of the shaft *N* the slide *P* is moved back and forth. *Q* is a pawl carried by the slide *P* and engaging the teeth of the ratchet *J*², so that each reciprocation of the slide *P* rotates the ratchet *J*² the distance of one tooth. As the sprocket wheel *J* is connected with the ratchet wheel *J*² it is moved with it and carries the pattern chain. As the cams *O*, *O* rotate in the direction of the arrow in Fig. 10 they alternately strike the arms *N*² and rock the shafts *N*. As these shafts are rocked together in opposite directions by reason of their connection through the pinions *N'*, *N'*, when the arm *N*² of one shaft is struck by its cam *O* and moved by it, the arm *N*² of the other arm is moved into position to be struck by the other cam *O*, and when it is in turn struck and moved by its cam the first arm *N*² is brought back into position to be struck by the first cam. Thus the shafts *N*, *N* are constantly rocked back and forth, and through the slide *P* and pawl *Q* and ratchet *J*² the pattern chain is operated. *R* is a second pawl wider than the pawl *Q* adapted to engage the teeth of the ratchet *K*, but projecting over the sprocket wheel *J*, so as to rest upon the surface of the pattern chain *J'*, the links of which project above the teeth of the ratchet *K*, and thus hold the pawl *R* out of engagement with the ratchet teeth. When however, a low link *j* or a notch in the pattern chain *J'* comes under the pawl *R*, the pawl is permitted to drop into engagement with one of the teeth of the ratchet and as it is moved forward by the slide *P*, it rotates the ratchet *K* the distance of one tooth and correspondingly turns the shaft *I* and toothed wheels *L*, *L'* and operates the rods *B'*, *B*² and the cams *b*, *b* in the manner described. As the pattern chain *J* continues to move and the notch *j* passes from under the pawl *R*, the pawl is again lifted and held out of engagement with the teeth of the ratchet *K* until the next notch *j* reaches it. The cams *b*, *b* thus remain in their last adjusted positions until they are again moved in the manner just described.

We prefer to construct the ratchet *J*² which drives the pattern chain *J'* with twice the number of teeth of the ratchet *K* which controls the cam operating devices, as by this means we are enabled to employ a shorter pattern chain.

From the foregoing description the operation of the machine will be readily understood. The yarn is fed by the guides *c* to the needles in the usual manner. As the needles are carried by the rotary needle dial and cylinder they are operated by the respective cams to take the thread and form the fabric in the well known manner. The character of the fabric produced is governed by the pattern chain which is carried upon the sprocket wheel *J* operated in the manner described. The operation of the needles con-

tinues in a uniform manner as in plain knitting or otherwise, until a notch *j* in the pattern chain comes under the pawl *R* when the latter immediately operates the ratchet and shaft *I* with its wheels *L*, *L'* and in the manner described moves the cams and thus draws the needles in or out as the case may be and correspondingly changes the character of the fabric produced. When the cams have been so changed the needles continue to operate in the same manner until the next notch *j* in the pattern chain passes under the pawl *R*, when they are moved back and correspondingly change the extent of movement of the needles and the character of the fabric produced.

We have shown one form of mechanism for operating the slide *P* in which two shafts *N*, *N* geared together were employed. In Fig. 2 we have shown a modified construction in which a single shaft is used. This shaft *S* is journaled vertically in a bearing *s* in the lower part of the machine and as in the former case with one of the shafts *N* will be operatively connected with the slide *P* by a crank *p*. The lower end of the shaft *S* is provided with an arm *S'* which runs in contact with a continuous cam *S*² on the lower part of the machine preferably on the tubular frame *O'*. The arm *S'* may be kept in contact with the cam *S*² by a spring as shown. With this construction the single shaft will be rocked back and forth through the cam *S*² and the arm *S'* and will reciprocate the slide *P* substantially as in the construction employing the two shafts *N*, *N*. In each case it will be observed that the operation of the pattern mechanism and cam connections is controlled wholly from the lower portion of the machine below the base plate.

It is apparent that it is wholly immaterial to our invention whether two movable cams be employed in the cam dial with a double feed as is particularly shown in the drawings, or whether a single needle directing cam be used with a single feed. In the latter case one of the rods *B'*, *B*², bell cranks *M*, *M'* and toothed wheels *L*, *L'* would be omitted.

It is also to be understood that our invention is in no way limited to any particular construction or arrangement of the needle directing cams operated by one of the devices of our invention, or to any of the minor details of construction which have been shown for the purpose of more clearly explaining our invention and may be varied without in any way departing from it.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a knitting machine, the combination with the rotary knitting head embracing the vertical needle cylinder and horizontal needle dial, of a cam dial, a movable cam for the horizontal needles of the needle dial, carried by the cam dial, mechanism for moving the cam to control the movements of the horizon-

tal needles, the base plate carried by the knitting head and moving with it, a pattern chain a rotary pattern chain wheel, driving devices for operating the pattern chain wheel extending below the base plate carried by the knitting head, cam devices located below the base plate and rotating with it to operate the driving devices for the pattern chain wheel, and devices controlled by the pattern chain for operating the mechanism for moving the needle controlling cam, whereby the operation of the needle is controlled from below the base plate of the machine.

2. The combination of the rotary knitting head embracing the needle cylinder and dial and having a depending frame extending below the base plate of the machine, actuating cams carried by the depending frame below said base plate, the cam dial and movable cam for the horizontal needles, and a train of devices comprising actuating and controlling elements between said movable cam and actuating cams and having provisions adapted to be acted upon by the latter.

3. In a knitting machine, the combination with the rotary knitting head embracing the vertical needle cylinder and the horizontal needle dial, of a cam dial, a needle directing cam for the needles of the horizontal needle dial carried by the cam dial, mechanism for moving the needle directing cam to control the operation of the needles, a rotary pattern chain wheel, a pattern chain carried thereby, a ratchet connected with the pattern chain wheel, a reciprocating slide, driving connections between the reciprocating slide and the rotary frame of the knitting head, a pawl to operate the ratchet carried by the reciprocating slide, a second ratchet for operating the mechanism for moving the needle directing cam, and a second pawl for operating the second ratchet carried by the reciprocating slide and resting on the pattern chain so as to be controlled directly by it.

4. In a knitting machine, the combination with the rotary knitting head embracing the vertical needle cylinder and the horizontal needle dial, of a cam dial, a needle directing cam for the needles of the horizontal needle dial carried by the cam dial, mechanism for moving the needle directing cam to control the operation of the needles, a rotary pattern chain wheel, a pattern chain carried thereby, a ratchet connected with the pattern chain wheel, a reciprocating slide, driving connections between the reciprocating slide and the rotary frame of the knitting head, a pawl to operate the ratchet carried by the reciprocating slide, a second ratchet for operating the mechanism for moving the needle directing cam having a smaller number of teeth than the first ratchet, and a second pawl for operating the second ratchet carried by the reciprocating slide and resting on the pattern chain so as to be controlled directly by it.

5. In a knitting machine, the combination with the rotary knitting head embracing the

vertical needle cylinder and the horizontal needle dial, of a cam dial, a needle directing cam for the needles of the horizontal needle dial carried by the cam dial, mechanism for moving the needle directing cam to control the operation of the needles, a rotary pattern chain wheel, a pattern chain carried thereby, a ratchet connected with the pattern wheel, a reciprocating slide, a pawl carried by the reciprocating slide for driving the ratchet, the vertical rock shafts N, N geared together so as to rock simultaneously and oppositely, operative connections between one rock shaft and the reciprocating slide, arms N² N² carried by the shafts N, N, cams O, O adapted to alternately strike the arms N², N², carried by the rotary frame of the knitting head, and connections for operating the mechanism for moving the needle directing cam controlled by the pattern chain.

6. In a knitting machine, the combination of a rotary knitting head embracing the vertical needle cylinder and the horizontal needle dial, of a cam dial, one or more movable needle directing cams for operating the horizontal needles of the needle dial carried by the cam dial, one or more bell cranks M having one arm operatively connected with the needle directing cam, a rotary shaft I, one or more toothed wheels carried by the shaft I and arranged to act upon the free arms of the bell cranks, a pattern chain wheel loose on the shaft I, a pattern chain carried thereby, a ratchet J² fast on the pattern chain wheel, a ratchet K fast on the shaft I, a reciprocating slide P, a pawl Q carried by the slide P and operating the ratchet J² and pattern chain wheel, a pawl R also carried by the slide P and adapted to operate the ratchet K and shaft I resting on the pattern chain and controlled directly by it, a rock shaft operatively connected with the slide P, and cam devices carried by the rotary frame of the knitting head to rock said rock shaft.

7. In a knitting machine, the combination of a rotary knitting head embracing the needle cylinder and dial, the cam dial, and movable cam for operating the needles, a shaft I, a ratchet J² loose on the shaft I, a pattern chain wheel carried with the ratchet, a pattern chain carried by the pattern chain wheel, a ratchet K fast on the shaft I, mechanism for operating the movable needle directing cam part of which is carried by the shaft I, a slide P, a pawl Q carried by the slide P and engaging the ratchet J², a second pawl R controlled by the pattern chain also carried by the slide P and engaging the ratchet K, the vertical rock shafts N, N geared together and having the arms N² N² adapted to be operated by the rotary knitting head, and an operative connection between the shafts N, N and the slide P.

8. In a knitting machine, the combination of the knitting head embracing the needle cylinder and dial, the cam dial, the movable needle directing cam carried by the cam dial,

the stationary frame I', the rocking lever M
pivoted to the frame I' connected at one end
to the movable needle directing cam and hav-
ing the arm M², the spring M³ located within
5 a recess in the frame I' and acting on the arm
M², and pattern controlled mechanism to op-
erate the lever M.

In testimony of which invention we have
hereunto set our hands.

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