

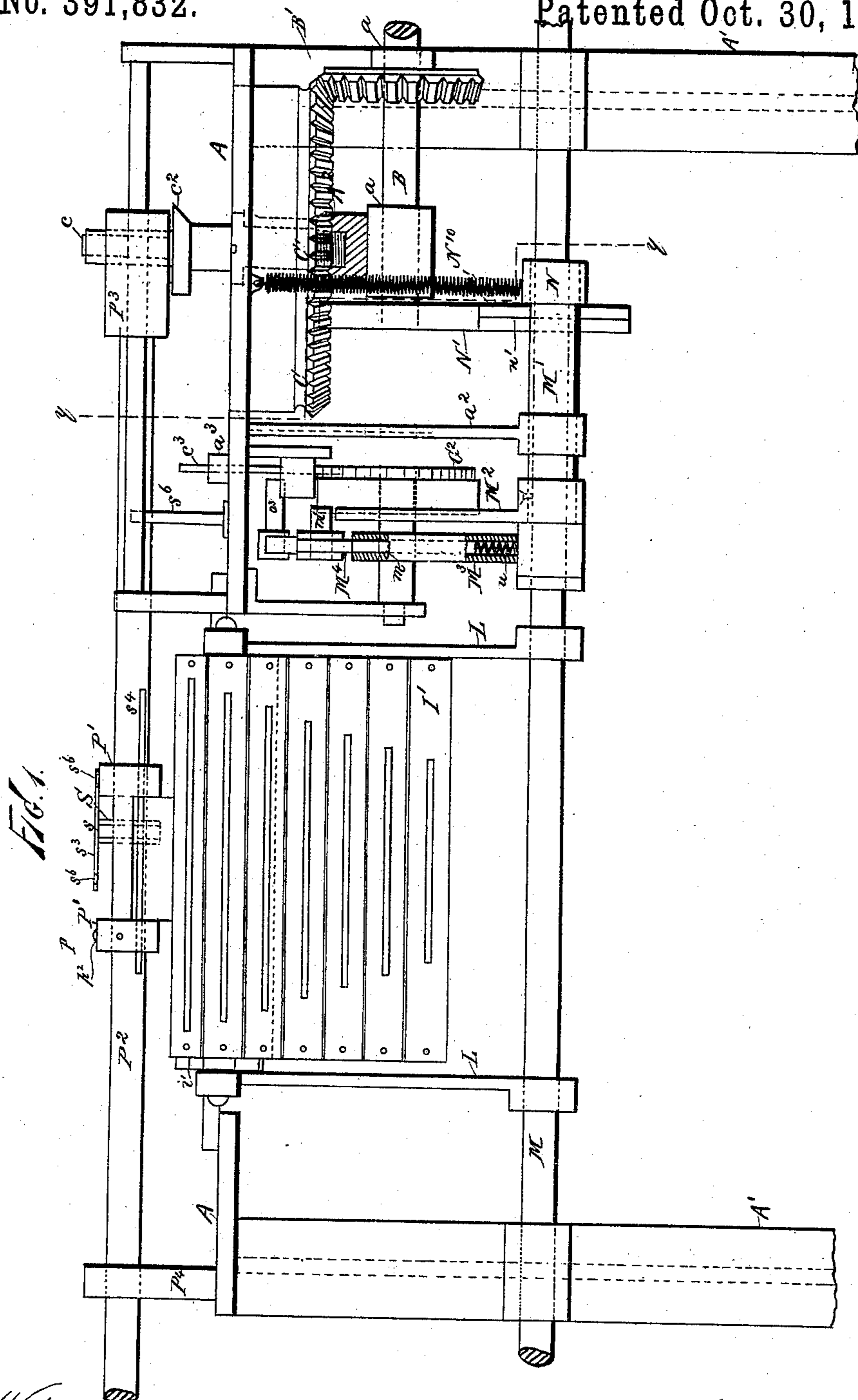
(No Model.)

4 Sheets—Sheet 1.

C. J. APPLETON.
STRAIGHT KNITTING MACHINE.

No. 391,832.

Patented Oct. 30, 1888.



Witnesses:
John Buckler,
George Hodgkinson.

Inventor:
Charles J. Appleton,
By *M. J. Appleton*,
Attorney.

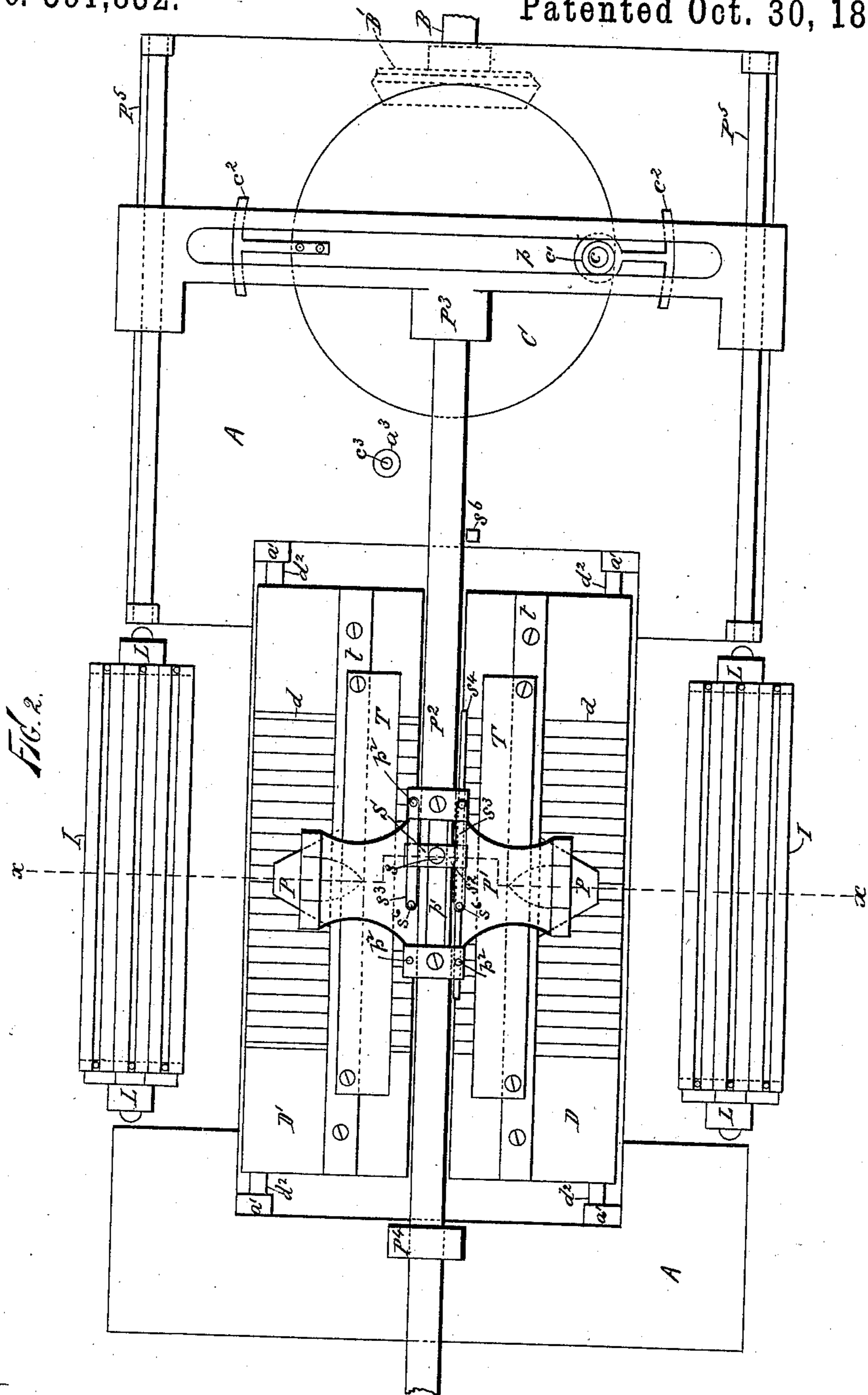
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4 Sheets—Sheet 2.

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John Buckle,
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Inventor:
Charles J. Appleton,
By *Wm. Appleton*
Attorney.

(No Model.)

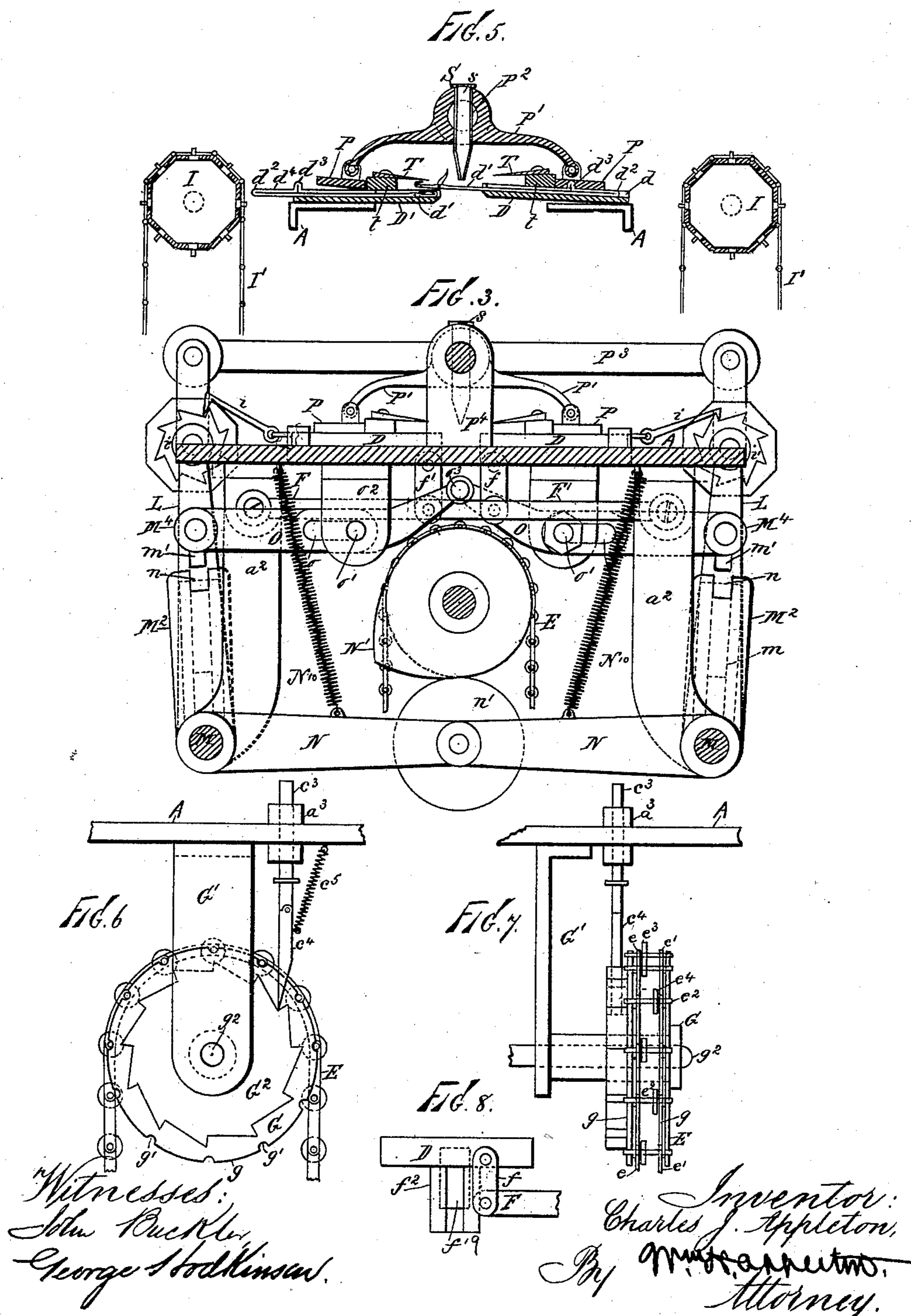
4 Sheets—Sheet 3.

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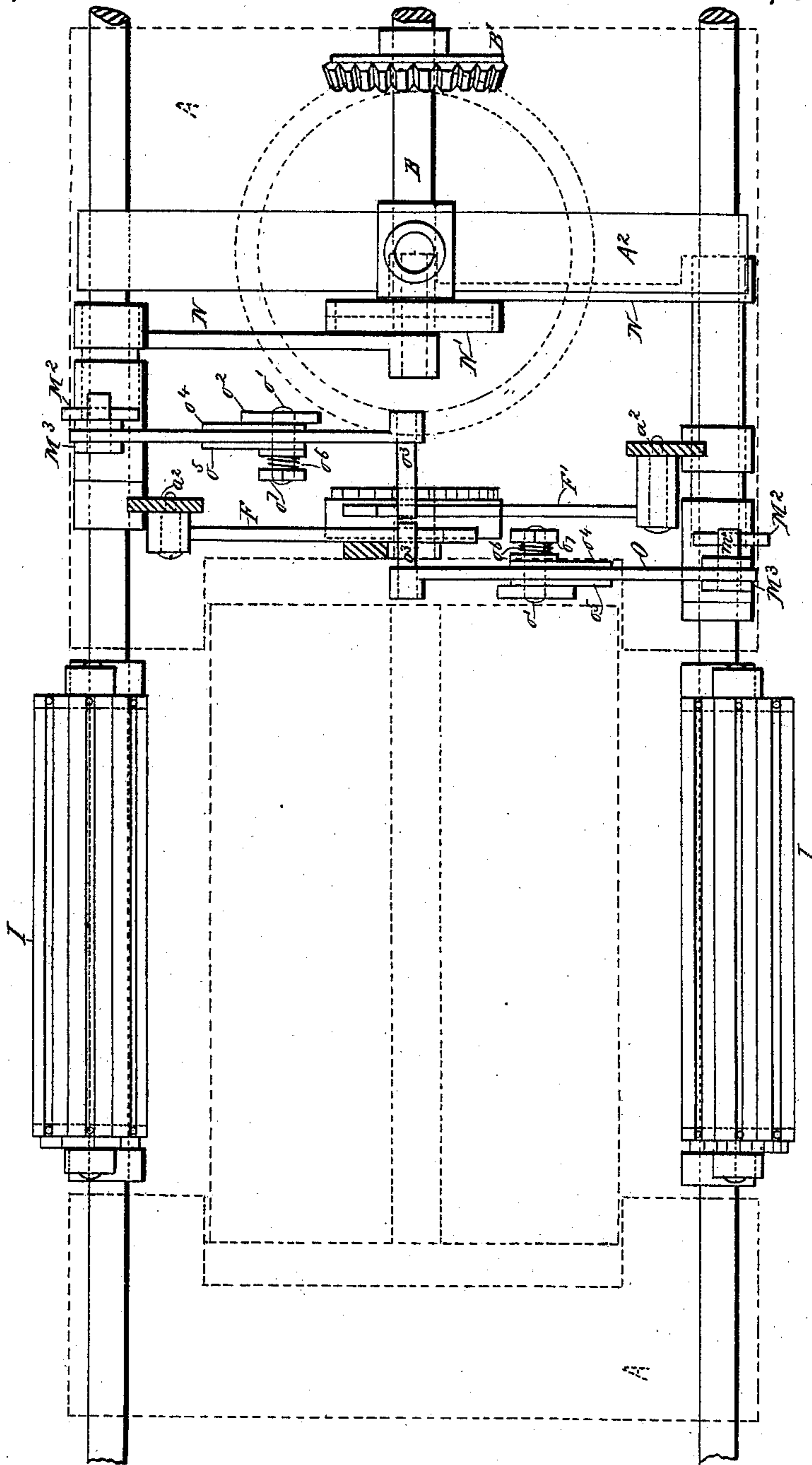
4 Sheets—Sheet 4.

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FIG. 4.



Witnesses:
John Buckle,
George Hollinson.

Inventor:
Charles J. Appleton,
By *Wm. H. Appleton*,
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES JAMES APPLETON, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF
TO JOHN L. LOGAN, OF SAME PLACE.

STRAIGHT-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 391,832, dated October 30, 1888.

Application filed December 8, 1886. Renewed February 4, 1888. Serial No. 263,060. (No model.)

To all whom it may concern:

Be it known that I, CHARLES JAMES APPLETON, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Straight-Knitting Machines, of which the following is a specification.

My invention relates to what are known in the art as "straight-knitting machines," or those in which the needles are arranged in straight rows, and especially to that class which are designed for knitting tubular fabrics, its objects being to produce a knitting-machine of this class which shall be simple and inexpensive in construction, shall be adapted to the production of a finer grade of work than has been possible with the machines heretofore in use, and which shall at the same time be capable of knitting an entire stocking or other tubular-fashioned articles automatically.

To this end my invention consists in the mechanism for accomplishing these results, the nature and distinguishing characteristics of which mechanism will be best understood by reference to the accompanying drawings, in which—

Figure 1 is a rear elevation of a machine embodying my invention, the girth for supporting the crank-shaft being shown in section. Fig. 2 is a plan of the machine, the needles and pattern-cards being removed. Fig. 3 is a sectional elevation of the machine, taken on the line *y y* of Fig. 1. Fig. 4 is a plan of the same, the base-plate, needle-bars, needles, needle-retracting cams, yarn-guide, and the retracting-cam and yarn-guide operating mechanism being removed. Fig. 5 is a section taken on the line *X X* of Fig. 2. Figs. 6 and 7 are details in side and front elevation, respectively, of the pattern-chain for alternately raising the needle-bars and a portion of the operating mechanism therefor; and Fig. 8 is a sectional detail showing a slightly-modified arrangement of the needle-bars.

In all the figures, *A* represents the base-plate, which is or may be supported upon a suitable frame-work—as shown, for instance, at *A'* in Fig. 1; and *B*, the driving-shaft by means of which the various parts of the machine are operated. This shaft is mounted in suitable bear-

ings, *a a*, attached to or formed in the frame-work *A*, and to or in the girth *A'*, secured to the under side of the base-plate *A*, said shaft being provided with a fast and loose pulley or other means for rotating it, (not shown,) and with a bevel-gear, *B'*, which meshes with and rotates a bevel-gear, *C*, of twice its own diameter, carried by a stud, *C'*, mounted in the girth *A'*, the object and purpose of which last-mentioned gear will presently appear.

D D' indicate the needle-bars, which are provided with the usual grooves, *d*, for the reception of the needles *d'*, that are fitted to reciprocate freely therein. These needle-bars are normally arranged in substantially the same plane, but, instead of being fixedly secured in place, as has been the custom in machines as heretofore constructed, are hinged at their rear edges in a recess formed in the base-plate *A* by means of journals *d'' d''*, which enter bearings formed in the lugs *a' a'*, so as to be capable of an upwardly and downwardly swinging movement therein, and in the operation of the machine each of these bars will be swung upward slightly from its normal position during or before the time that the needles carried thereby are being reciprocated, in order that they may be carried above the other bar while being thus operated, as shown in Fig. 5. To effect this upwardly-swinging movement of the needle-bars automatically, the pattern-chain *E* is employed, which acts against the under side of the levers *F F'*, pivoted at their rear ends to the depending lugs *a'' a''*, and connected at their other or free ends, by means of links *f f'*, to the inner edges of the needle-bars, the lever *F* being thus connected to the needle-bar *D* and the lever *F'* similarly connected to the needle-bar *D'*.

The pattern-chain *E* may be of any of the well-known forms. I prefer, however, to employ that form illustrated in Figs. 6 and 7 of the drawings, as being the most simple and effective. This chain is constructed of two sets of links, *e e'*, the links of each of the sets, as well as the two sets, being connected together by means of rods *e''*, passing through suitable apertures in the ends of the said links and extending across from one set of links to the other. These rods extend slightly beyond the

outer sides of the links $e e'$, and are provided between said links with rollers $e^3 e^4$, for engagement with the levers $F F'$, respectively, the order of arrangement of said rollers depending upon the form of the article to be knitted, it being understood that in the knitting of tubular articles the needle-bars $D D'$ will be alternately raised and lowered with respect to each other, and in knitting a flat web only one of said bars will be thus operated, the rollers on the pattern-chain being properly arranged for effecting these results.

G indicates the drum upon which the pattern-chain is mounted and over which it is moved progressively, it being constructed in the form of a disk, with circumferential flanges g projecting from the edges of its periphery, which flanges are provided with notches or recesses g' for engagement with the rods e^2 of the pattern-chain. This drum is supported in proper position beneath the levers $F F'$ by means of a stud, g^2 , secured to the lower end of the lug G' , depending from the under side of the base-plate A , and is rotated from the gear C on the stud C' with an intermittent movement through the intervention of cams c^2 , secured to the upper side of said gear, the sliding bar c^3 , working through a suitable bearing, c^3 , of the base-plate A , the pawl c^4 , and the ratchet G^2 , secured to the side of the drum, a spring, c^5 , being employed to retract the sliding bar and pawl after having been depressed by the cams c^2 .

The needles d' are of the ordinary latch form; but, instead of having their shanks constructed as has been common heretofore, I bend the wire out of which they are formed back upon itself, as shown at d^2 , and solder or otherwise secure this returned portion to the upper side of the main body of the needle, forming the butts d^3 at some distance from their rear ends, thus leaving tails d^4 projecting some distance beyond said butts. These needles may be reciprocated in any of the well-known ways common to straight-knitting machines. I prefer, however, to advance or thrust them forward by means of a Jacquard mechanism and to retract them by means of cams which are traversed back and forth across their shanks, as I am thereby the better enabled to control their movements during the knitting operations.

The Jacquard mechanism employed by me for advancing the needles is shown more clearly in Figs. 1, 2, 3, 4, and 5 of the drawings, $I I$ being grooved octagonal prisms, $I' I'$ the pattern-cards mounted upon them, and $L L$ the arms for supporting said prisms from the rock-shafts $M M$, which in turn are mounted in suitable bearings in the frame A' . The parts as thus described are of well-known form, and the prisms are rotated intermittently to feed the pattern-cards forward by the ordinary pawls, $i i$, engaging with the ratchets i' , secured to their ends. These prisms, and with them the pattern-cards, are not vibrated continuously, however, as is the case in Jac-

quard mechanism generally, but instead thereof are so moved only when the needle-bar carrying the particular row of needles that is to be operated is swung upward, at other times such prisms and pattern-cards remaining stationary. In order, therefore, to thus move them in unison with the needle-bars, I provide each of the rock-shafts $M M$ with a sleeve, M' , which, while oscillated continuously through the instrumentality of an arm, N , a friction-roll, n' , thereon, a cam, N' , fast on the driving-shaft B , and a spring, N^{10} , is yet free to move upon said shaft, but may be locked thereto and the latter made to oscillate therewith. The means whereby this locking of the sleeve to the rock-shaft is effected at the desired times is as follows: To the inner end of sleeve M' is fixedly secured an arm, M^2 , which is provided in its upper end with a notch or recess, n , and is vibrated back and forth continuously with the sleeve M' as the latter is oscillated by the cam N' . Secured to the rock-shaft M , adjacent to the arm M^2 , by a screw or otherwise, is an arm, M^3 , in a socket, m , formed in which is fitted to slide a rod or bar, M^4 , provided on the side next to the arm M^2 with a projection or lug, m' , of such dimensions in cross-section as to fit the notch or recess n in the upper end of arm M^2 . The position of this projection or lug is normally above and out of the path of the arm M^2 as the same is vibrated, it being held in that position by a spring, u , or other equivalent means; but it may be brought into engagement with the notch or recess n , formed in the upper end of said arm, by depressing the rod or bar M^4 . This depression of the bar or rod may be effected in various ways. I prefer, however, to employ a lever, O , which is jointed to the upper end of said rod or bar, is provided near its center with a slot, o , which receives and permits the bar to move upon a fulcrum-pin, o' , projecting from the side of the hanger o^2 , depending from the under side of the base-plate A , and is provided at its inner end with a stud or pin, o^3 , which rests upon the upper side of the lever F or F' , the lever O , that depresses the bar M to bring into operation the particular prism and pattern-cards required, resting upon the lever F or F' of the needle-bar that is to be operated.

A Jacquard mechanism is employed for the operation of each of the two rows of needles, and it will be seen that when either the one or the other of the needle-bars is swung upward by the pattern-chain E to bring its needles into operation the rod or bar M^4 of the Jacquard mechanism belonging thereto will be depressed, forcing the projection or lug m' down into the notch or recess n , formed in the upper end of the arm M^2 , locking the sleeve M' to the rock-shaft M and compelling the latter to move in unison with the former. This movement of the rock-shaft causes the prism I to be carried back and forth toward and away from the tails d^4 of the needles, the forward reciprocation thereof forcing the pattern-cards I' against the ends of such tails and

advancing the needles to receive the yarn in the operation of knitting, the number of and the particular needles thus advanced at each forward movement of the pattern-cards depending upon the number and arrangement of the perforations in the latter. The opposite or backward reciprocation of the said prism, through the operation of the spring N^{10} upon the arm N of the sleeve m' , causes its own rotation by the engagement of the pawl i with the teeth of the ratchet i' , secured to its end. These operations continue as long as the needle-bar remains in an elevated position, but ceases the moment that it is depressed, as the rock-shaft M is thereby unlocked from the sleeve M' by the removal of the lug m' from the notch or recess n in the upper end of the arm M^2 , consequent upon the depression of the inner ends of the levers F or F' and of lever O . It will thus be seen that each of the Jacquard mechanisms is under the control of the lever which raises its corresponding needle-bar, and is brought into or carried out of operation as such needle-bar is raised or lowered.

In order to restrain the movement of the rock-shaft M and the Jacquard mechanism carried thereby, when the former is thrown out of engagement with the sleeve M' , I apply to the fulcrum-pin o' washers $o^4 o^5$, which are held against the sides of the levers $O O$ with a yielding pressure by means of a spiral spring, o^6 , and an adjusting-nut, o^7 , screwed onto the end of said fulcrum-pin, and in some cases I find it convenient to support such rock-shaft and the sleeve, M' , carried thereby at a point near the arm M^2 of the latter by a bearing formed in the lower end of the depending lug a^2 , which is extended downward for that purpose—as shown, for instance, in Fig. 1.

$P P$ indicate the cams for retracting the needles after they have been thrust forward by the action of the pattern-cards, the same being constructed of a general triangular form, and being hinged to the under side of the carrier P' , secured to the rod P^2 , which rod is longitudinally reciprocated from the bevel-gear C through the intermediary of a wrist-pin, c , secured in its upper side, and a cross-head, P^3 , in a slot, p , formed in which said wrist-pin slides. The inclined edges of these cams operate against the inner side of the butts d^3 to retract the needles successively, and said cams are reciprocated as is common in knitting-machines; but instead of being arranged to rest upon the upper side of the needles when the needle-bars are in their normal position, these cams are arranged slightly above them, in order to permit of the raising of the former by the pattern-chain E , and to prevent the cams during their reciprocating movement from coming in contact with the butts of the needles of the bar that has been depressed, thus obviating any undue strain upon the loops carried by said needles.

The wrist-pin c , I provide with a friction-roller, c' , to reduce to the minimum the friction occasioned by its movement in the slot p , and

in order that the rod P^2 and its cross-head P^3 may be properly supported and operated I provide the bearing P^4 and the guide-rods $P^5 P^5$, in and upon which said rod and cross head are fitted to slide.

S indicates the guide, by means of which the yarn is supplied to the needles when the machine is in operation. This guide is constructed in the form of a tube, s , its exterior surface being shaped to fit and slide in a slot, p' , formed in the rod P^2 , and being provided at its upper end with a flange, s^2 , which extends out over the upper side of said rod.

$s^3 s^3$ indicate springs, through the instrumentality of which the guide is locked to the carrier P' and caused to move therewith, the same being secured to the flange s^2 , and having their ends extended some distance beyond said flange and provided with apertures or recesses $s^6 s^6$, which engage with one or the other of the round-headed studs $p^2 p^2$, according as the carrier is moved in one or the other direction; and in order to adjust said guide automatically, so as to cause it to lay its yarn in the hooks of the needles before the cams P commence to retract them, rod s^4 is secured to the side thereof and strikes against the stop s^6 and bearing P^4 as carrier P' is reciprocated, changing it from one end of the slot p' to the other, and vice versa, thus bringing it into position to lay its yarn into the hooks of the needles ahead of the cams in whichever of the two ways they may be moving.

$T T$ indicate the latch-openers, which are constructed in the form of metal plates. These openers are secured by screws or otherwise to the upper sides of the bars $t t$, which retain the needles in their bars, and are arranged in such relation to the needles as to enter between their hooks and latches when said needles are advanced and prevent such latches from closing down upon the hooks before the latter have taken the yarn.

The operation of the machine is as follows: Yarn being supplied to the yarn-carrier, the rollers on the pattern-chain being properly arranged, the requisite pattern-cards being supplied to the Jacquard prism, and the machine started, the needle-bars will be raised by the action of said rollers, the yarn-guide carried back and forth across the needles through the medium of the reciprocating rod P^2 , and the needles in the needle-bars, as the latter are raised, will be advanced by the action of the Jacquard mechanism to take the yarn—their retraction, to draw the yarn thus taken through the loops already on their shanks, being effected by the action of the cams $P P$ as they are reciprocated back and forth with the yarn-guide. The several operations result in the interlooping of the yarn and the production of a knitted fabric. If the arrangement of the rollers upon the pattern-chain be such as to cause the alternate raising of the needle-bars, a tubular fabric will be formed, the yarn being carried up on one side and interlooped by the needles of the bar on that side, thence

across at the end and down on the other side, where it is interlooped with the needles of the other bar, thence across and up on the first side, and so on, such operations continuing as long as it may be desired to knit a tubular fabric. If, on the other hand, it be desired to knit a flat fabric, the roller on the pattern-chain will be so disposed as to elevate only one of the needle-bars, and the yarn will be interlooped by the needles carried thereby during the reciprocation of the yarn-guide in both directions.

To effect the widening or narrowing of the fabric, the needles are thrown out of or brought into operation, as is common in knitting-machines; but instead of operating the needles to effect these results, as has been the custom in machines as heretofore constructed, I operate them automatically by the action of the Jacquard mechanism, the pattern-cards thereof being so perforated as to admit of the desired number of needles being brought into or carried out of operation at each reciprocation of the yarn-guide.

From the above it will be seen that I produce a machine which is not only simple in construction, but which is at the same time adapted to the production of either flat or tubular-fashioned articles automatically.

By arranging the needle-bars so as to render them capable of a swinging movement, and by raising the inner or front edge of each of them when its needles are to be reciprocated to permit of their passing above the other bar, I am enabled to dispense with sinkers or a sinker-bar for holding back the work when the needles are advanced, the inner or front edge of the needle-bar remaining down serving for that purpose. Moreover, as a result of such arrangement and operation, I am also enabled to bring the needle-bars into closer relation than has been possible with machines of this class as heretofore constructed, thus obviating to a great extent the straining of the yarn, and the consequent evil effects, due to the carrying across of the yarn from one row of needles to the other, as is required in the operation of knitting. Furthermore, by the construction of parts above set forth I am enabled to produce tuck-work and various other forms of ornamentation with great facility, the governing of the movements of the needles by Jacquard mechanism admitting of an almost endless variety therein.

While I have shown the best means contemplated by me for mounting the needle-bars, I wish it distinctly understood that I do not restrict myself to these exact means, as it is obvious that instead of hinging them I may raise the entire bar, as shown, for instance, in Fig. 8, wherein the needle-bar is shown at D, the lever for raising it at F, and the connecting-link at *f*, the said bar being provided with depending lugs *f*¹⁹, which slide in suitable guide-ways, *f*², formed in the framing of the machine, and hold the bar in proper position while being operated. Neither do I limit myself to the

exact construction and arrangement of the remaining parts, as it is obvious that they may be modified in various ways without departing from the spirit of my invention.

With the mechanism above described may be employed any of the well-known take-up devices, tension devices, and means for adjusting the cams for making longer or shorter loops, and, if desired, two or more of the machines may be mounted upon a single table and the various movements effected in them by a single group of operating devices arranged at the ends thereof.

Having described my invention and one means by which it is or may be carried into effect, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination, with the needle-bars arranged in substantially the same plane and needles mounted therein, of mechanism for reciprocating said needles and pattern devices for automatically raising the needle-bars in predetermined orders, substantially as described.

2. The combination, with the needle-bars of a straight-knitting machine and a support to which they are hinged, of a pattern mechanism for swinging upward their inner or front edges at predetermined intervals and devices intermediate said needle-bars and pattern mechanism, substantially as described.

3. The combination, with the needle-bars of a straight-knitting machine and a support to which they are hinged, of needles arranged in said bar, mechanism for reciprocating said needles, a pattern-chain and intermediate devices for raising the inner or front edges of said bars, and mechanism for supporting said pattern-chain and feeding it forward, substantially as described.

4. The combination, with the needle-bars of a straight-knitting machine and a support to which said bars are hinged, of needles arranged in said bars, Jacquard mechanism for advancing said needles, cams for retracting them, and pattern mechanism for raising the inner or front edges of said needle-bars prior to the advancement of the needles carried by said bars, substantially as described.

5. The combination, with the needle-bars of a straight-knitting machine and pattern mechanism for raising the same in predetermined orders, of needles arranged in said bars, Jacquard mechanism for advancing said needles, and devices, substantially as specified, for bringing said Jacquard mechanism into operation when the respective needle-bar to which it belongs is brought into action, substantially as described.

6. The combination, with the needle-bars arranged in substantially the same plane, a support to which they are hinged, and a pattern-chain, levers resting upon said chain, and links connecting such levers with the inner or front edges of the needle-bars, of mechanism for operating said pattern-chain, substantially as described.

7. The combination, with a pattern mechanism, a lever resting thereon, a Jacquard mechanism, and a shaft upon which it is supported, of a sleeve mounted upon said shaft, mechanism for oscillating said sleeve, a locking device, by means of which the shaft may be locked to the sleeve or unlocked therefrom, and a lever operated by the lever which rests upon the pattern mechanism to bring the locking device into operation to cause the locking together of the shaft and sleeve or their unlocking, substantially as described.

8. The combination, with the pattern mechanism, the lever F, resting thereon, the Jacquard mechanism, and the shaft M, for supporting it, of the sleeve M', mounted upon said shaft and provided with the arm M², having a notch formed in its upper end, the arm M³, secured to the shaft and provided in its upper end with a socket, a rod or bar, M⁴, arranged to slide in said socket and provided with the lug m', the lever O, jointed at the upper end of said rod or bar and provided with a pin which rests upon the upper side of the lever F, the spring u, and mechanism for oscillating the sleeve M', whereby the lug m' is carried into engagement with the notch in the upper end of arm M², and the shaft and sleeve thereby locked together and caused, with the Jacquard mechanism, to oscillate in unison or removed therefrom, and the shaft and Jacquard mechanism allowed to remain at rest, substantially as described.

9. The combination, with the carrier P' and

the mechanism for reciprocating it, of the cams hinged thereto, the needles, the needle-bars, and mechanism for raising the inner or front edges of said needle-bars, substantially as described.

10. The combination, with the rod P², provided with the slot p', and mechanism for reciprocating said rod, of the yarn-guide S, mounted in said slot, the rod s⁴, connected to said yarn-guide, and stops against which the ends of the rod strike when the rod P is reciprocated, substantially as described.

11. The combination, with the rod P², provided with the slot p', and mechanism for reciprocating said rod, of the carrier P', provided with the studs p² p², the yarn-guide S, having the flange s², mounted in said slot, the springs s³ s³, provided with apertures s⁶ s⁶, the rod s⁴, connected to said yarn-guide, and stops against which the ends of said rods s⁴ strike when the rod p² is reciprocated, substantially as described.

12. The combination, with the needle-bars, needles, and mechanism for advancing said needles and raising the inner or front edges of the needle-bars, of the latch-openers T T, substantially as described.

In testimony whereof I have hereunto subscribed my name.

CHARLES JAMES APPLETON.

Witnesses:

OWEN A. CLARK,

GEORGE HODKINSON.