Apr. 10, 1923. 1,450,946

A. GAGNÉ

OPEN OR LACE WORK KNITTING MACHINE

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Fig. 1.

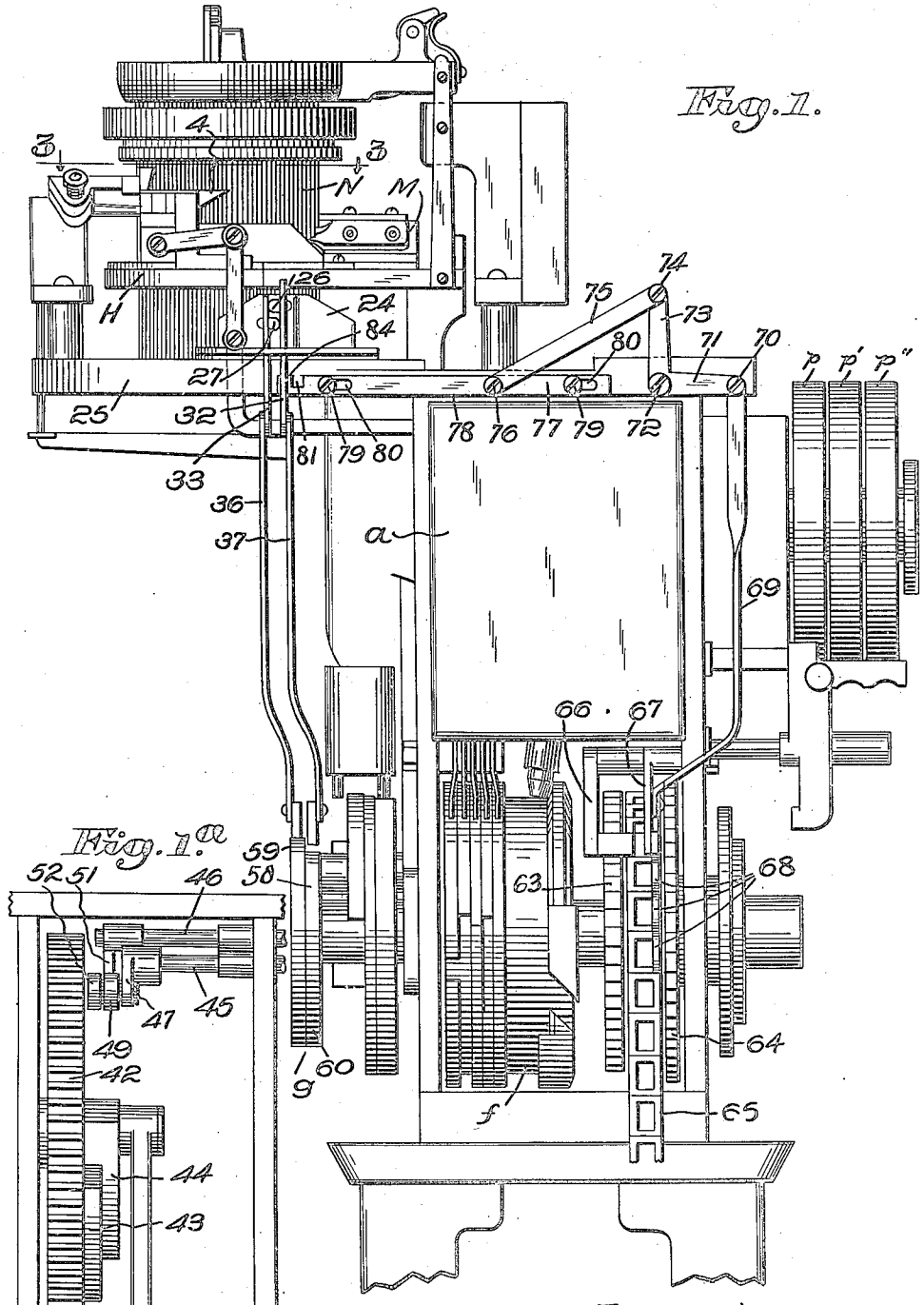


Fig. 1a

Inventor:
Augustin Gagné,
by Emery, Booth, Janney and Varney
Attys.

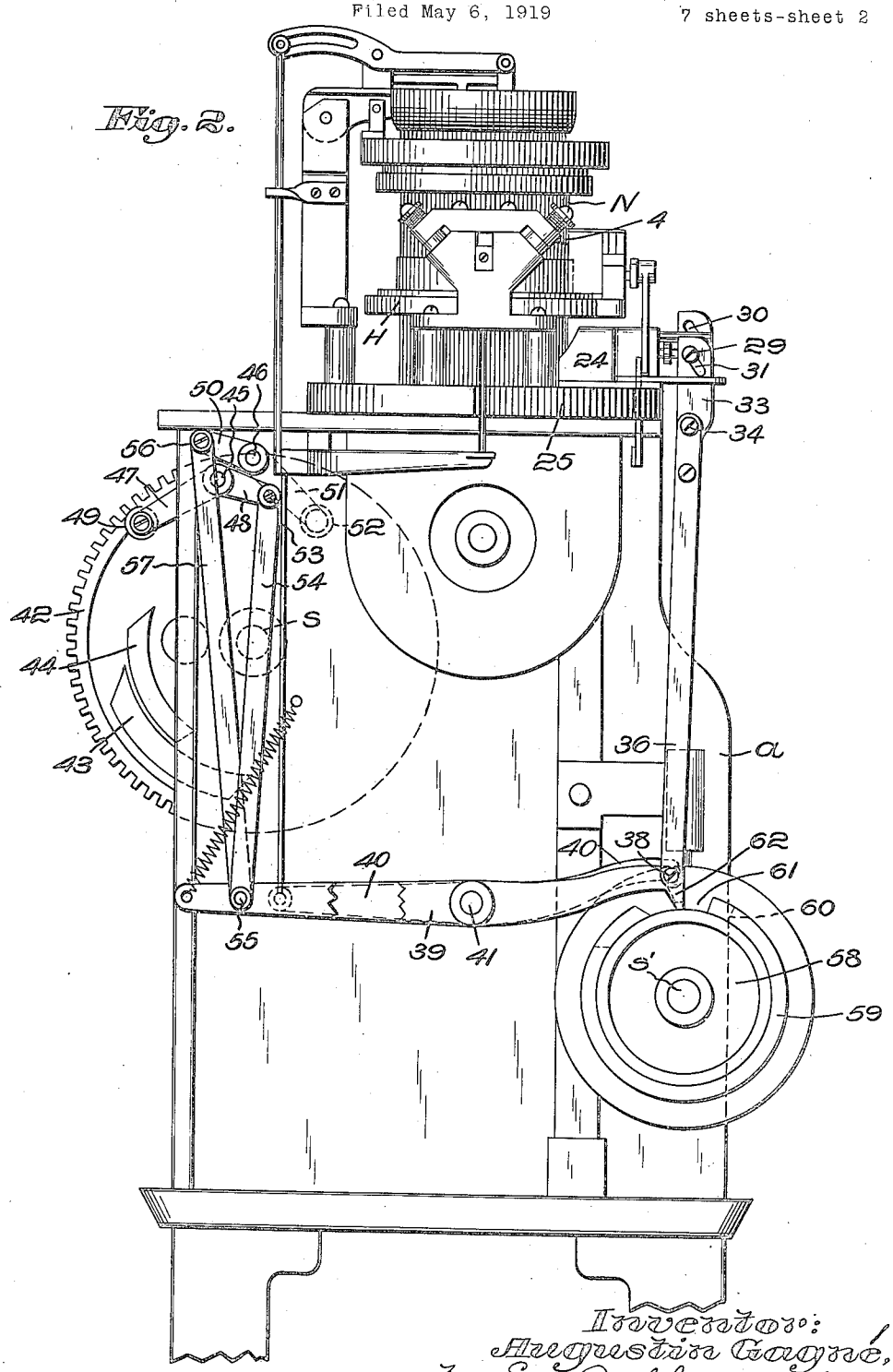
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A. GAGNE

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Fig. 2.



Inventor:
Augustin Gagné,
by Emery, Booth, Jamey and Vaney
Attys

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A. GAGNÉ

OPEN OR LACE WORK KNITTING MACHINE

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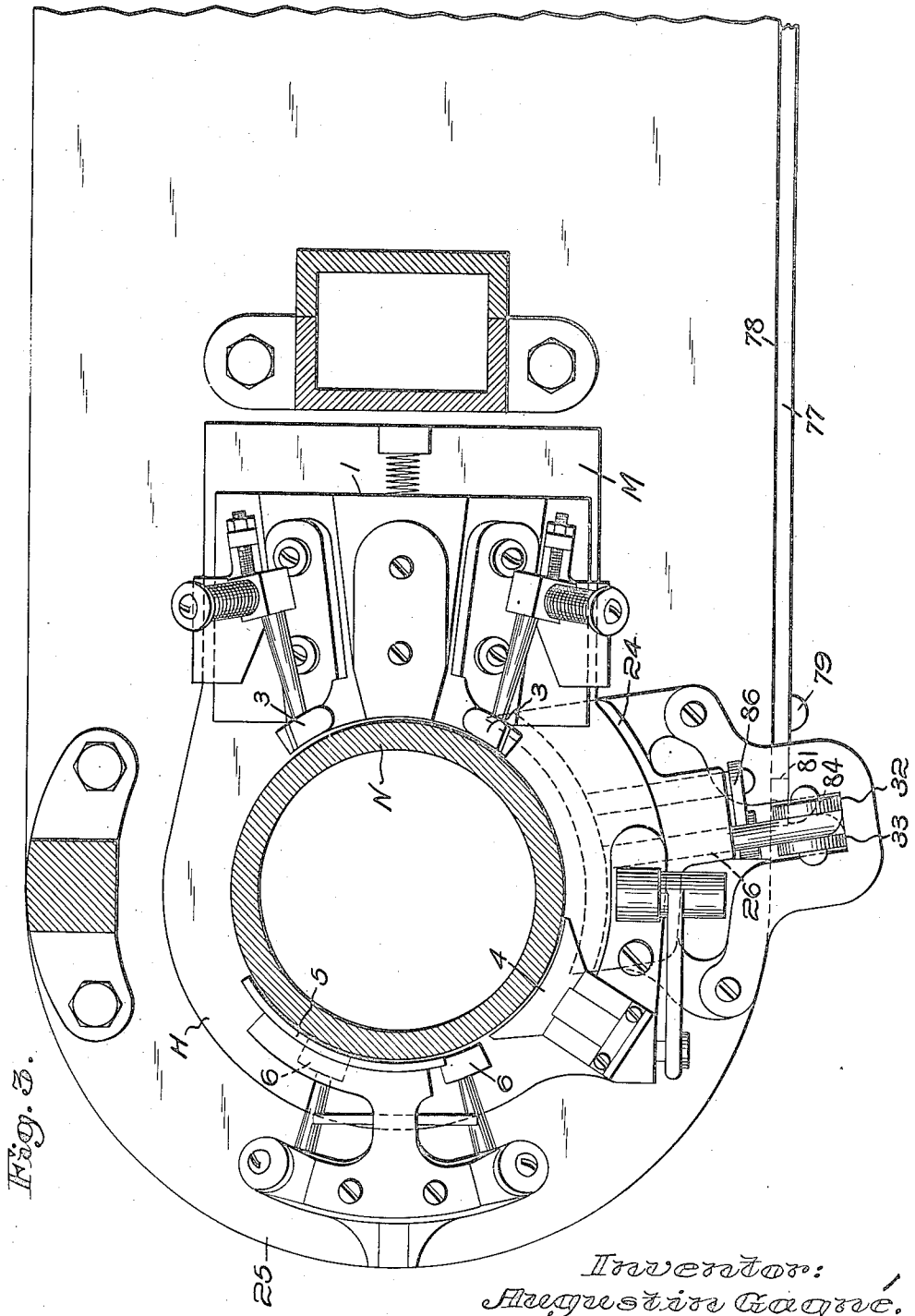


Fig. 3.

Inventor:
Augustin Gagné.
by Emery, Booth, Janney and Varney
Attys.

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A. GAGNÉ

OPEN OR LACE WORK KNITTING MACHINE

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Fig. 4a

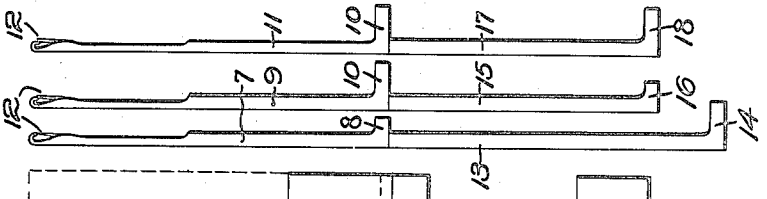
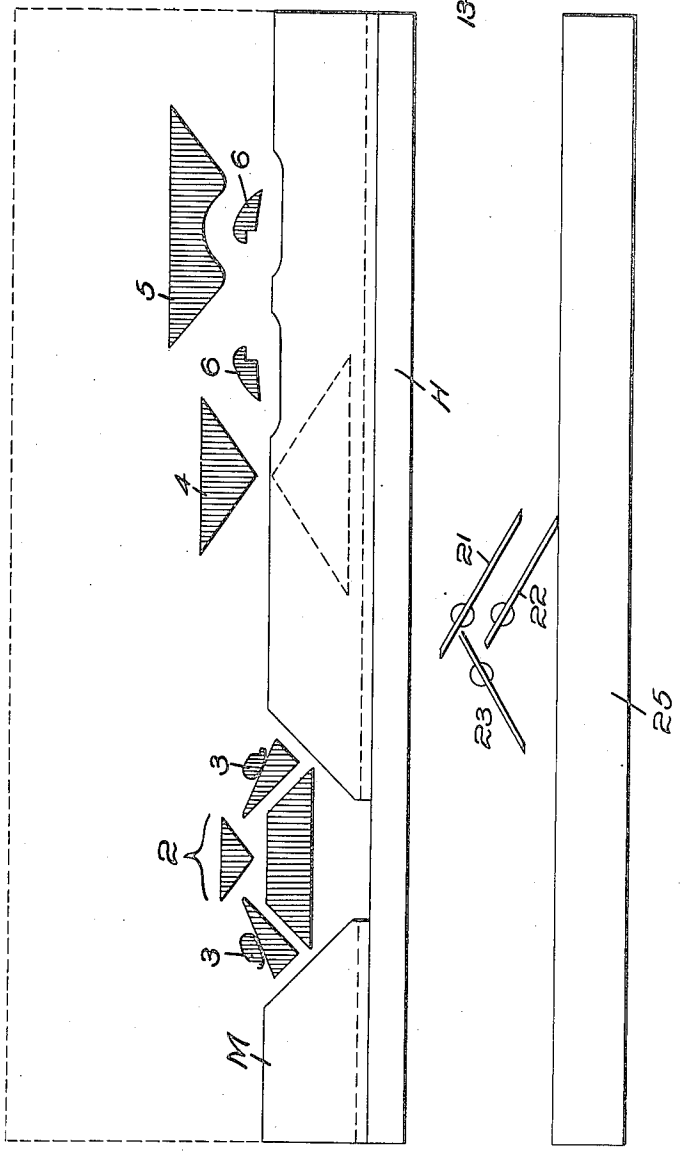


Fig. 4.



Inventor:
Augustin Gagné,
by Emery, Booth, Janney and Varney
Attys

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A. GAGNÉ

OPEN OR LACE WORK KNITTING MACHINE

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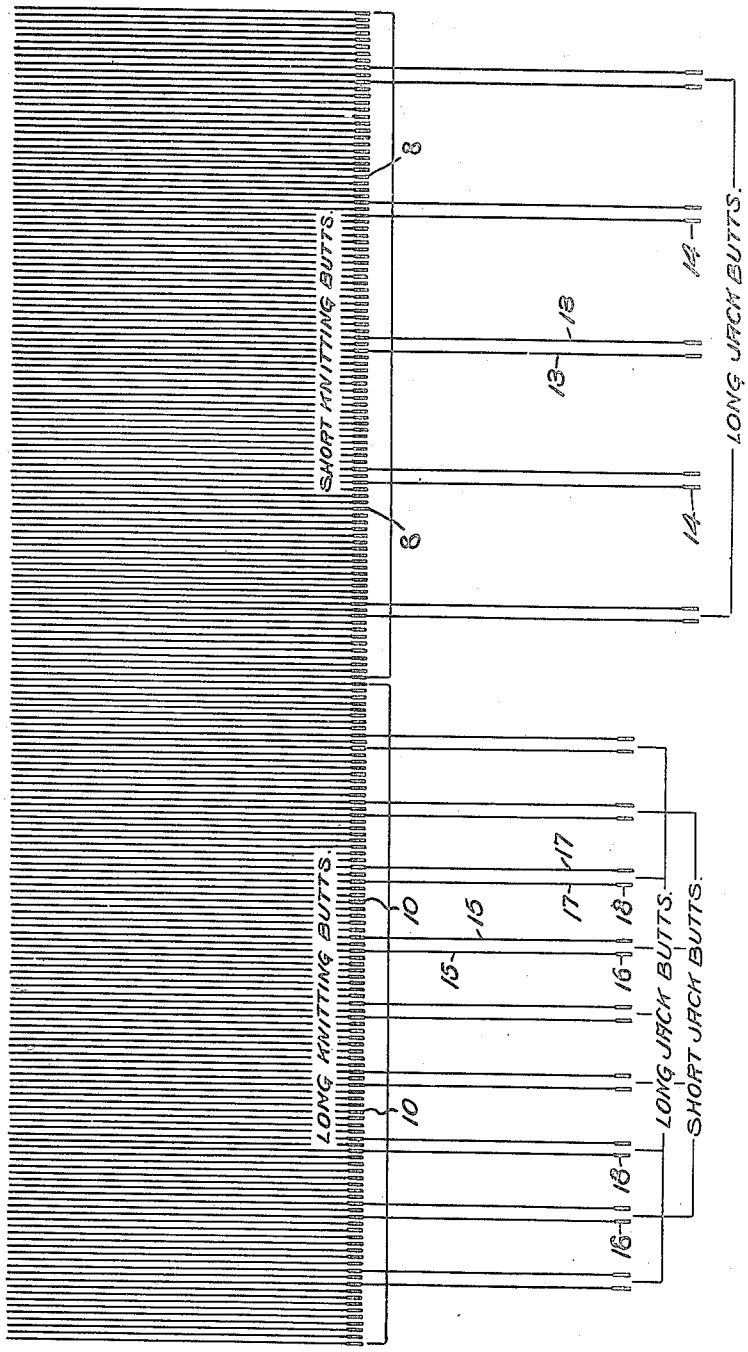


Fig. 5.

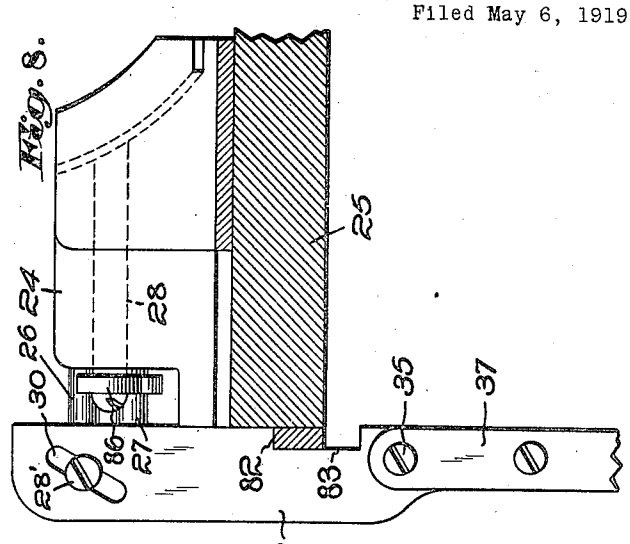
Inventor:
Augustin Gagné,
by Emery Booth, Janney and Vaney
Attys.

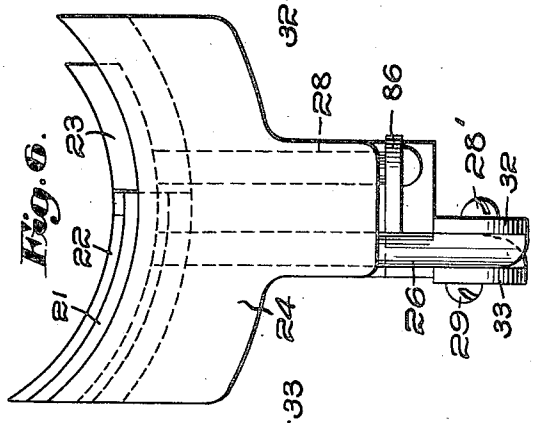
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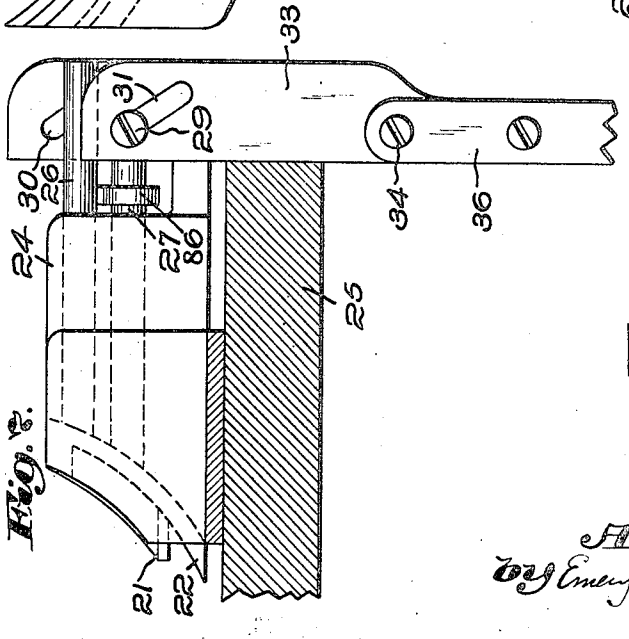
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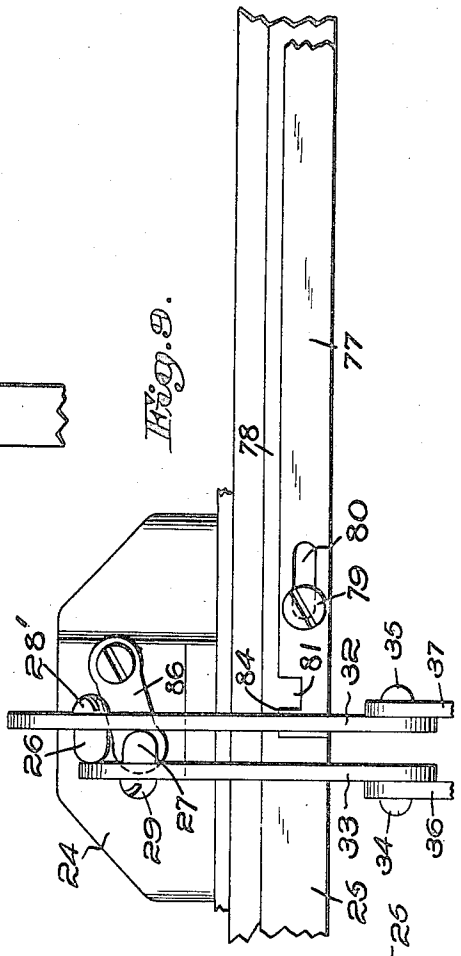
OPEN OR LACE WORK KNITTING MACHINE

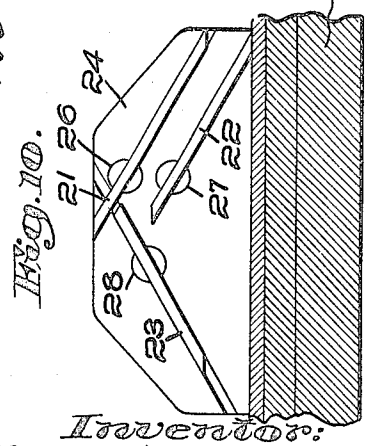
Filed May 6, 1919 7 sheets-sheet 6











Inventor:
Augustin Gagné,
by Emery, Booth, Janney and Varney,
Attys

Apr. 10, 1923. 1,450,946

A. GAGNÉ

OPEN OR LACE WORK KNITTING MACHINE

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Fig. 11.

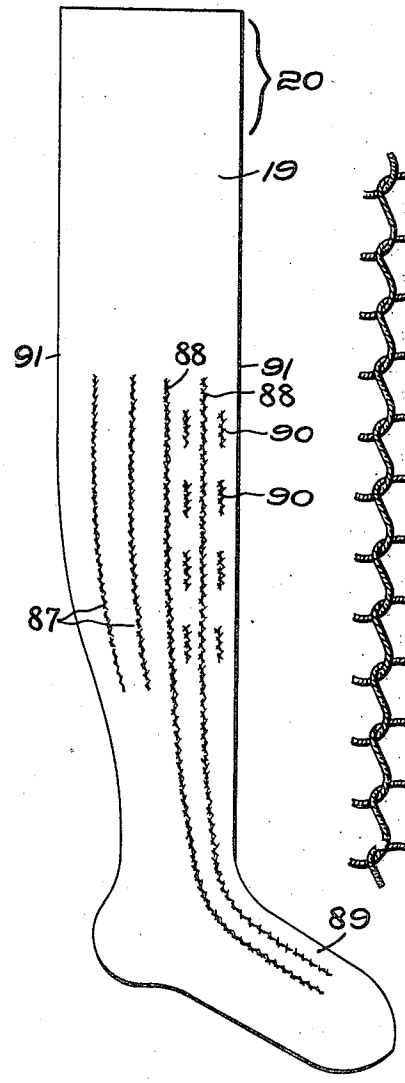
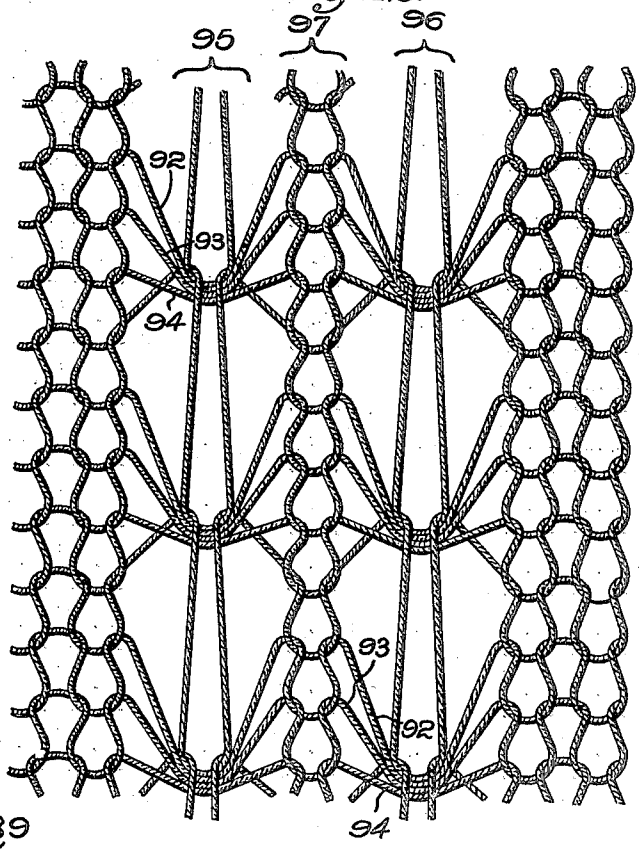


Fig. 12.



Inventor:
Augustin Gagné,
by Emery, Booth, Janney and Varney,
Attys.

Patented Apr. 10, 1923. 1,450,946

UNITED STATES PATENT OFFICE.

AUGUSTIN GAGNÉ, OF CENTRAL FALLS, RHODE ISLAND, ASSIGNOR TO HEMPHILL COMPANY, OF CENTRAL FALLS, RHODE ISLAND, A CORPORATION OF MASSACHUSETTS.

OPEN OR LACE WORK KNITTING MACHINE.

Application filed May 6, 1919. Serial No. 295,120.

To all whom it may concern:

Be it known that I, AUGUSTIN GAGNÉ, a subject of the King of Great Britain, and a resident of Central Falls, in the county of Providence and State of Rhode Island, have invented an Improvement in Open or Lace Work Knitting Machines, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to knitting machines and more particularly to machines for knitting hosiery with so-called open work or lace effects caused by structural variations of any suitable character in the knitted fabric. In order that the principle of the invention may be readily understood, I shall describe one embodiment of my invention, to which, however, the same is in no wise limited.

In the drawings,—

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

Fig. 1ª is a detail of certain parts shown in Fig. 2;

Fig. 2 is an end elevation thereof;

Fig. 3 is a horizontal section thereof upon the line 3—3 of Fig. 1;

Fig. 4 represents a development of the cams to act upon the needles and jacks;

Fig. 4ª is a side elevation representing the various needles and jacks employed in this embodiment of my invention;

Fig. 5 is a development of the needles and jacks employed in this embodiment of my invention, with no attempt, however, to represent the exact number of either;

Fig. 6 is a plan view of a bracket wherein are mounted the jack controlling cams;

Fig. 7 is a left side elevation of said bracket and of a part of the means for acting upon said cams;

Fig. 8 is a right side elevation thereof;

Fig. 9 is a front elevation thereof;

Fig. 10 is an elevation or face view from the inside of the cylinder of the jack-controlling cams;

Fig. 11 is a side elevation, somewhat diagrammatic, of a stocking constructed by the knitting machine of my invention; and

Fig. 12 is an enlarged detail representing the knitted loops providing the open or lace work effect in accordance with this embodiment of my invention.

My invention may be embodied in many different types of knitting machines and is not limited in this respect. I have chosen to represent my invention as embodied in a circular knitting machine of the so-called Banner type, one form of which is disclosed in the patent to Hemphill, No. 933,443, September 7, 1909, to which reference may be made for a complete disclosure of parts herein unnecessary to set forth in detail.

I shall proceed to describe my invention as applied to a machine of the Banner type, but it is to be understood that such specific description is in no sense a limitation of the scope of the invention.

Inasmuch as certain general parts of the mechanism herein shown may be and preferably are the same as those shown in the said patent to Hemphill, No. 933,443, I have designated such parts by the same reference characters that are employed in the said patent. Thus, the machine frame is marked *a*, the rotatable needle cylinder is marked N, the non-rotatable cam carrier is marked H, and the annular portion or ledge of the cam carrier is marked M. The pulleys for the driving band are marked respectively *p*, *p'* and *p''* in Fig. 1 (quick speed, slow speed and loose), and at *s* in Fig. 2 is indicated the main shaft on which the said pulleys are mounted. The pattern shaft is indicated in Fig. 2 at *s'*, *f* and *g* being the pattern or cam drums or barrels upon the said shaft. Upon said drum or barrel *f* is preferably provided a pattern ring engaging the clutch shifting lever whereby the clutch is shifted so as to operate by rotary or round and round knitting throughout the formation of the leg and preferably the foot of the stocking, and by reciprocating knitting throughout the formation of the heel and toe in a manner not herein necessary more fully to describe. In the disclosed application or embodiment of my invention, the needle cylinder rotates and reciprocates and the cam ring is stationary, but obviously the reverse construction and operation may be employed. Moreover my invention may be embodied and practiced in other types of machines, such for example as those

adapted to knit so-called split foot hosiery, or in machines that reciprocate throughout, as in the production of gloves or of full fashioned stockings, or in so-called straight machines of the independent needle type. So far as my invention is concerned, it is merely necessary to provide for a relative movement between the needle carrier and the needle operating cams.

Upon the usual cam block diagrammatically indicated at 1 are mounted the usual stitch cams shown in outline at 2 in Fig. 4 and upon said cam block are also preferably mounted the usual narrowing pickers 3. At a suitable point upon the cam ring is mounted the usual instep cam 4 to lower all the needles and there is also preferably provided the levelling cam 5 and also the widening pickers 6, 6, here shown as two in number, and preferably constructed and operating substantially as shown in the said patent to Hemphill. If desired, a single widening picker may be employed instead and operated in a manner not herein necessary more fully to describe.

In practicing my invention, so far as the present embodiment thereof is concerned, I preferably provide needles, all having the same length of latch, as indicated in Fig. 4ª and arrange them in five groups as follows:

First, needles without jacks but having long knitting butts. These needles are positioned to knit the front of the stocking.

Second, needles without jacks but having short knitting butts. These needles are positioned to knit the back of the stocking.

Third, needles with short jacks but having long jack butts. These needles are positioned preferably in groups of two at intervals to knit at the front of the stocking.

Fourth, needles with short jacks and having short jack butts. These needles are positioned singly between the two members of each group of said needles with short jacks having long jack butts;

Fifth, needles with long jacks and having long jack butts. These needles are positioned preferably in groups of two at intervals to knit at the back of the stocking.

While I refer to needles as having jacks, it is obvious that needles with suitable extensions may be provided instead. I prefer, however, to have jacks separate from the needles, permitting separate control thereof, as in returning the needles to action for plain knitting.

In Fig. 4ª, I have represented at 7 a needle having a short knitting butt 8, at 9 a needle having a long knitting butt 10, and at 11 another needle having a long knitting butt 10, all of these needles having latches 12 of equal length. Cooperating with the needle 7 is represented a long jack 13 having a long jack butt 14. Cooperating with the needle 9 is a short jack 15 having a short jack butt 16 and cooperating with the needle 11 is a short jack 17 having a long jack butt 18. The said jacks are not connected to the needles in this embodiment of my invention, but act to elevate the needles by a pushing action from below, the needles being lowered by suitable cams as hereinafter set forth. As already stated, suitable extensions upon the needles may be employed instead of jacks.

It will be understood from the foregoing that needles similar to the needles 9 but without jacks are employed to knit the front of the stocking where plain knitting is performed, that needles similar to the needles 7 but without jacks are employed to knit the back of the stocking where plain knitting is performed, that the needles 7 having jacks 13 are employed in said groups of two in producing the so-called open-work or lace effect in stripes at the front of the stocking, that needles 9 having jacks 15 are employed singly in knitting the front of the stocking and between the jacks 13, and that the needles 11 having the jacks 17 are employed in groups of two to knit at the back of the stocking.

In order to control the said several groups of needles I provide any suitable mechanism. It will be understood that the knitting cams 2 act upon all the needles in the production of plain knitting and that therefore if some part of the stocking or other fabric be knitted wholly in plain knitting, as, for example, the upper part 19 of the stocking 20 shown in Fig. 1, that all the needles cooperate in producing the same.

When it is desired to produce the so-called open-work or lace effect, by which I mean any structural variation that will cause such or a like effect, the needles that are temporarily rendered inactive are in this embodiment of the invention elevated beyond the reach of the knitting cams 2 or as may be more broadly stated, are removed from the action of said knitting cams 2, this being done in any suitable manner.

Herein for the purpose I have provided suitable cams which act upon the butts of the needle jacks so as to push the needles pertaining to the respective jacks above the reach of the knitting cams 2, from which position they are restored to the control of the knitting cams by the instep cam 4, which in this embodiment of my invention is located somewhat to the left, viewing Fig. 3, of the jack controlling cams hereinafter described, and between the same and the widening pickers.

Referring more particularly to Fig. 4 and to Figs. 6 to 10 inclusive, I have therein represented two radially movable cams 21, 22, the former serving to elevate the short jacks and the latter serving to elevate the long

jacks, and therefore the needles controlled thereby. In addition I provide a third radially movable cam 23 which is connected as hereinafter described with the cam 22 and acts to lower at the proper time (and in this embodiment of my invention immediately), the jacks which have been elevated by the cam 22, leaving the needles that were elevated by said jacks, to be lowered by the instep cam 4, and then immediately to be again elevated by the cam 22 through the agency of the long jacks, if said cam 22 is still in action, and to be acted upon by the knitting cams if said cam 22 has been removed from action. The jacks that are elevated by the upper cam 21 are at the proper time lowered by the instep cam 4 which pushes down the needles pertaining to said jacks, which needles in turn push down their jacks, to be re-elevated if the said cam 21 is still in action. If said cam 21 is not in action, then the said needles are acted upon by the knitting cams and produce regular knitting.

The upper cam 21, in this embodiment of my invention, has three positions. When it is moved radially inward to its full extent, it acts upon the short butts 16 of the jacks 15 and also upon the long butts 18 of the jacks 17, thereby elevating beyond the action of the knitting cams the needles 9 and 11. When said upper cam 21 is half way in, that is, when it occupies an intermediate radial position, it acts only upon the long butts 18 of the short jacks 17 and hence elevates only the needles 11 above the knitting cams 2. When said upper cam 21 is in its outermost radial position, it does not act upon any of the jacks and hence all the needles, at any other time controlled by this cam, produce regular knitting.

The lower cam 22, in this embodiment of my invention, has two positions. When said cam 22 occupies its inner radial position, it acts on the butts 14 of the long jacks 13 and hence elevates the needles 7 beyond the knitting cams 2. When said cam 22 occupies its outer radial position, it does not act upon any of the jacks and hence all the needles, at any time controlled by said cam 22, produce regular knitting.

I will now describe one form of means whereby said cams 21 and 22 are given their several positions. The cams 21, 22 and 23 are supported in a bracket 24 shown most clearly in Figs. 7 to 10 inclusive, as mounted upon the part 25 of the bed of the machine. The said cams are respectively mounted in said bracket preferably for in and out or radial movement with respect to the centre of rotation of the needle cylinder and are herein shown as all arranged at an incline as most clearly represented in Figs. 4 and 10. They may, however, be removed from action in any suitable way. To each of said cams is connected a horizontal rod respectively numbered 26, 27, 28 adapted to slide in the bracket 24 and from near the outer ends of the rods 26, 27 laterally project screws 28′, 29 that enter inclined slots 30, 31 respectively, in upright slides or bars 32, 33, which are secured by screws 34, 35, to the upper end of links 36, 37. Said links are at their lower ends pivotally secured by pins, one of which is shown at 38 in Fig. 2, to levers 39, 40, pivoted upon the framing of the machine at 41.

Upon the gear shaft *s* of the machine is fast a gear 42 having thereon face cams 43, 44 at different radial distances from the shaft *s*. Upon the frame of the machine are mounted two shafts 45, 46, the former 45 having fast thereon a lever having arms 47, 48, the arm 47 at its free end having a roll 49, and the latter 46 having thereon a bell crank lever with arms 50, 51, the arm 51 at its free end being provided with a roll 52. The roll 49 is adapted to be acted upon by the cam 43 and the roll 52 is adapted to be acted upon by the cam 44 so as to swing said bell crank levers upon their pivotal points 45, 46.

The lever arm 48 at its outer end 53 is pivotally connected to a link 54, the lower end of which is pivotally connected at 55 to the lever 39, and the lever arm 50 at its outer end 56 is pivotally connected to a link 57 which at its lower end is connected to the lever 40.

The construction and operation of parts are such that the elevation of either roll 49, 52 depresses the corresponding link 54, 57, and thereby elevates the corresponding link 36, 37 so as to act upon the rods 26, 27 through the inclined slots 30, 31, and hence to move the cams 21, 22 in and out, thereby positioning them in their defined positions at the proper times.

Inasmuch as the gear 42 is constantly rotated, it is evident that the cams 43, 44 would act upon the levers 39, 40 periodically throughout the formation of the entire stocking or other fabric, with the result that the open or lace-work stripes or effects would be produced throughout the entire length of the stocking, or other fabric, were not means provided to prevent at times the functioning of the levers 39, 40 and the parts controlled thereby. To this end, any suitable means may be provided. For the purpose, I have represented the shaft *s′* as having thereon beyond the drum *g* to the left viewing Fig. 1, a disk 58 having cams 59, 60 extending part way only circumferentially thereabout, so as to leave a space or spaces 61 Fig. 2 permitting the heads 62 of the levers 39, 40 to enter thereinto. When the said lever heads 62 ride upon the cams 59, 60, the links 36, 37 and the slides 32, 33 are elevated to their high-

est extent, and hence the cams 21, 22 are moved radially outward to their extreme extent and are rendered inactive. When the shaft s' has rotated sufficiently to permit the heads of the levers 39, 40 to ride in the depression 61, the levers 39, 40 may then be acted upon by the cams 43, 44 so as at the desired and proper times to move the cams 21, 22 radially inward, the cam 22 being moved inward to its full extent, and the cam 21 being moved inward to its full extent, or to its intermediate position.

I will now describe one form of means for positioning the cam 21 in its intermediate position, but desire it to be understood that any other suitable means may be employed.

As shown most clearly in Fig. 1, the shaft s' (itself shown in Fig. 2) is provided with ratches 63, 64 similar to the corresponding parts in the Hemphill Patent No. 933,443, and with a pattern chain 65 controlled thereby in a manner not necessary more fully to describe. Upon a suitable stud upon the framing of the machine is provided a pawl 66 controlling said ratchet 63 and also the pawl 67 controlled by three lugs 68 upon said pattern chain and adapted to swing said pawl upon its pivot and thereby to elevate at the proper times a link 69 connected to said pawl at its lower end and at its upper end pivoted at 70 to the arm 71 of a bell crank lever pivoted at 72 and having its arm 73 pivoted at 74 to a link 75 that at its opposite end is pivoted at 76 to a horizontal slide 77 guided upon the part 78 of the framing of the machine by means of pins or screws 79 upon the framing entering elongated horizontal slots 80 in said slides. Near its inner end the said slide 77 is provided in its upper edge with a notch or cut-out portion 81, which when brought into line with the slide 32 as shown most clearly in Figs. 8 and 9, is adapted to receive a horizontal shoulder 82 formed by providing a notch 83 in the adjacent edge of the said slide 32.

When the slide 77 is moved by one of the lugs 68 upon the pattern chain into its innermost position so that the notch 81 is brought into line with the slide 32, then the said slide 32 is permitted to descend to its lowest position and through the action of the inclined slot 30 the cam 21 is moved radially inward to its full extent. When the slide 77 is moved to the right so as to bring it into the position shown in Fig. 1, and so that the shoulder 82 is received upon the upper edge 84 of said slide, then the slide 32 is brought into its intermediate position, or that shown in Fig. 8, and through the agency of the inclined slot 30, the cam 21 is brought into its intermediate position.

It will be observed that the slide 77 cooperates only with the slide 32, since the slide 33 has, in this embodiment of the invention, only the two positions corresponding to the two positions of the cam 22.

The cam 23 is provided for the purpose of lowering the needle jacks that have been elevated by the cam 22, and it partakes of the same movements as said cam 22. To that end it is provided with a rod 28 connected by link 86 to the rod 27, so as to move therewith.

In Fig. 11, I have shown a stocking 19 provided at certain points with lace-work stripes or effects. Herein I have represented the calf of the stocking, that is, the rear half of the stocking at the calf, as provided with vertical stripes 87, and I have represented the front of the stocking as provided with vertical stripes 88 which are herein represented as extending down into the foot 89 thereof. It is to be understood, however, that the lace effect may be provided at any desired point and as long or short stripes, or even as spots or marks, this depending upon the position of the cams 21, 22. I have also represented the stocking 19 as having at the front thereof between certain of the stripes 88 short stripes 90 which may also be provided at the back of the stocking or at any desired part thereof.

The top of the stocking is preferably knitted plain. When the knitting has progressed to substantially the line 91, 91, the upper cam 21 is moved to its intermediate position with the result that it acts only on the long butts of the short jacks 13, which, as already stated, are arranged in groups of two, so as to knit at the front of the stocking and produce the stripes 88. The detail construction of these stripes, as constructed in accordance with this embodiment of the invention, is represented in Fig. 12, from an inspection of which it will clearly appear that during three successive courses, the loops 92, 93, 94 are held and are then cast off with the fourth course, so as to make a series of tuck stitches along the lines 95, 96. Between said vertical lines of tuck stitches 96 is a single wale 97 of regular knitting, which is produced by the needle controlled by the jack 15, as indicated in Fig. 5; that is to say, a short jack having a short jack butt. Obviously any other form of tuck stitch or of other stitch resulting in a suitable structural variation from plain knitting may be employed instead, and the production thereof is within the scope of my invention.

When the top cam 21 is moved into its full extent, it acts upon not only the short jacks 17 having the long butts 18, but also upon the short jacks 15 having the short

butts 16, with the consequence that not only are the stripes 88 continuous, but the interspersed short stripes 90 are formed.

The stripes 87 at the rear of the stocking are, as previously stated, controlled by the cam 22 and are produced when said cam is moved inward so as to act upon the butts 14 of the long jacks 13.

Although I have described the cams 21, 22 as acting upon the butts of needle jacks, it is to be understood that the said cams may be so arranged as to act upon the needles themselves, and that many changes may be made within the scope and spirit of my invention.

Although I have described my invention in connection with the production of hosiery, it is to be understood that it is not limited in this respect, but may be used in the production of any knitted fabric, such, for example, as underwear, or even of hand coverings.

While I have specifically described an open or lace-work effect formed by tuck stitches, I desire it to be understood that such effects may be otherwise produced, as, for example, by drop stitches or by draw stitches, or in any other suitable manner, whereby structural variations are caused in the fabric, and the knitting is changed from regular knitting.

Having thus described one illustrative embodiment of my invention, I desire it to be understood that although specific terms are employed, they are used in a generic and descriptive sense and not for purposes of limitation, the scope of the invention being set forth in the following claims.

Claims:

1. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with contrasting length formations, knitting cams, means to impart relative movement to said parts, a tuck stitch elevating cam adapted to move needles out of action of the knitting cams, means to place said tuck stitch cam in a plurality of radial positions for action or non-action upon certain of said formations, and a second tuck stitch elevating cam active upon certain needles only.

2. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with contrasting length formations, knitting cams, means to impart relative movement to said parts, a plurality of tuck stitch cams to move needles out of action of the knitting cams, and means to place each of said plurality of cams in a plurality of different radial positions for action or nonaction upon certain of said formations.

3. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts, needles without jacks and arranged in two groups having long and short butts respectively needles with short jacks having long and short butts respectively, and arranged with relation to their length of butts, and needles with long jacks having butts, and one or more lace or open-work cams adapted by acting upon the butts of the needle jacks to control the formation of the lace or open-work effect.

4. Knitting mechanism adapted to produce so-called open or lace-work effect comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts, needles without jacks and arranged in two groups having long and short butts respectively, needles with short jacks having long and short butts respectively, and needles with long jacks having long jack butts, and a plurality of lace or open-work cams to act upon said jack butts, and means to vary the position of said lace or open-work cams, thereby to control their action upon said jack butts.

5. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts a set of needles having equal length latches but having contrasting length butts for action thereon by lace or open-work cams, and a plurality of radially movable open or lace-work cams adapted to act upon selected needles of a corresponding plurality of groups, while retaining their loops, to produce open or lace-work effects.

6. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts, needles provided with different length butts, and a lace or open-work cam having means to place the said cam in any one of three different radial positions and thereby to act upon certain needles, while said needles retain their loops or to be rendered inactive and a second lace or open work cam, and means to cause the same to act only upon certain loop retaining needles not acted upon by the first mentioned lace or open work cam.

7. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts, needles having different length butts a lace or open-work cam having means to place the same in an inner, an outer or an intermediate radial position,

and thereby to act upon one or two groups of needles or to be inactive with respect to both of said needles and a second lace or open work cam, and means to cause the same to act only upon certain loop retaining needles not acted upon by the first mentioned lace or open work cam.

8. Knitting mechanism comprising in combination, a needle cylinder, a cam ring having knitting cams, means to impart relative rotation to said cylinder and cam ring, certain of said needles having co-acting needle-prolongating means of different length provided with butts of different length and a plurality of open or lace work effect cams to act upon respectively different sets of said butts, together with means to place each of said cams in a plurality of different positions with respect to said butts.

9. Knitting mechanism comprising in combination, a needle cylinder, needles provided with a different length of butts, a cam ring having knitting cams, means to impart relative rotation to said cylinder and cam ring, a pair of tucking cams each pertaining to its own set of needles only and adapted periodically to move certain needles out of the path of action of said knitting cams, and pattern means to position said pair of cams in different radial positions for action or non-action upon said butts.

10. Knitting mechanism comprising in combination, a needle cylinder, a cam ring having knitting cams, means to impart relative rotation to said cylinder and cam ring, needles without jacks but having long butts to knit the front of the stocking produced by the knitting mechanism, needles without jacks but having short butts to knit the back of the stocking produced by the knitting mechanism, needles with short jacks having long jack butts, and needles with short jacks having short jack butts interspersed among said needles without jacks but having the long knitting butts, and needles with long jacks and having long jack butts interspersed among said needles without jacks but having short butts, and means to act upon the butts of said jacks.

11. Knitting mechanism comprising in combination, a needle cylinder, a cam ring having knitting cams, means to impart relative rotation to said cylinder and cam ring, needles without jacks but having long butts to knit the front of the stocking produced by the knitting mechanism, needles without jacks but having short butts to knit the back of the stocking produced by the knitting mechanism, needles with short jacks having long jack butts, and needles with short jacks having short jack butts interspersed among said needles without jacks but having the long knitting butts, and needles with long jacks and having long jack butts interspersed among said needles without jacks but having short butts, a plurality of cams to act upon said jack butts, and automatic means to place said latter cams in a plurality of different positions.

12. Knitting mechanism comprising in combination, a needle carrier, stitch cams, means to impart relative movement to said parts, needles without jacks but having long butts to knit a part of the fabric produced by the knitting mechanism, needles without jacks but having short butts to knit another part of the fabric produced by the knitting mechanism, needles with short jacks having long jack butts, and needles with short jacks having short jack butts interspersed among said needles without jacks but having the long knitting butts, and needles with long jacks and having long jack butts interspersed among said needles without jacks but having short butts, a plurality of cams to act upon said jack butts and automatic means to place said latter cams in a plurality of different radial positions, thereby to control the action of said cams upon said jack butts.

13. Knitting mechanism comprising in combination, a needle cylinder, a cam ring having knitting cams, means to impart relative rotation to said cylinder and cam ring, needles without jacks but having long butts to knit the front of the stocking produced by the knitting mechanism, needles without jacks but having short butts to knit the back of the stocking produced by the knitting mechanism, needles with short jacks long jack butts, and needles with short jacks having short jack butts interspersed among said needles without jacks but having the long knitting butts, and needles with long jacks and having long jack butts interspersed among said needles without jacks but having short butts, a plurality of cams to act upon said jack butts, automatic means to place one of said cams in either an active or inactive position, and automatic means to place another of said cams in either of two different active positions or in an inactive position.

14. Knitting mechanism adapted to produce so-called open or lacework effects comprising in combination, a knitting cylinder, needles provided with different length butts, knitting cams, means to impart relative rotation to said cylinder and cams, a pair of tuck cams each adapted to act upon its own set of needles only and adapted to move such needles out of action of said knitting cams, automatic means to move one of said cams radially into either an active or inactive position, and automatic means to move the other of said cams into either of two different active radial positions or in an inactive position.

15. Knitting mechanism adapted to produce so-called open or lace work effects com-

prising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a lace or open work cam adapted to move certain needles out of action of the knitting cams without dropping their loops, means to place said lace or open work cam in a plurality of radial positions for action or non-action upon certain of said butts, and a second lace or open work cam adapted to move out of action of the knitting cam without dropping their loops, needles other than those acted on by the first mentioned lace or open-work cam.

16. Knitting mechanism adapted to produce so-called open or lace work effects comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts, needles without co-acting prolongating means therebelow and arranged in two groups having long and short butts respectively, needles with short coacting prolongating means therebelow, said co-acting prolongating means having long and short butts respectively and arranged with relation to the length of butts, and needles with long co-acting prolongating means therebelow having butts and one or more lace or open work cams adapted to be acting upon the butts of said co-acting prolongating means to control the formation of the lace or open work effect.

17. Knitting mechanism adapted to produce lace work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a plurality of tuck stitch cams each adapted to move needles pertaining respectively and only thereto out of action of the knitting cams, and means to place each of said plurality of cams in a plurality of different radial positions for action or non-action upon said different length butts.

18. Knitting mechanism adapted to produce lace work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a plurality of tuck stitch cams adapted to move needles out of action of the knitting cams while retaining their loops, means to place said tuck stitch cams in a plurality of radial positions for action or non-action upon said butts and means to render said last mentioned means ineffective during any desired part of the knitting.

19. Knitting mechanism adapted to produce so-called open or lace work effects comprising in combination, a needle carrier, knitting cams, means to impart relative movement to said parts, a plurality of radially movable slides, one having a lace or open work cam adapted to move needles out of action of the knitting cams and also having a needle restoring cam, and the other slide having an open work cam to move other needles out of action.

20. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a tuck stitch cam adapted to move certain needles out of action of the knitting cams, means to place said tuck stitch cam in a plurality of radial positions for action or non-action upon certain of said butts, and a second tuck stitch cam adapted to act only upon certain needles not acted upon by the first mentioned tuck stitch cams.

21. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a tuck stitch cam adapted to move certain needles out of action of the knitting cams, means to place said tuck stitch cam in a plurality of radial positions for action or non-action upon certain of said butts, and a second tuck stitch cam adapted to act only upon certain needles not acted upon by the first mentioned tuck stitch cams, together with means to position said second mentioned tuck stitch cam in a plurality of different radial positions for action or non-action upon certain of said butts.

22. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a plurality of tuck stitch cams to move needles out of action of the said knitting cams, each of said tuck stitch cams being adapted to act only upon needles unacted upon by the other tuck stitch cam, and means to place each of said plurality of cams in a plurality of different radial positions for action or non-action upon said butts.

23. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a plurality of tuck stitch cams to move needles out of action of the said knitting cams, each of said tuck stich cams being adapted to act only upon needles unacted upon by the other tuck stitch cam, and means to place each of said plurality of cams in a plurality of different radial positions for action or non-action upon said butts, and means distinct from said plurality of tuck stitch cams to move the

needles in a direction opposite to that in which they are moved by said tuck stitch cams.

24. Knitting mechanism adapted to produce so-called open or lace-work effects comprising in combination, a needle carrier, needles provided with different length butts, knitting cams, means to impart relative movement to said parts, a plurality of tuck stitch cams adapted to elevate needles out of action of the knitting cams, each of said tuck stitch cams being adapted to act only upon needles not acted upon by the other tuck stitch cam, means to place each of said plurality of tuck stitch cams in a plurality of different radial positions for action or non-action upon said butts, and means distinct from said plurality of tuck stitch cams to depress the said needles subsequent to their elevation by said tuck stitch cams.

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

AUGUSTIN GAGNÉ.