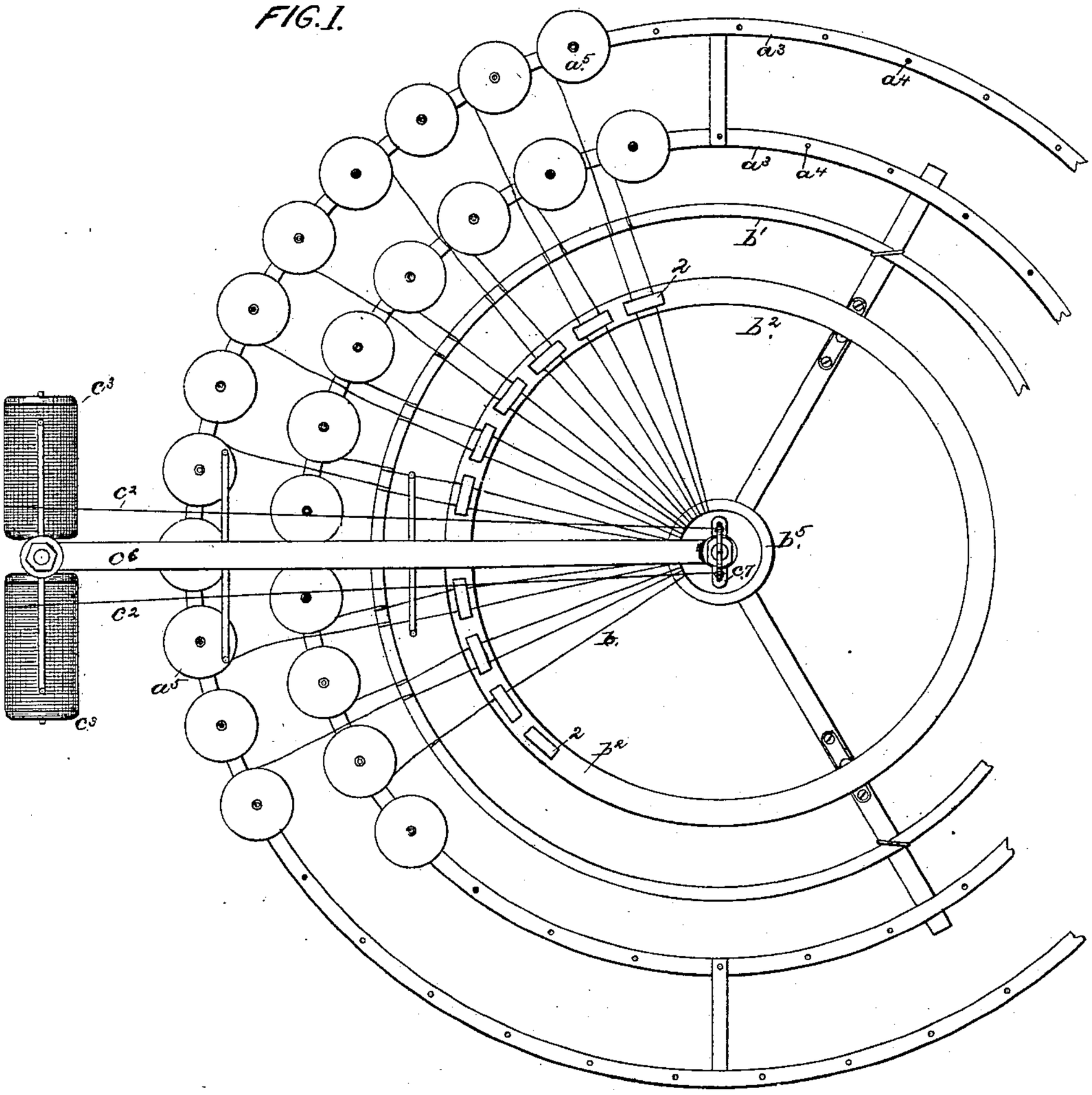
(No Model.) 6 Sheets—Sheet 1.

C. CALLAHAN.

KNITTING MACHINE.

No. 246,288. Patented Aug. 30, 1881.

FIG. 1.



Witnesses.
Arthur Reynolds
W. H. Leggiston.

Inventor:
Cornelius Callahan,
by Crosby Gregory Attys

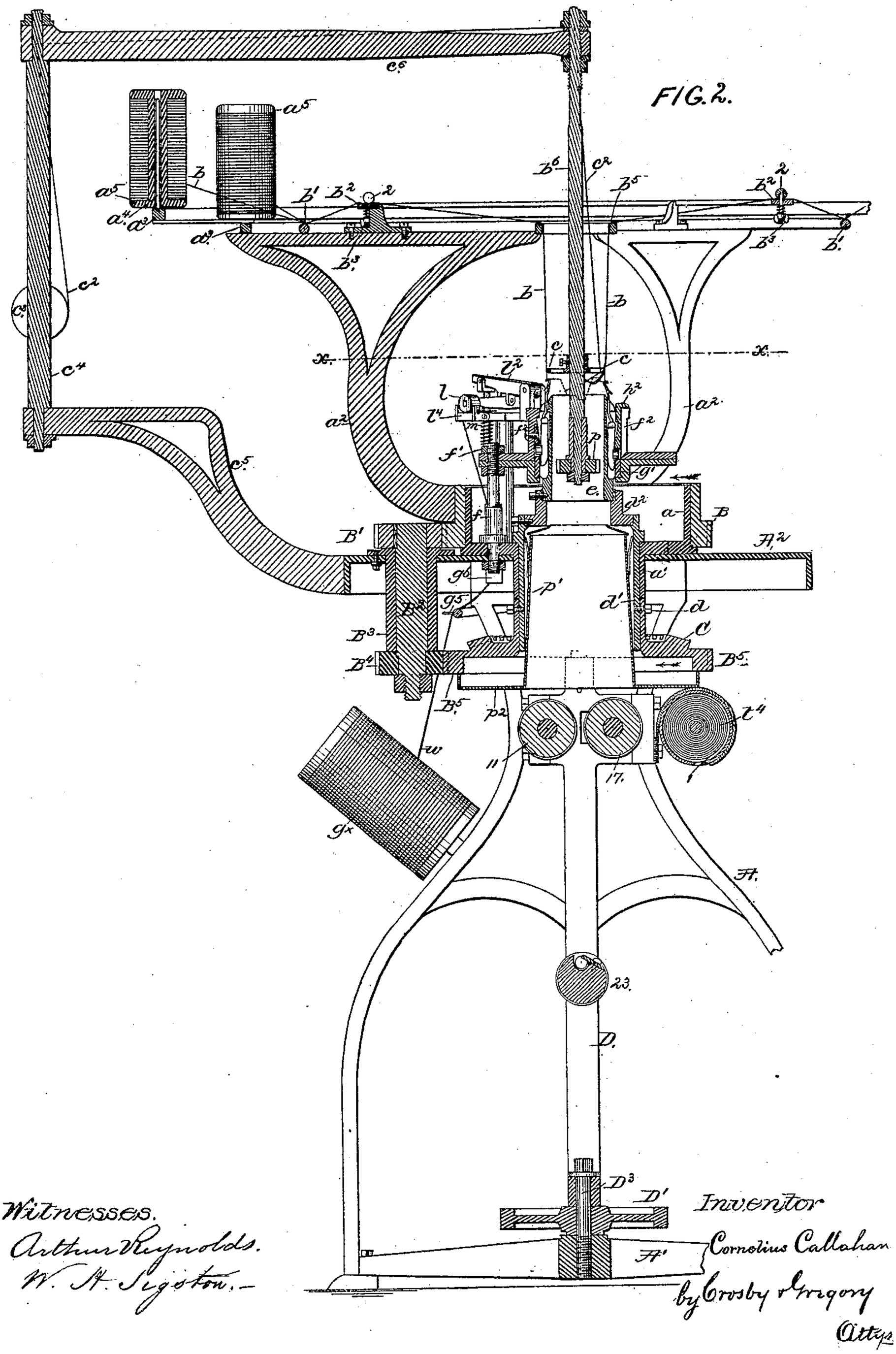
(No Model.) 6 Sheets—Sheet 2.

C. CALLAHAN.

KNITTING MACHINE.

No. 246,288. Patented Aug. 30, 1881.

FIG. 2.



Witnesses.
Arthur Reynolds.
W. H. Leighton.

Inventor
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Attys

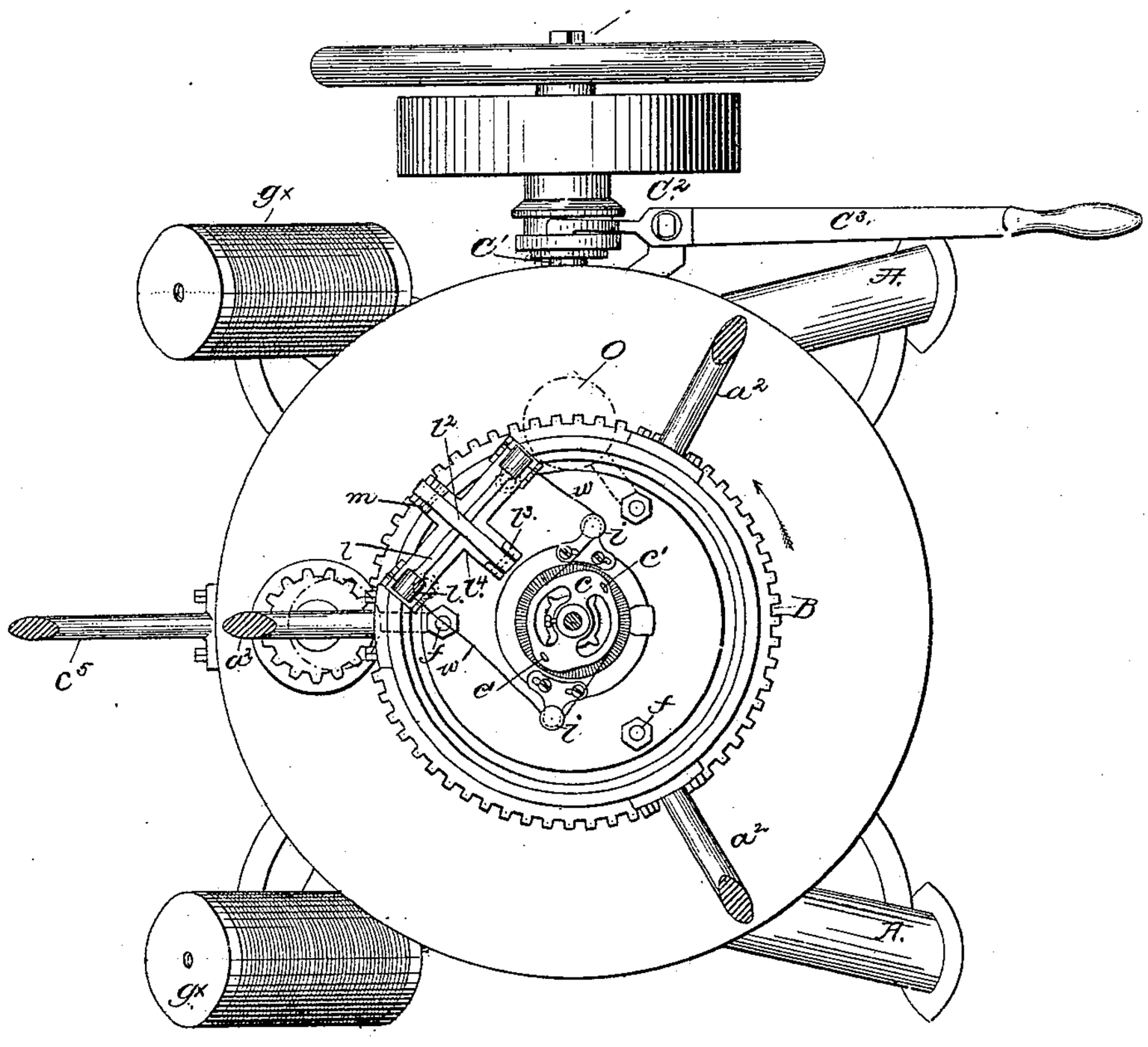
(No Model.) 6 Sheets—Sheet 3.

C. CALLAHAN.

KNITTING MACHINE.

No. 246,288. Patented Aug. 30, 1881.

FIG. 3.



Witnesses.
Arthur Reynolds.
W. H. Singleton.

Inventor:
Cornelius Callahan
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(No Model.) 6 Sheets—Sheet 4.

C. CALLAHAN.

KNITTING MACHINE.

No. 246,288. Patented Aug. 30, 1881.

FIG. 5.

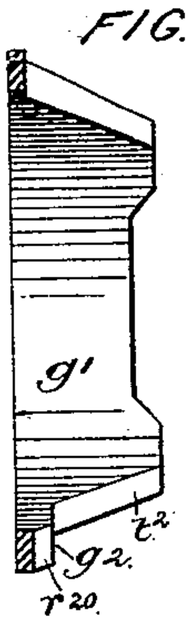


FIG. 4.

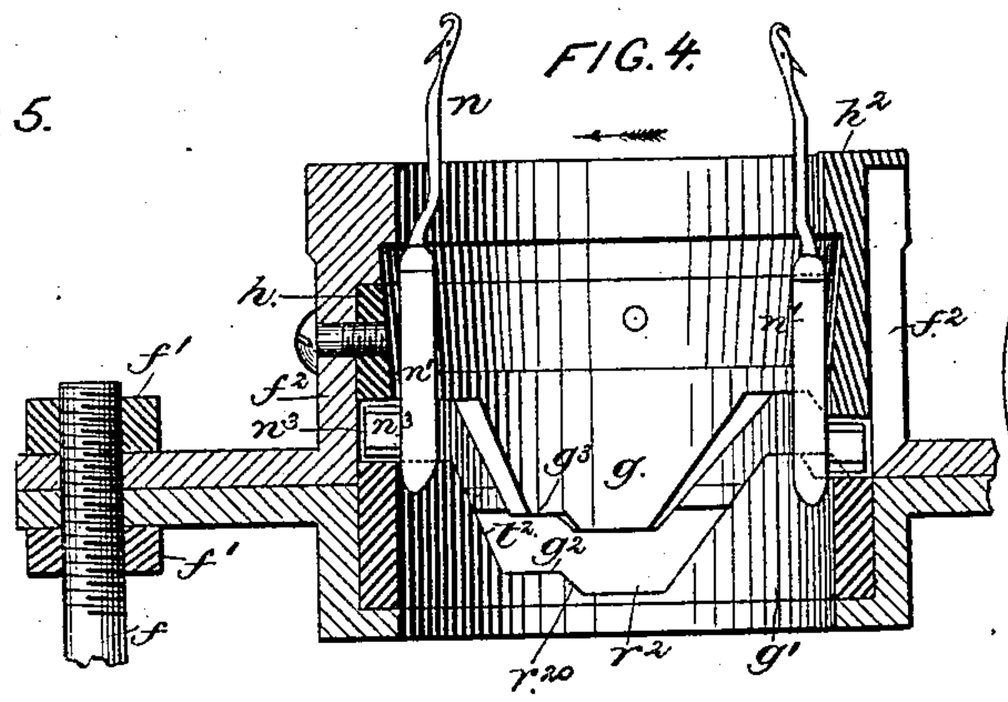


FIG. 6.

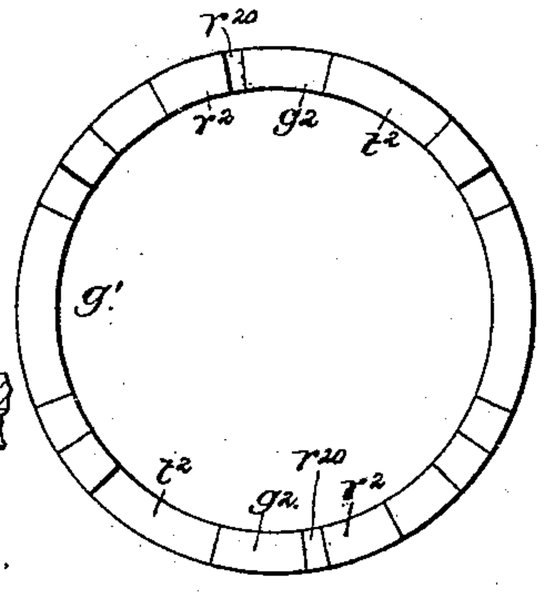


FIG. 7.

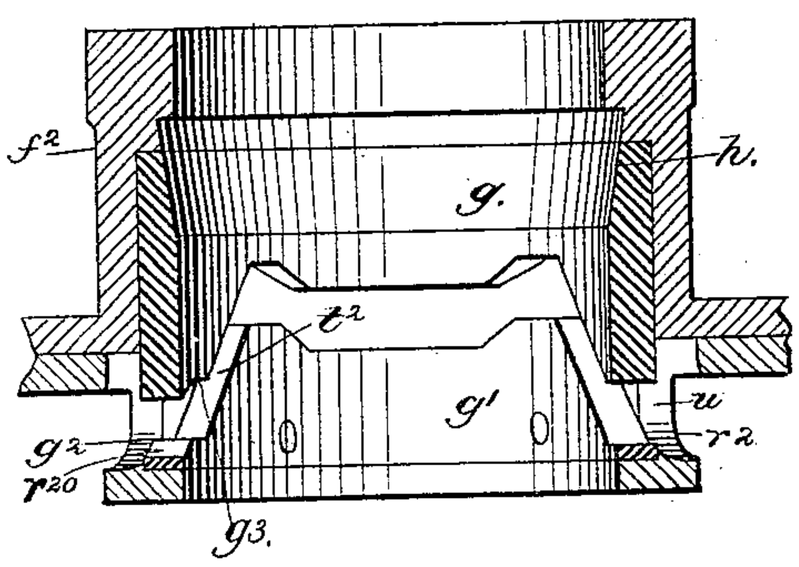


FIG. 8.

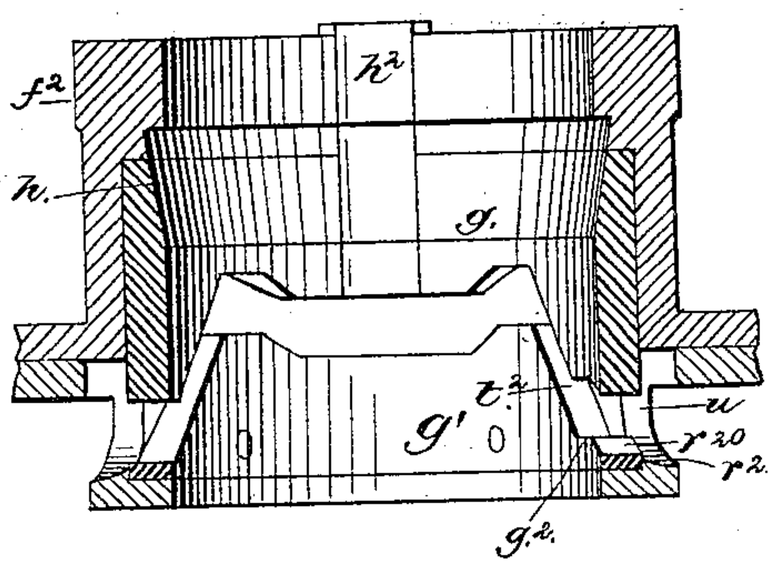
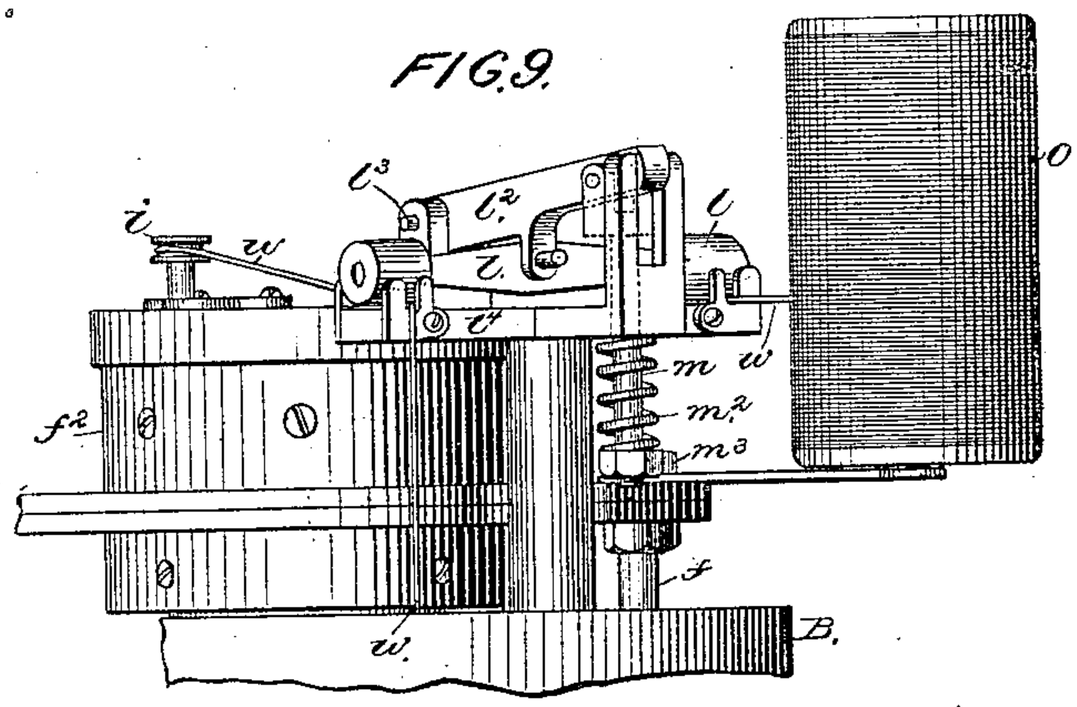


FIG. 9.



Witnesses.
Arthur Reynolds.
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(No Model.) 6 Sheets—Sheet 5.

C. CALLAHAN.

KNITTING MACHINE.

No. 246,288. Patented Aug. 30, 1881.

FIG. 10.

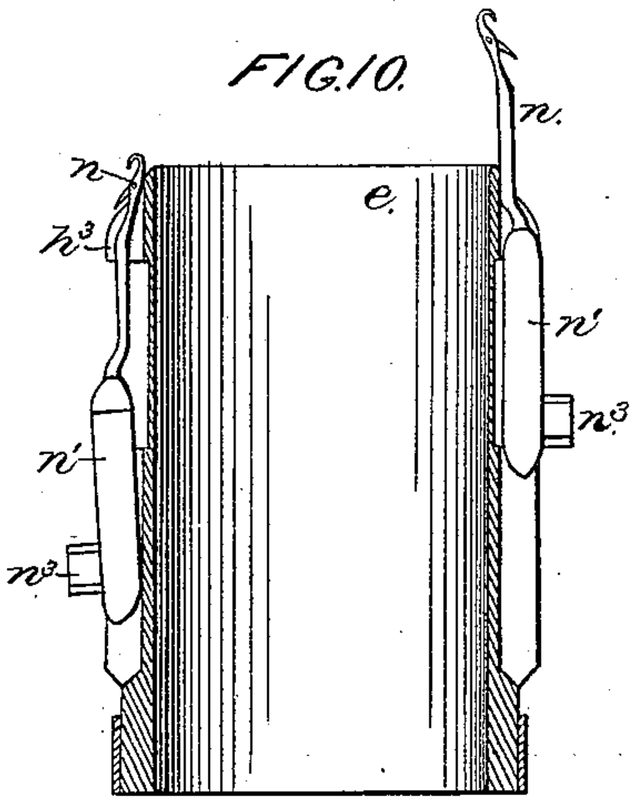

FIG. 11.

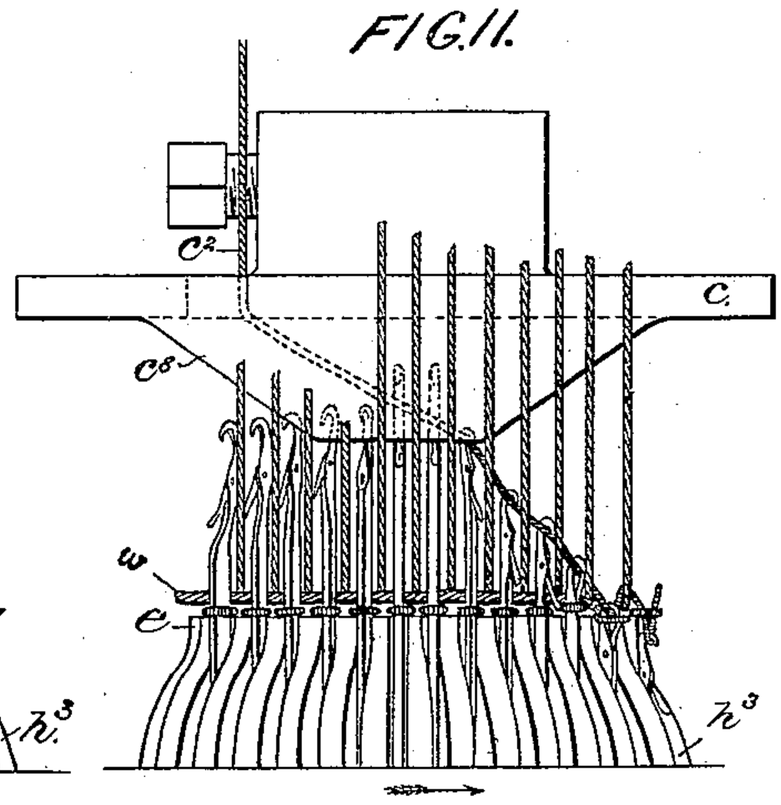

FIG. 12.

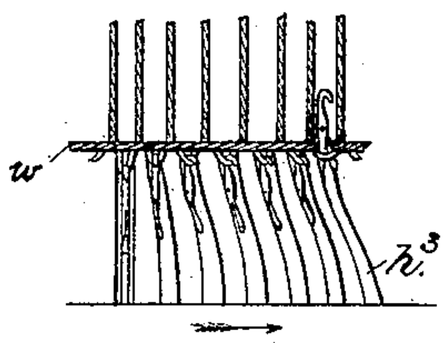

FIG. 13.

Witnesses.
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N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 6 Sheets—Sheet 6.

C. CALLAHAN.

KNITTING MACHINE.

No. 246,288. Patented Aug. 30, 1881.

FIG. 14.

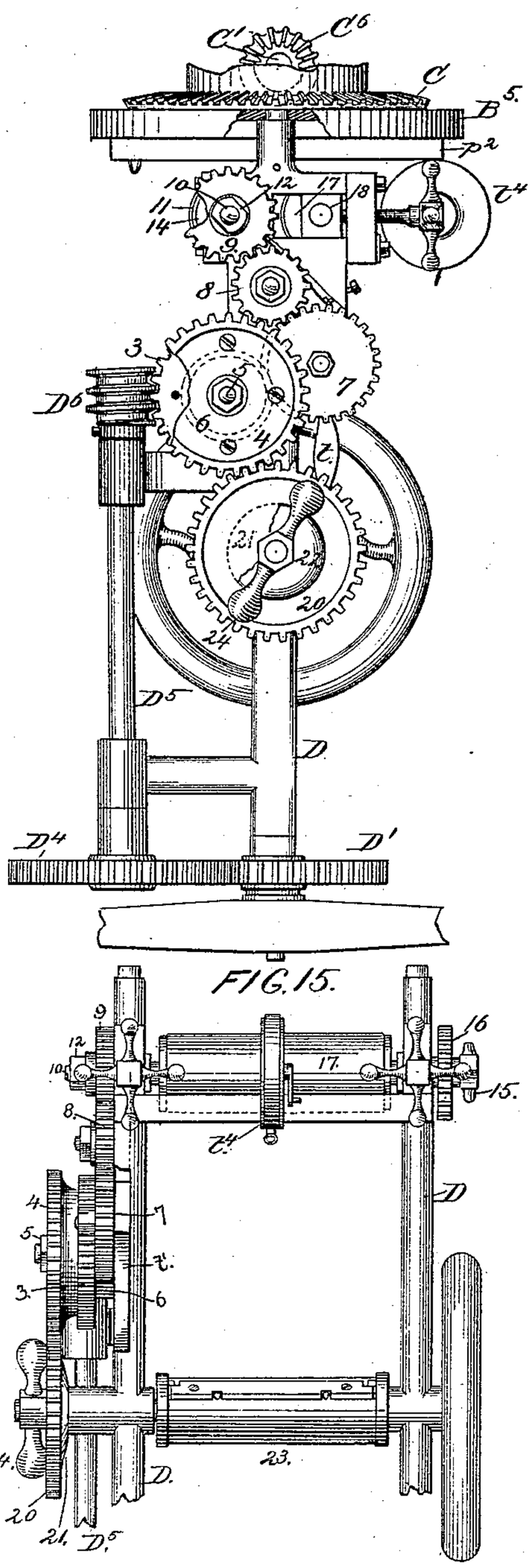

FIG. 18.

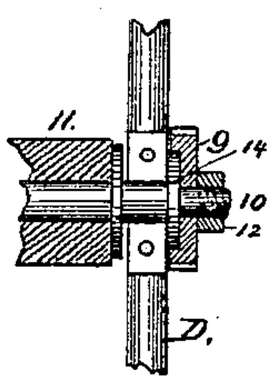

FIG. 16.

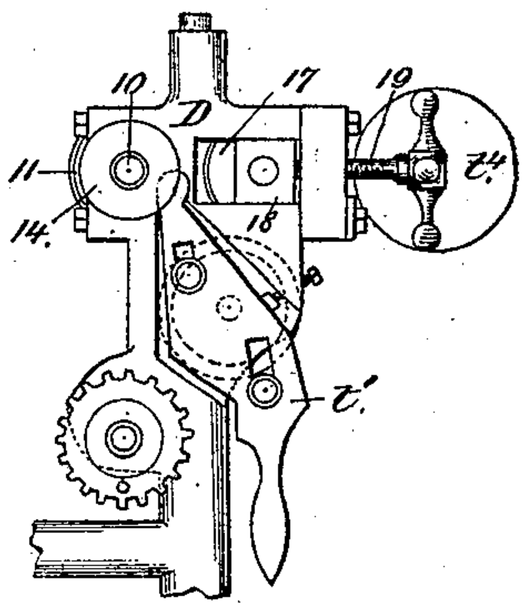

FIG. 17.

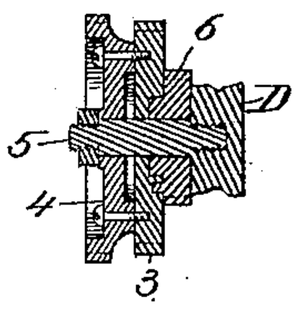

FIG. 15.

Witnesses.
Arthur Reynolds
W. H. Eglinton

Inventor:
Cornelius Callahan,
by Crosby & Gregory
Attys.

UNITED STATES PATENT OFFICE.

CORNELIUS CALLAHAN, OF CHELSEA, MASSACHUSETTS.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 246,288, dated August 30, 1881.

Application filed April 19, 1881. (No model.)

To all whom it may concern:

Be it known that I, CORNELIUS CALLAHAN, of Chelsea, county of Suffolk, State of Massachusetts, have invented an Improvement in Knitting-Machines, of which the following description, in connection with the accompanying drawings, is a specification.

This invention in knitting-machines is embodied in a machine of the circular class, adapted to knit a tubular fabric, having additional warp-threads incorporated in a well-known way with the knitting-threads, which may be more or less in number, according to the diameter of the tube to be knitted and the class of fabric to be made.

In my machine I employ a series of latched needles on slides held in grooves of a revolving needle-cylinder, and reciprocated in the said grooves by the cams of a stationary cam-cylinder. The warp-threads are taken from spools carried by a revolving warp carrying or holding frame extended above the needles, the hub or gear carrying the said frame having its bearings below the needle and cam cylinders, the upwardly-extended arms forming part of said warp-carrying frame revolving outside the said cam-cylinder in unison with the needle-cylinder, which is revolved inside the cam-cylinder.

To enable me to use such a machine as referred to, introduce a weft-thread, obtain access to the parts necessary to do knitting, and keep the machine in order, I have provided the machine with a weft-holding stud or projection, from which the weft is delivered into the fabric at the rear of the rising needles, and have arranged the said weft-holder so that it remains stationary near the needle-cylinder, it, however, being so located as to permit the warp-holding frame to revolve freely and in no way disturb the delivery of the weft-thread from its spool or spools. The cam-cylinder is provided with one cam portion, on which the projections of the needle-slides rest when the needles are most depressed; but immediately next such cam portion, and between it and the usual needle-lifting cam, I have arranged a short preliminary lifting-cam and butt-supporting surface, the purpose and object of which is to temporarily lift several of the needles to slacken the tension on the warp and knitting threads held under strain by the needle and support the needles partially lifted, so that the weft-thread may, without fail, pass to the rear of the said needles before they are started in their final ascent, thus insuring the certain passage of the needles upward in front of the weft-thread.

The specific features and organizations of mechanical devices constituting my invention will be set forth at the end of this specification.

Figure 1 is a partial top view, showing the revolving warp-holding frame at the top of the machine, with a few of the warp-spools with their warp-threads extended under the tension device and down through the tube sizing or gaging ring at the center of the said frame, and also the two knitting-threads and their spools. Fig. 2 is a vertical section of my improved machine, a part of the frame at the right being broken away; Fig. 3, a view of that part of my machine below the dotted line *x x*, Fig. 2. Fig. 4 is an enlarged vertical section of the needle-actuating cam-cylinder and needles. Figs. 5 and 6 are sectional and detached top views of the lowermost cam for moving the needles. Figs. 7 and 8 represent, in section, both halves of the stationary needle-cylinder with its cam; Fig. 9, a detail of the cam-cylinder, one of the weft-bobbins, and weft-tension device; Fig. 10, a vertical section of the needle-cylinder, showing one needle in elevated and another needle in depressed position. Fig. 11 is a detail of the stationary warp-throwing cam, part of the needle-cylinder, and some needles and warps, some of the needles taking and drawing down the knitting-thread; Fig. 12, a detail, showing the position of some more of the needles at the right of those shown in Fig. 11, with the weft-thread strained across the warp-threads, just above the hooks of the needles, the farthest needle at the right having been started upward above and at the front of the weft-thread. Fig. 13 is a section taken through the warp-throwing cam at its longest part; Fig. 14, a side view of the take-up devices and actuating-gear removed from the machine; Fig. 15, a partial right-hand view of Fig. 14, and Fig. 16 a detail to be referred to; Fig. 17, a vertical sectional detail of the parts shown in Figs. 14 and 15, and designated by same characters; and Fig. 18 is a vertical sec-

tional detail of the gear 9, disk 14, and roller 11 of Fig. 14.

This machine is adapted to knit a tubular fabric having warp and weft introduced therein, such fabric being chiefly used for hydraulic hose; but, if desired, the said machine may be used to knit fabrics or tubes of large diameter, to be cut and made into cloth for clothing purposes, any desired number of weft-feeds being added, according to the diameter of the tube.

The side frames, A, are connected at bottom by the cross-brace A′, which serves to support the foot or lower journal of the revolving take-up mechanism, to be hereinafter described. At their upper ends the side frames support the table A^2, cut away at its center to receive the two cylindrical flanged stationary bushings *a* *a′*, which are attached firmly to the said table by suitable screws. The exterior of the fixed bushing *a* serves to support internally the necked gear B, from which rises the arms a^2 of the warp-holding frame, having, as herein shown, one or more rings, a^3, provided with pins a^4 to receive the series of spools a^5 a^6 for the warp-threads *b*. These arms also carry the leading-ring *b′*, about which the warp-threads *b* are wrapped once, in order that the kinks in the warp-threads may be removed before passing under the tension devices.

Each tension device consists, as herein shown, of a short cylinder having a screw-threaded rod extended from it at right angles, (see right of Fig. 2,) where it receives a spring and a thumb-nut, b^3, by which the pressure of the short cylinder upon the two warp-threads between it and the said ring b^2 may be regulated. These arms also carry the tube gaging or sizing ring b^5, it receiving over its smooth top and down through it all the warp-threads *b*, the interior diameter of the said ring substantially determining the diameter of the tube to be knitted and keeping the warps in a circle of smaller diameter than the diameter of the circle occupied by the outer portions of the needles *n* below the top of the needle-cylinder when depressed. The annular series of warp-threads *b*, between the gaging-ring b^5 and fabric on the needles, is contracted slightly as the warp-threads approach the fabric or tube. The annular series of warp-threads is supported internally, just above the highest point reached by the needles in their ascent, by a stationary warp-throwing cam, *c*, adjustably attached to the stationary rod b^6, connected with the bar c^6 of a standard, c^4, fitted to arm c^5, suitably secured to the table A. The standard c^4 supports two spools, c^3, containing the knitting-threads c^2, which are passed from guides c^7 directly down through the gaging-ring b^5 and openings *c′* (see Fig. 3) in the said warp-throwing cam *c*, the said knitting-threads c^2 passing down behind the depending portions c^8 (see enlarged detail, Fig. 11) directly to the usual needles, the hooks of which, when elevated and thrown inward toward the center of the needle-cylinder, as will be hereinafter described, take hold of the knitting-thread c^2 at the rear of the said depending portion c^8 and back of the warp-threads *b*, opposite those needles which are receiving thread, the said warp-throwing cam, inside the annular series of warp-threads, temporarily deflecting or throwing outward a portion of the warp-threads, to permit the knitting-thread to be deposited between the elevated needles and the inside of the warp-thread, held temporarily by the cam *c* away from the knitting-thread.

The necked gear B is rotated by the gear B^5 through the intervention of the gear B^4 on the shaft B^2 in the bearing B^3 and the gear B′ at the upper end of the said shaft, as shown clearly in Fig. 2. The gear B^5 derives its movement from its connected bevel-gear C, driven by a bevel-pinion, C^6, (see Fig. 14,) fixed upon the inner end of the main or power-driven shaft C′, having upon it any suitable friction-clutch, C^2, under control of a hand-lever, C^3, so as to start or stop the machine at will. The hub of the gear B^5 receives and has secured to it, by suitable screws, *d*, the shank of the needle-cylinder bearing *d′*, made hollow for the passage through it of the knitted tube or fabric. The upper end, d^2, of this shank is held detachably in place by suitable screws, to thus enable it to be changed whenever it is desired to employ a needle-cylinder, *e*, of greater or less diameter. I denominate the upper end, d^2, of this cylinder-shank as the "reducing-collar." The needle-cylinder *e* is attached to this reducing-collar by suitable screws, as shown in Fig. 2, and the said cylinder, collar, and shank, together with the needles *n*, the slides *n′* of which are fitted into grooves in the needle-cylinder, all rotate in unison with the gear B^5.

Within the stationary flanged bushing *a*, and extended through holes made in the top of the table A^2, are placed the shanks of the supports *f*, preferably three in number, screw-threaded at top and provided each with two suitable nuts, *f′*, (see Fig. 4,) between which are adjustably held the double flanges of the cylindrical shell f^2, within which are secured and held by suitable screws the cam portions *g* *g′*, which, acting on the projecting butts n^3 of the slides *n′*, raise and lower the needles in proper time and order to do knitting. These two cam portions *g* *g′* are just as usual, with the exception that I have added the small preliminary needle-rising portion r^{20} and needle-butt-supporting surface g^2, and made a corresponding notch, g^3, as shown clearly in Fig. 4, above the surface g^2. This portion r^{20} is just high enough to lift the needles *n* for a distance substantially equal to the length of the new loops drawn down by their hooks through the old loops, as shown by the intermediate needles of Fig. 12, and when so raised, the said needles, preferably about five in practice, are held with the tops of their hooks substantially at the level of the knitted goods then resting on the top of the needle-cylinder *e*, as shown in Fig. 12, the supporting-surface g^2 being of sufficient length to rigidly support the butts of several of the said needles in the same plane just af-

ter they are lifted by the incline r^{20} from the surface r^2. Holding a few of the needles rigidly when slightly elevated, as described, just after they have been fully drawn down, as represented by the right-hand needle, Fig. 11, and just at the rear of those needles which are started upward in front of the weft-thread g, then held taut and bearing against the outer sides of those warp-threads b which are held in true circle by the truly circular portions of the warp-throwing cam c, enables me to slacken a little those warp-threads immediately opposite the needles whose butts rest on the butt-supporting portion g^2 of the cam, so that the weft-thread w may settle back and move back with it the said warps b, against which it bears, so that the said weft-thread falls in a curved line just at the rear of the needles which rest on the said portion g^2 just before they are started upward by the rising portion t^2, so that the said needles, when acted upon by portion t^2, will always rise in front of the said weft-thread w. Were it not for this preliminary rising portion r^{20} and the portion g^2 of the cam g' the needles would be held with their hooks so far down (see extreme right of Fig. 11,) as to hold the loops of knitting-thread so taut that the weft-thread w, in its efforts to strain the warps b back to the rear of the said needles, would be apt to break the loops of knitting-thread, and often break the needles, and the warp-threads not being permitted to yield sufficiently to the weft-thread, the needles would be liable at times to rise at the rear side of or behind the said weft-thread w, making imperfections in the fabric. The more dense and compact the material being knitted the greater the importance of this preliminary rising portion r^{20} and portion g^2.

Referring to Fig. 4, it will be seen that the upper portion of the cam part g and the interior of the shell f^2 are cut out, as at h, to receive the upper ends of the slides n' of the needles as the needles reach their lowest positions, they being moved outward radially as the rear sides of the hooks of the needles bent backward from their shanks (shown clearly in Figs. 4 and 10) travel down in contact with the cylindrical needle-cylinder e. These bent needles operate substantially as in my former Patent of the United States, No. 140,809, to which reference may be had.

To vary the length of loop for loose or tight knitting, the cylinder-shell f^2 and cams within it may be lowered or raised by adjusting the nuts f', the needle-cylinder e always remaining, however, at the same height.

To remove or replace a needle, I have provided the shell with the usual gate, h^2. (See Figs. 4 and 8.

Referring to the enlarged detail, Fig. 10, where the needle at the left is shown fully depressed, and the needle at the right fully elevated in the needle-cylinder e, it will be seen that the hooks of the needles in their two extreme positions occupy circles of different diameters, the larger circle being that defined or bounded by the outside of the cylinder when the needles are depressed.

The specific construction of the needle-cylinder herein shown, whereby cutting of the loops drawn down by the hooks of the needles is obviated by cutting away the upper portion of the cylinder, has been made the subject of another application, No. 37,552, filed July 11, 1881, and is not, therefore, herein claimed.

The weft-threads w, before referred to, two being preferably used at the same time, are taken, as shown in full lines, Fig. 3, from spools $g^\times$ on pins secured to the side frames, A, and are led through guides g^5, one of which is shown in Fig. 2, up through hollow sleeves g^6, preferably composed of short pieces of gas-pipe inserted through the table A, and flanged bushing a inside the hollow gear B, from which sleeves the weft-threads are led under the ends of one tension device, l, shown as a lever pivoted centrally to a lever-carrier, l^2, pivoted at its rear end upon an ear, l^3, of a fixed frame or tension-bed, l^4, also supported within the flanged bushing a.

The free end of the lever l^2 has connected with it a screw-threaded rod, m, surrounded by a spring, m^2, the upper end of which bears against the under side of the tension-bed l^4, the said threaded rod receiving upon it below the said spring an adjusting-nut, m^3, (see detail, Fig. 9,) by which the downward pressure of the lever l^2 and tension device l may be regulated.

The tension device l herein described is free to rise at either end to adapt itself to any inequality of the weft-thread without affecting the tension of the thread under the opposite end of the said device. By this device I am enabled to keep both the weft-threads w under exactly the same tension by a single adjustment.

The weft-threads w beyond the tension device are extended about the flanged weft-holding studs i, secured to the top of the cylinder-shell f^2 at such heights and in such positions with relation to the needle-operating cams as to enable the weft-threads w to be led to the fabric in straight lines just above the tops of those needles which have been partially lifted by the preliminary lifting portion r^{20}, and held by portion g^2, before described, and as shown in Fig. 12.

It will be noticed that the tension device and studs i are fixed in position with relation to, and are located within, the circle or space about which the arms a^2 and warp-frame of the machine rotate. Such location of the weft-tension device and studs was devised to enable me to employ a machine in which the warps might rotate, and in which frame-work or parts moving the said warps might have its bearing below the top of the needle-cylinder and the needles, thus enabling me to extend the warps from above down to the needles in nearly a vertical plane, and always afford space for ready access to the latches of the needles, and to enable me to readily reach

the weft and knitting threads, where they are being worked into the fabric, which in practical work is a matter of great importance.

In knitting a fabric for clothing purposes, where colors are desired in the weft, one or more of the weft-threads will preferably be held on a spool, such as represented at *o* in dotted lines, Fig. 3, and in side elevation, Fig. 9.

The lower end of the fixed rod b^6 is provided with a work-holding friction-wheel, *p*, down around and about which the tubular fabric is drawn, the said wheel rotating with the fabric and acting to prevent the lower end of the rod b^6 from being strained or deflected laterally out of place.

The hollow shank of the needle-cylinder bearing *d'* has inserted within it a work-shield, *p'*, the lower end of which is made as a pan, p^2, to catch and prevent the possibility of oil dropping upon the fabric.

The take-up is composed of a revolving frame, D, joined at its top with the gear B^5. The lower cross-bar of frame D has a gear, D', suitably bolted or fixed to it, while a stud or bolt, D^3, serves for the center about which the lower end of the frame and gear revolve. The gear D' engages and rotates a gear, D^4, at the lower end of a shaft, D^5, held in suitable bearings of the said frame D. The shaft D^5 has a worm, D^6, which engages a worm-gear, 3, having attached to it a gear, 4. On the stud 5, carrying the worm-gear 3, (see, also, Fig. 17,) is a small pinion, 6, which engages the intermediate gear, 7, (see Figs. 14 and 15,) which rotates a second intermediate gear, 8, that engages and drives the toothed gear 9, frictionally secured upon the end of the shaft 10 of the fabric-drawing roll 11, preferably covered with india-rubber, and opposed to a like roller, 17. This gear 9 is recessed at its rear side (see Fig. 18) to fit over a disk, 14, secured to the shaft 10 outside the frame part D, and this gear is pressed against the side of this disk by the nut 12, the disk and gear being held together by friction, so that should the fabric between the rolls 11 and 17 and the needles *n* become slack the said nut may be loosened and the rolls 11 and 17 be turned independently by hand, through the hand-wheel 15 and its gear 16, both fixed to the second roll, 17, having its journals in the boxes 18, made adjustable by the screws 19. The gear 16, when moved by the hand-wheel 15, engages the gear (not shown) at the end of the roll 11 opposite the end shown in Fig. 14, the said gear being of the same size as the gear 16, and enables the said rolls 11 and 17 to be turned as may be desired. The gear 4 engages a gear, 20, held pressed frictionally between the disks 22 and 21. The disk 21 is secured to the shaft of the taking-up roll 23. The disk 21 is shown in dotted lines at the rear of the gear 20. The disk 22 is forced against the front side of the wheel 20 by the nut 24. This frictional connection between the gear 20 and the shaft of the take-up roll enables the gear to slip sufficiently on the shaft of the said roll to accommodate for the increasing size or diameter of the fabric on the take-up roll, so as to take up the fabric uniformly, notwithstanding the increasing diameter of the said roll. The two intermediates 7 8 have their studs held in an adjustable lever, *t'*, which may have co-operating with it suitable devices to hold the said lever in adjusted position.

When it is desired to change the speed of the take-up, the pinion 6 is changed and one of another size substituted for it, and the lever *t'* is moved far enough in one or the other direction to properly engage and drive the gear so added.

A most important feature in connection with the practical success of my invention is that of the provision shown and described of delivering the weft-thread from spools held on fixed parts of the frame, the weft-threads being held and delivered to the needles of the elevated rotating needle-cylinder outside the elevated cam-cylinder and within the space surrounded by the revolving warp holding or carrying frame.

The surface r^2 of the cam *g'* is that on which the butts n^3 of the slides of the needles rest when the needles are most depressed. Instead of starting the lifting-surface t^2 directly from the surface r^2, as commonly done, I have interposed the preliminary lifting-surface r^{20} and horizontal portion g^2, they being essential to lift and hold some of the needles while the weft-thread is delivered with certainty behind them, as has been explained.

The bushing *a* constitutes the hollow bearing about which the warp holding or carrying frame rotates, and within the said bearing I have fixed the parts which support the stationary cam-cylinder located above the said hollow bearing, and I have also supported the weft-delivering stud *i* on a stationary part of the machine. The gear B at the lower end of the warp-holding frame constitutes a hollow foot for the said frame, which foot turns on the hollow bearing *a* as a center.

I claim—

1. The needle-cylinder, its reciprocating series of needles, and the weft-thread holder or stud, combined with the cam-cylinder having cam-surfaces r^2, r^{20}, g^2, and t^2, the preliminary needle-lifting surface r^{20} and butt-supporting surface being arranged between the surfaces r^2 and t^2 to hold the upper ends of several of the needles in position, as described, after they have been partially lifted to permit the weft-thread, directed and guided by the stud, to be placed with certainty at the rear of the needles just before they are to be raised by the cam-surface t^2, substantially as described.

2. The rotating needle-cylinder, the revolving warp holding or carrying frame, the hollow bearing *a* for the same, and the rotating needle-carrying cylinder, of smaller diameter, extended above the said bearing, and suitable intermediate connections between the frame and needle-cylinder to insure the movement of

the needle-cylinder and the said frame in unison, combined with a stationary cam-cylinder, also extended above the said hollow bearing, and a series of reciprocating needles, substantially as described.

3. The revolving warp holding or carrying frame, the hollow bearing *a* for the same, the rotating needle-carrying cylinder of smaller diameter extended above the said bearing, and suitable intermediate connections between the warp-frame and needle-cylinder to insure their movement in unison, and the stationary cam-cylinder, also extended up through or above the said bearing, and the series of reciprocating needles, combined with the weft holder or stud *i*, fixed with relation to the needle cylinder, substantially as described.

4. The table A^2, hollow fixed bearing *a*, and revolving warp-holding frame, having its hollow foot or gear fitted thereon, and the needle-cylinder and needles therein elevated above the said hollow bearing, and suitable gearing to connect the said warp-holding frame and needle-cylinder, combined with the stationary cam-cylinder arranged inside the space included within the said frame as it revolves, and above the said hollow bearing, substantially as described.

5. The table A^2, the hollow fixed bearing *a*, the cam-cylinder and its supports *f*, extended upward from within the said fixed hollow bearing, and tension device and weft-holding stud, combined with the revolving warp-holding frame having its foot fitted to the said bearing, and the revolving needle-cylinder, and suitable connecting means between it and the said revolving frame, substantially as described.

6. The revolving needle-cylinder *e* and its shank *d'* and bearing *a'* for it, combined with the intermediate removable reducing-plate, d^2, substantially as described.

7. The hollow needle-cylinder and its neck, combined with the shield *p'*, provided at its end with the oil-receiving pan p^2, substantially as described.

8. The tension device composed of the plate l^4, the lever l^2, and suitable means to adjust its position, and the pivoted lever *l*, to bear on the threads *w*, as set forth, the one lever, *l*, operating at each end upon a different thread, the tension on each being regulated by one adjusting device, substantially as described.

9. In a circular-knitting machine, the revolving warp-holding frame, the revolving needle-cylinder and its series of reciprocating needles, means to connect and revolve the said frame and needle-cylinder in unison, and a stationary cam-cylinder, combined with a series of adjustable tension devices, substantially such as described, attached to the said frame and operating upon the warp-threads, substantially as set forth.

10. In a circular-knitting machine, the revolving warp-holding frame, its hollow fixed bearing *a*, the revolving needle-cylinder *e*, arranged above and of smaller diameter than the said hollow bearing, the series of reciprocating needles, means to connect and revolve the said frame and needle-cylinder, and stationary cam-cylinder, also arranged above the said hollow bearing, combined with the tube sizing or gaging ring, to contract and gather the warps above the needles and permit them to be delivered vertically, or nearly so, to the said needles, substantially as described.

11. In a circular-knitting machine, the revolving warp-holding frame, its hollow fixed bearing *a*, the revolving needle-cylinder *e*, arranged above and of smaller diameter than the hollow bearing, the series of reciprocating needles, means to connect and revolve the said frame and needle-cylinder together in unison, and the stationary cam-cylinder, also arranged above the said hollow bearing, combined with the tube sizing or gaging ring b^5 and the warp-throwing cam *c*, and suitable means to hold it stationary within the circle of the revolving warps held by the said ring, substantially as described.

12. The revolving warp-holding frame, its tube sizing or gaging ring b^5, the rotating needle-cylinder, suitable means to connect and rotate them together in unison, a series of reciprocating needles, and stationary cam-cylinder, combined with the stationary ring b^2, its adjustable warp-tension devices thereon, and the warp-throwing cam *c*, provided with holes to deliver the knitting-threads to the needles between the needles and the rear sides of the warp-threads, substantially as described.

13. The revolving warp-holding frame, its tube sizing or gaging ring b^5, the rotating needle-cylinder, suitable means to connect and rotate them together in unison, a series of reciprocating needles and stationary cam-cylinder, combined with the stationary ring b^2, the adjustable warp-tension devices thereon, and the warp-throwing cam *c*, provided with holes to deliver the knitting-threads to the needles between the needles and the rear sides of the warp-threads, and the loose wheel *p*, located within the knitted tube, substantially as and for the purpose described.

14. The revolving warp-holding frame and revolving needle-cylinder, and series of reciprocating needles, and means to connect and revolve the said frame and needle-cylinder, and a stationary cam-cylinder, combined with the gear B^5, frame D, take-up rolls 11 and 17, shafts 23 and D^5, and gearing, substantially as shown and described, to operate the said rolls and shaft 23, as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CORNELIUS CALLAHAN.

Witnesses:
G. W. GREGORY,
ARTHUR REYNOLDS.