6 Sheets—Sheet 1.

B. L. STOWE.

Machine for Knitting Tubular Fabrics.

No. 221,628. Patented Nov. 11, 1879.

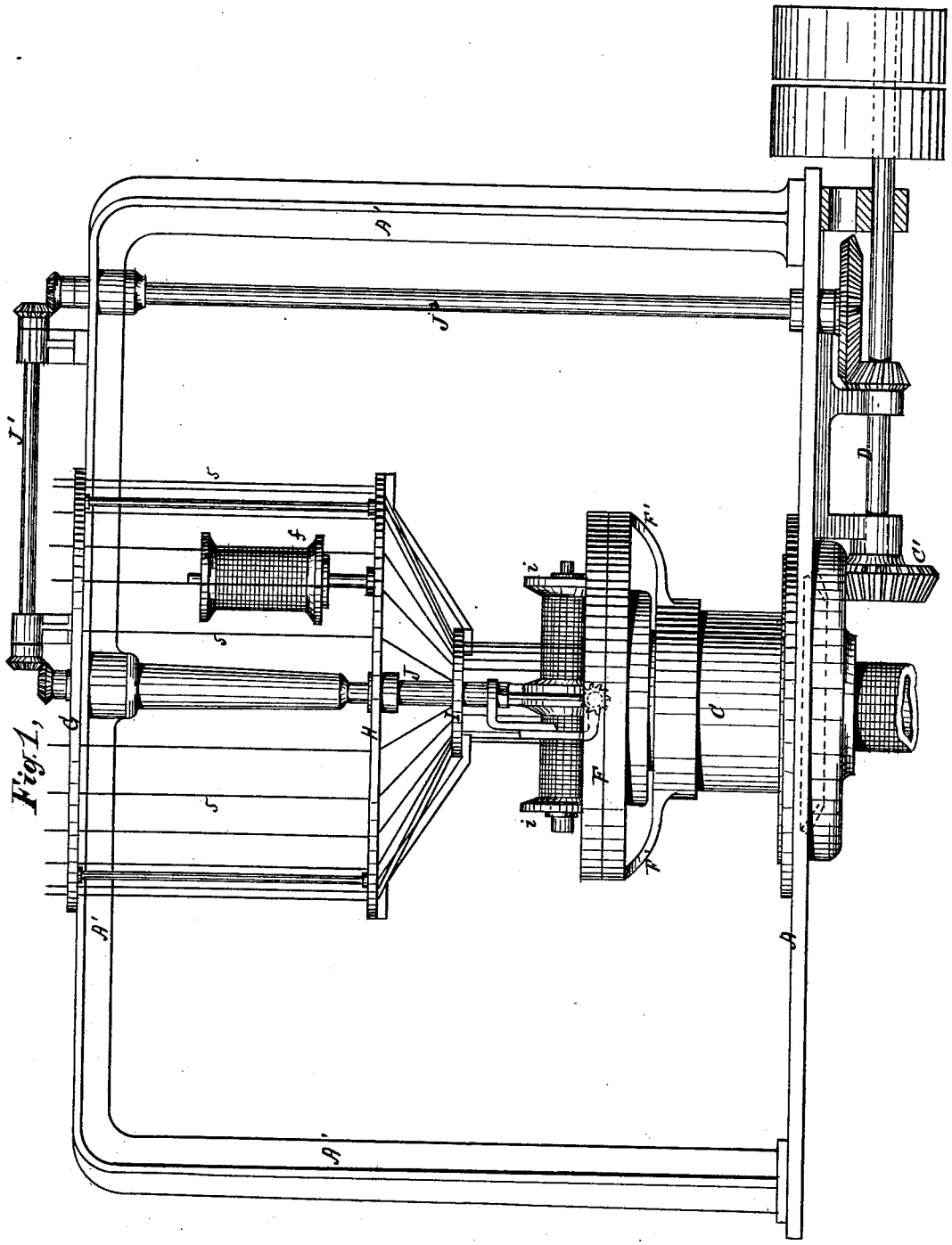

Fig. 1.

Witnesses:
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Arnet Reeds

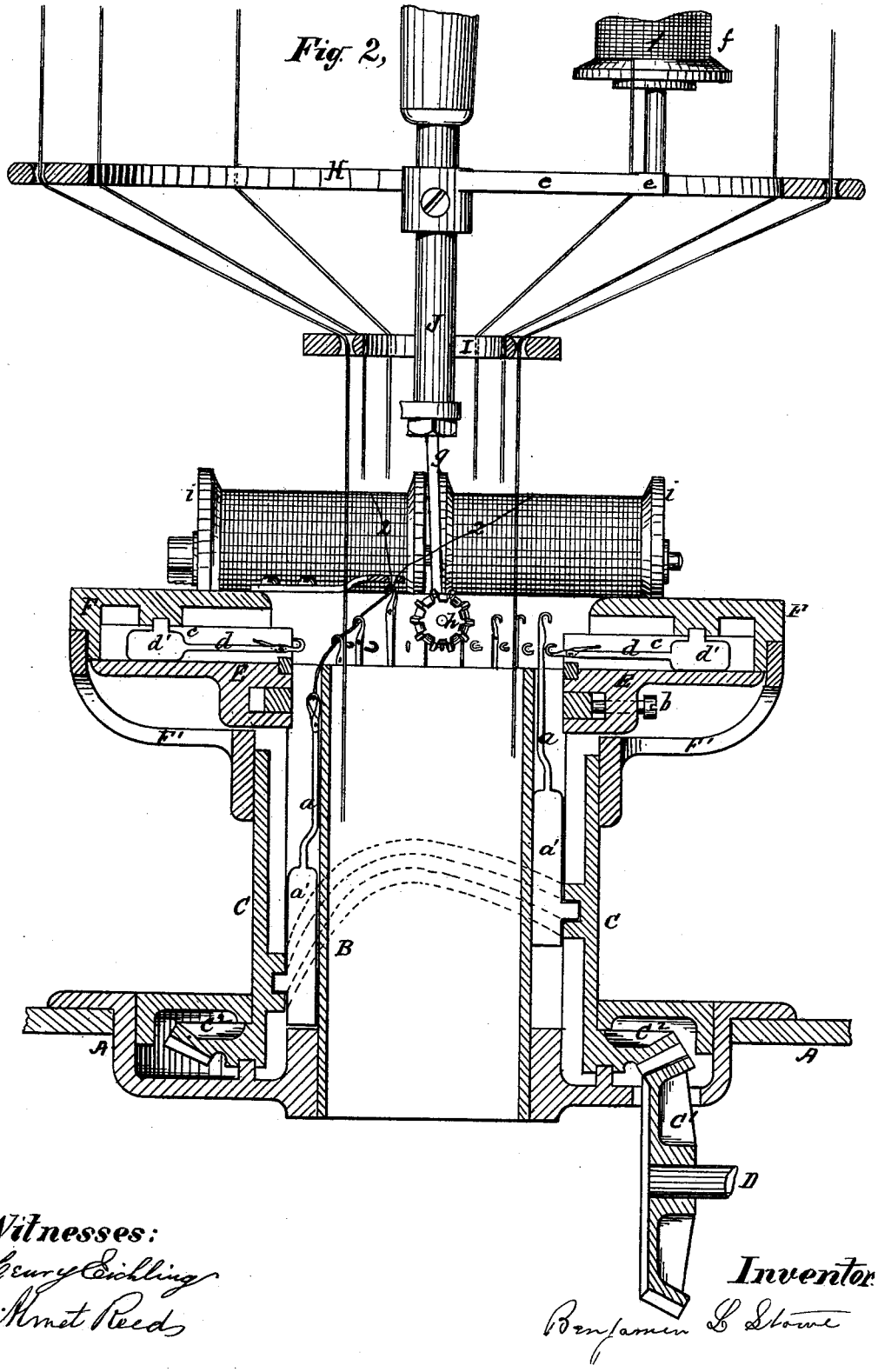
Inventor:
Benjamin L. Stowe

B. L. STOWE.

Machine for Knitting Tubular Fabrics.

No. 221,628. Patented Nov. 11, 1879.

Fig. 2,



Witnesses:
Henry Eichling
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Inventor:
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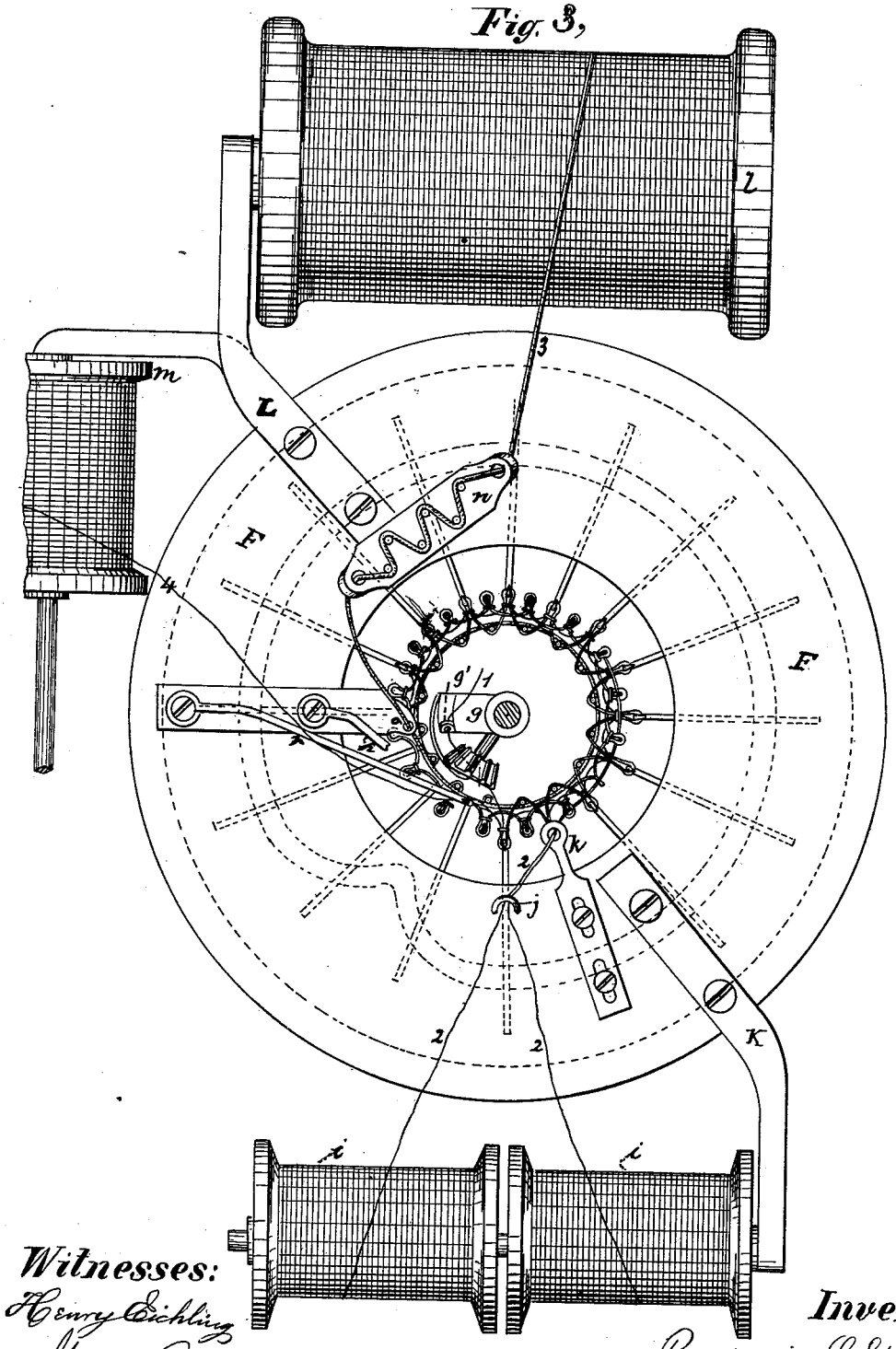
Fig. 3,



Witnesses:
Henry Eichling
Ahmet Reed

Inventor
Benjamin L Stowe

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No. 221,628. Patented Nov. 11, 1879.

Fig. 4.

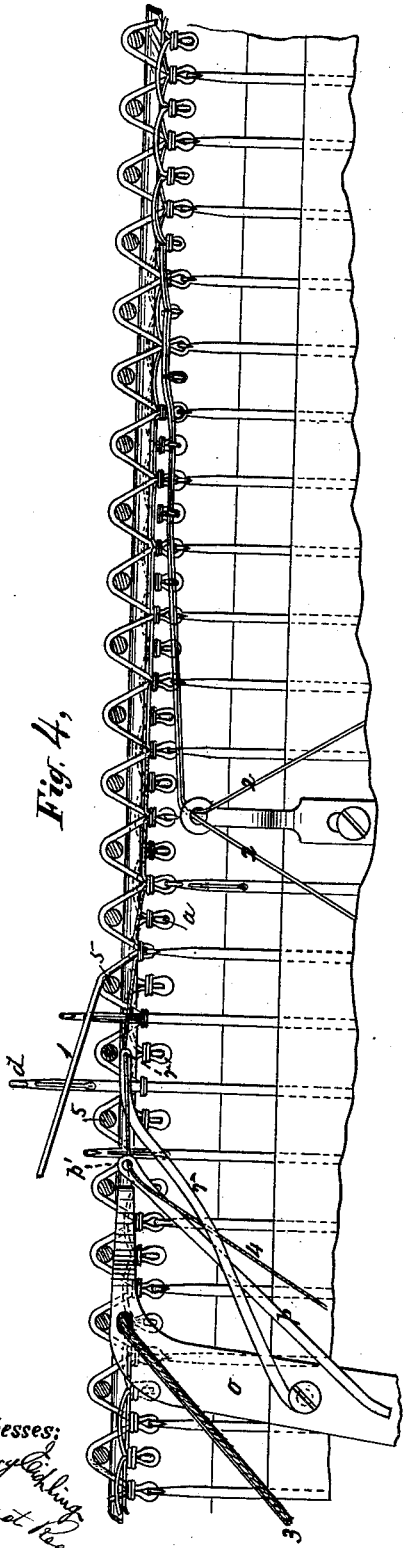
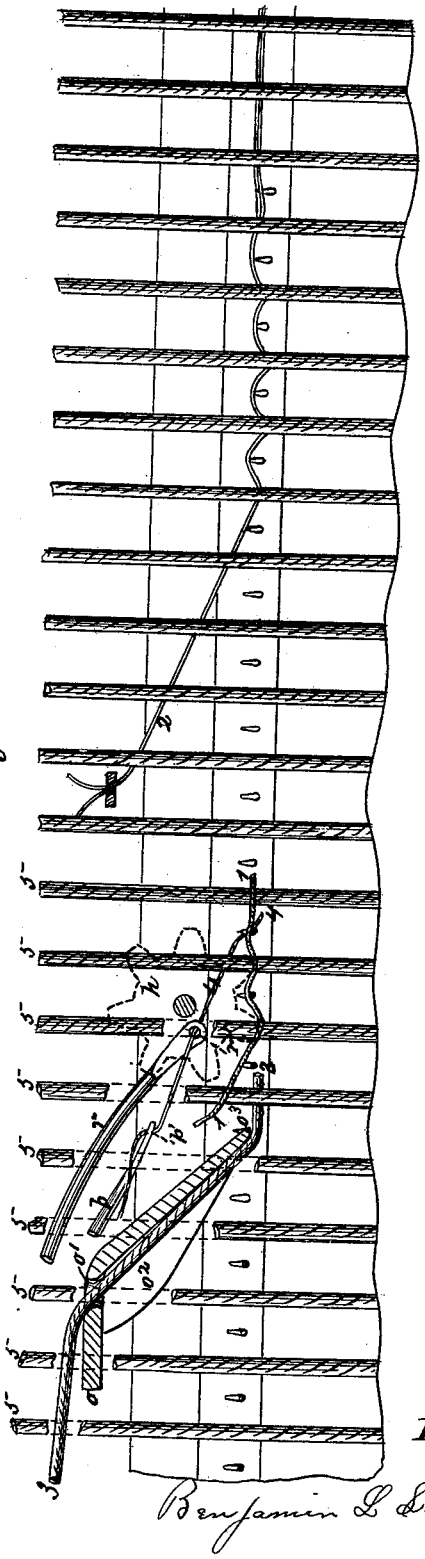


Fig. 5.



Witnesses:
Henry Ashley
Ernest Reed

Inventor:
Benjamin L. Stowe

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Machine for Knitting Tubular Fabrics.

No. 221,628. Patented Nov. 11, 1879.

Fig. 6,

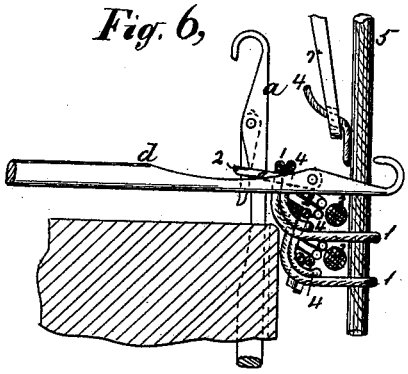


Fig. 9,

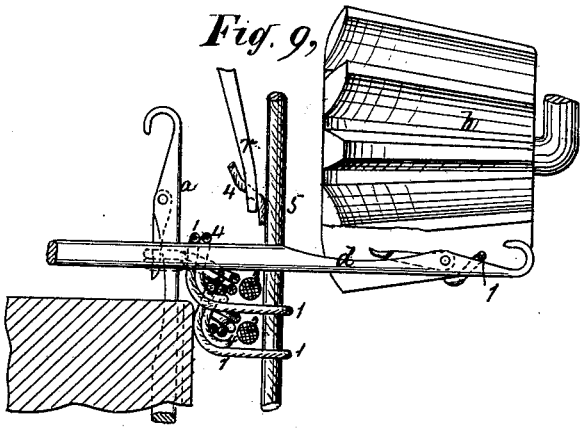


Fig. 7,

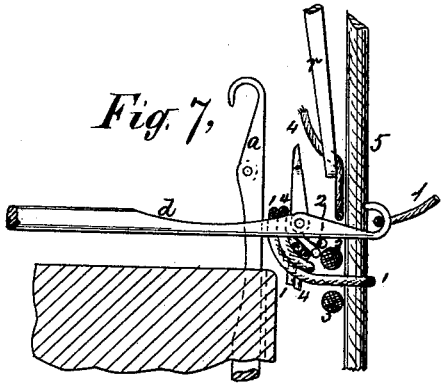


Fig. 10,

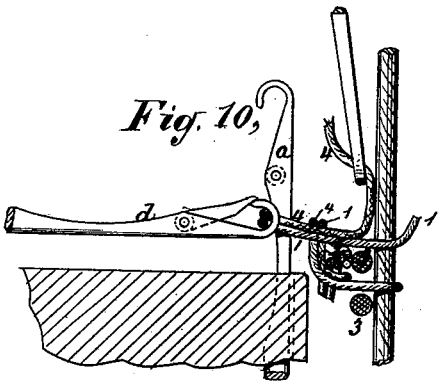
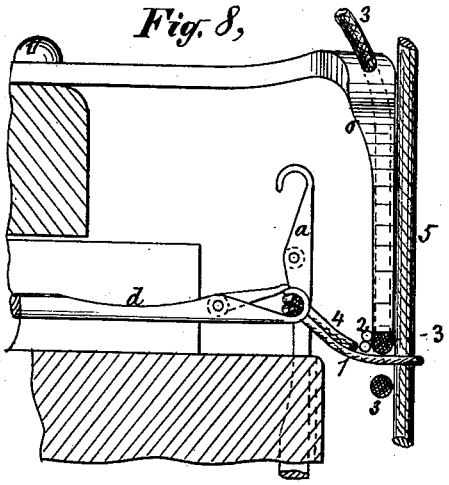


Fig. 8,



Witnesses:
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6 Sheets—Sheet 6.

B. L. STOWE.

Machine for Knitting Tubular Fabrics.

No. 221,628. Patented Nov. 11, 1879.

Fig. 11,

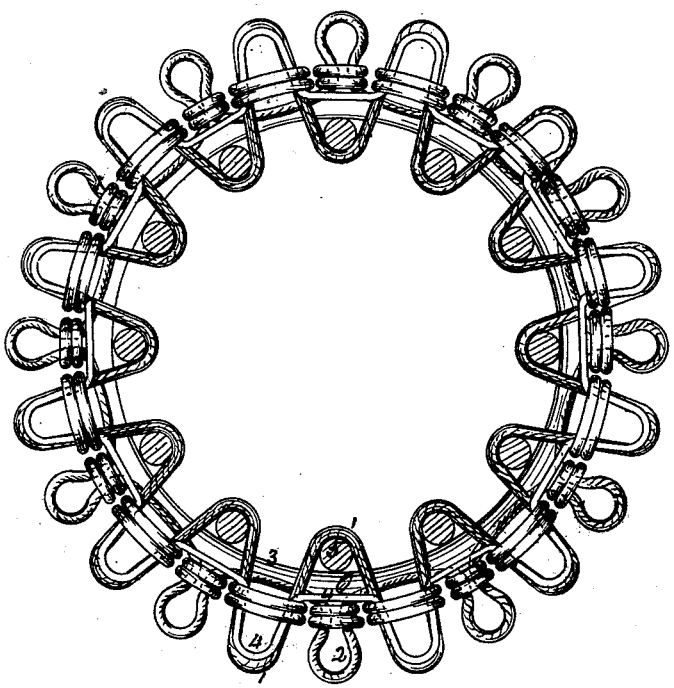
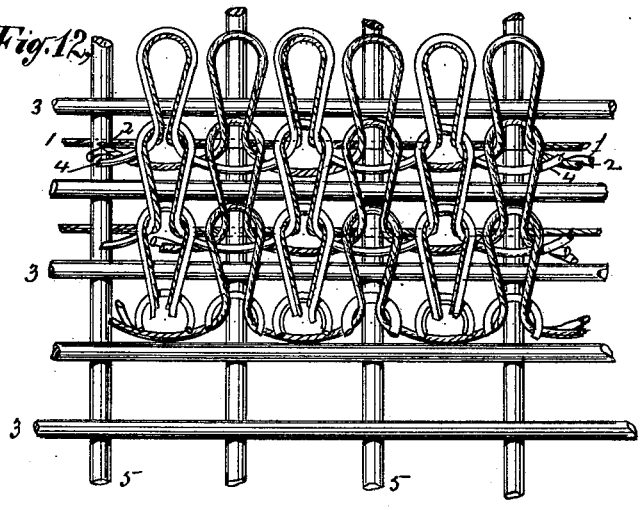


Fig. 12,



Witnesses:
Henry Eichling
Arnet Reed

Inventor
Benjamin L. Stowe

UNITED STATES PATENT OFFICE.

BENJAMIN L. STOWE, OF NEW YORK, N. Y., ASSIGNOR TO J. VAN D. REED, OF SAME PLACE.

IMPROVEMENT IN MACHINES FOR KNITTING TUBULAR FABRICS.

Specification forming part of Letters Patent No. **221,628**, dated November 11, 1879; application filed September 12, 1879.

To all whom it may concern:

Be it known that I, BENJAMIN L. STOWE, of the city, county, and State of New York, have invented certain new and useful Improvements in Machines for Knitting Tubular Fabrics, of which the following is a specification.

My invention relates to machinery for knitting tubular fabrics for use as hydraulic or fire hose, and for other purposes. I have in view a tubular knit fabric, the body of which shall be as strong or even stronger than ordinary knit tubular fabrics of a similar class, while requiring less weight of material for its production. I make the fabric for this purpose of longitudinal inner strands, exterior knitting-warp, and intermediate weft, in combination with an independent warp, whose loops extend from the interior to the exterior of the fabric, binding solidly together the knitting-warp and the longitudinal strands upon the intervening weft.

I remark that the fabric itself I have made the subject of a separate application for Letters Patent of even date herewith. My present application is directed to machinery which I have found well adapted to produce said fabric.

In this machine I make use of two sets of needles, each set of needles receiving and operating on a warp separate from and independent of the other. In conjunction with these instrumentalities I employ longitudinal strand-guides, a weft-guide, and also guides which deliver to the two sets of needles their respective warp-threads.

The nature of my improvements and the manner in which the same are or may be carried into effect can, however, best be explained and understood by reference to the accompanying drawings, in which—

Figure 1 is an elevation of a knitting-machine embodying my improvements. Fig. 2 is a vertical central section of the same. Fig. 3 is a plan of the same with the longitudinal strand-guides removed. Fig. 4 is a plan, and Fig. 5 is an elevation, of a portion of the needle-cylinder developed, in order to show more clearly the construction and relative arrangement of the several thread or cord guides. Figs. 6 to 10, inclusive, are enlarged sectional views, hereinafter referred to, designed to represent the binding warp-stitch in different stages of its formation. Fig. 11 is a sectional end view of the fabric on an enlarged scale. Fig. 12 is an elevation of a portion of the said fabric.

The machine contains two sets of needles, *a* and *d*, the former the usual vertical needles, and the latter horizontal needles, adapted to move to and from the center of the machine in the spaces between the upper ends of the vertical needles. The vertical needles *a* and their blanks *a'* are supported in the needle-cylinder B and operated by the upright cam-ring C. The cylinder B rests on the bed A, and the cam-ring C receives motion from the main driving-shaft D through beveled gearing $C' C^2$.

The arrangement of these parts resembles that of the like parts of ordinary circular-knitting machines, and requires no further explanation.

About the upper end of cylinder B, and firmly fixed to it by gibs and set-screws *b*, is a horizontal needle-plate, E, having in its upper side radial grooves *c*, in which the horizontal needles *d* and their blanks *d'* slide in and out to and from the center of the machine. These needles are operated by the horizontal rotary cam-plate F, which is attached to the upright cam-cylinder C by arms F', and moves with said cylinder.

The stitches made by each set of needles can be lengthened or shortened by the usual appliances, which I have not deemed it necessary to represent in the drawings, inasmuch as they are well known and require no description.

Attached to the bed A is an upright frame, A', which has fastened to it two large annular perforated plates, G H, placed over and concentrically with the needle-cylinder, the number of perforations being equal to the number of longitudinal strands employed, this number usually corresponding to that of the vertical needles. Below these plates and attached to the lower one, is a smaller annular plate, I, correspondingly perforated or notched on its inner edge or otherwise formed

or provided with guides, one for each longitudinal strand. The perforations or guides for the strands in this plate are preferably arranged directly over or a little to the inside of the circle of vertical needles, so that each thread as it is carried vertically down shall be opposite to the inner side of one of the vertical needles.

Immediately over the center of the needle-cylinder a vertical shaft, J, passes down through a bearing attached to frame A′, and it is connected to and receives motion from the main driving-shaft D through the intermediary of shafts J′ J² and beveled gearing, as shown in Fig. 1, in such manner that it is caused to rotate in unison with the cam-rings. Attached to shaft J is an arm, *e*, carrying the bobbin *f*, from which one thread, 1, is supplied to the horizontal needles, said thread being guided to the needles by passing through a guide-eye, *g′*, on an arm, *g*, fastened to the shaft, Fig. 3. The arm *g* also carries a toothed wheel, *h*, Fig. 2, whose teeth work in the spaces between the horizontal needles, and whose function is to press the thread 1 down far enough to insure its being taken by the said needles. The thread 1 is one of the binding-warps.

The knitting-warp, which is operated on by the vertical needles, is shown at 2. It is supplied from one or more bobbins, *i*, carried by an arm, K, fastened to and moving with the horizontal cam-ring F, and is guided properly to the vertical needles through a hook, *j*, and eye *k* on the cam-ring F. Another arm, L, upon the opposite side of the cam-ring F, carries two bobbins, *l* and *m*, the former supplying the weft 3, and the latter carrying a second warp-thread, 4, for the horizontal needles. The weft 3 passes through the tension *n*, or its equivalent, and thence to the guide *o*, by which it is deposited in its proper place in the fabric. This guide consists of an arm attached to cam-ring F, which arm extends inwardly until it nearly touches the longitudinal strands 5 as they pass from the guide I to the working-point, and then turns obliquely down until its delivery-point is just below the level of the horizontal needles, as shown plainly in Figs. 4 and 5. It has an eye, *o′*, at its top, and a flange or lip, *o²*, extending downward on its inner side, in such manner as to prevent the tension from drawing the weft against the longitudinal strands until a point low enough to prevent its tension from forcing the longitudinal strands too much toward the center is obtained.

The thread 4 from the spool *m* passes through the eyes *p′* and *r′* in the ends of two arms, *p r*, both of which are fastened to the horizontal cam-ring F, and at their guide ends extend to within a short distance of the longitudinal strands. The eye *p′* is high enough to hold the thread above the tops of the vertical needles, and the eye *r′* is between the longitudinal strands and the vertical needles, and just above the level of the horizontal needles, as will be seen by reference to Figs. 4 and 5.

I thus use in the machine four threads or sets of threads—viz., the longitudinal strands 5, the knitting-warp 2, the weft 3, and the binding-warp 1 4. The manner in which these threads are conducted to the working-point has already been indicated in the foregoing description. I may add that the strands 5 are carried in any convenient manner from the spools upon which they are mounted (not shown in the drawings) to a point over the machine, whence they are brought down to and passed through the annular perforated plates hereinbefore referred to, passing down into the fabric upon a line parallel, or nearly so, with the axis of the machine.

I also remark, with respect to the binding-warp thread or cord 1, that it passes from its spool *f* (which is inside the cage formed by the annular plates G H and the strands 5) first through a suitable eye or guide to lead it in a direct line from the spool, and then to and through the eye *g′*, which is placed just above the level of the horizontal needles and at a point a little in advance of the point to which these needles are successively advanced by the horizontal cam-ring F.

The other binding warp-thread, 4, is delivered from its guide *r* just in advance of the point at which the latch of the horizontal needle is closed upon the inside warp-thread, 1, by the stitch or loop already on the body of the needle, so that the latch in closing shuts down also upon this thread and presses it into the hook of the needle along with the thread 1.

The weft 3 is deposited by its guide just as the horizontal needle begins advancing, and is crowded low enough by the point *o³* of that guide to admit of the needle passing above it.

The operation of the parts above described is as follows, it being supposed that some knitting has already been done upon the machine, and that the needles are in the positions in which they are shown upon the left of the developed plan and elevation, Figs. 4 and 5: In this position the vertical needles are elevated sufficiently to hold the loops of the knitting-warp 2 upon them.

The horizontal needles are withdrawn, the binding warp-thread 4 passes from the hooks of one to another of these needles outside of the longitudinal strands and under the knitting-warp 2 as it leads from one to another of the vertical needles, and the binding-warp 1 also leads from one to another of the horizontal needles, but, unlike warp 4, passes around the inside of one of the longitudinal strands 5 in its passage, and binds the whole fabric firmly together. The weft is below all these stitches.

Referring now to diagram, sectional, Figs. 6 to 10, inclusive, if the machine be put in motion the guide *o* will presently press all of these stitches down and will deposit the weft above them, as seen in Fig. 8. One of the

horizontal needles will advance immediately behind the point of guide *o* and will pass over the weft just deposited. The knitting-warp 2, as it leads from one vertical needle to another, passes over the warp constituting the previously-formed loop on the horizontal needle, and the weft-thread just deposited will prevent said loop from advancing with the horizontal needle, and consequently the latch of the latter will be opened and the loop crowded back upon its body, as seen in Fig. 6. After penetrating the circle of longitudinal strands 5, the point or hook of the horizontal needle will pass under warp 1 as it leads from its guide, and the toothed wheel *h*, following immediately after, will crowd the warp 1 low enough for the hook of the needle to engage it, as seen in Fig. 9. The end of guide *r*, with warp 4 just outside of the longitudinal cord 5, will also be observed in this figure. The horizontal needle then withdraws until the loop already on the body of the needle causes its latch to partly close, as seen in Fig. 7, at which time the warp 4, by its guide *r*, is laid just above the needle in such manner that the latch, as it continues to close, will press the warp 4 into the hook of the needle along with warp 1, and the result will be as shown in Fig. 10.

The movement of the machine being continued, the knitting-warp 2 is presented to the vertical needles by its guide, after which it falls and forms its stitches as in an ordinary machine.

The fabric produced by a machine thus organized is represented in Figs. 11 and 12, the vertical rows of stitches formed by the binding-warp 1 4 being laid in the grooves that would otherwise intervene between the rows of loops or stitches of the knitting-warp.

The fabric thus made possesses much strength and durability. It is not so liable to break as ordinary fabric of this class, and in event of any one stitch of one warp becoming cut there is another independent warp behind it, which holds the stitches upon either side of it, and prevents the fabric from opening at that point.

Inasmuch as I may use only a single binding-warp or set of warp-threads arranged as thread 1 to pass from the inside to the outside of the fabric, the bobbin and the guide or guides for the thread 4 may be dispensed with. I prefer, however, to use for the binding-warp the two threads 1 and 4 in conjunction.

I have indicated one way in which my invention can practically be carried into effect. It is manifest, however, that the details of the machine can be varied, and that the construction and arrangement of the several guides may be modified without departure from my invention—as, for instance, the weft 3 may, by proper arrangement of the guide which deposits or delivers it, be deposited outside of the circle of vertical needles instead of within that circle. In that event it would still be held in position by the binding-warp and knitting-warp whether the longitudinal strands were used or not, and in this way I could produce a fabric from which the longitudinal strands would be omitted. For some purposes such a fabric would be available; but generally it is desirable to retain the longitudinal strands, especially in knitting hose.

Having described my improvements, what I claim, and desire to secure by Letters Patent, is—

1. In machinery for knitting tubular fabrics, the combination, with vertical needles, horizontal needles working in and out in the spaces between said vertical needles, and cam-rings, and actuating mechanism for operating both sets of needles, of a longitudinal strand-guide, a weft-guide, a binding-warp guide which delivers binding-warp to the horizontal needles at a point within the circle of longitudinal strands, and a guide for delivering knitting-warp to the vertical needles, said warp and weft guides being mounted on the cam-rings or some part moving in unison therewith, and arranged to deliver their respective threads relatively to one another, substantially as hereinbefore set forth.

2. In machinery for knitting tubular fabrics, organized and operating substantially as described, the combination, with the vertical and horizontal needles and guiding means for the longitudinal strands, of the two binding-warp guides, arranged to deliver to the horizontal needles the two threads of the binding-warp, the one at a point within the circle of longitudinal strands, the other at a point between said strands and the vertical needles, substantially as and for the purposes hereinbefore set forth.

3. The combination of the vertical and horizontal needles and their actuating mechanism, the guide or guides for delivering binding-warp to the horizontal needles, the guide or guides for delivering knitting-warp to the vertical needles, and the guide for delivering or depositing the weft relatively to the binding and the knitting warps, substantially as hereinbefore set forth.

In testimony that I claim the foregoing I have hereunto set my hand.

BENJAMIN L. STOWE.

Witnesses:
ALMET REED,
NATHAN STOWE.