(No Model.) 3 Sheets—Sheet 1.

G. H. KNIGHT.

PAPER TUBE MACHINE.

No. 574,034. Patented Dec. 29, 1896.

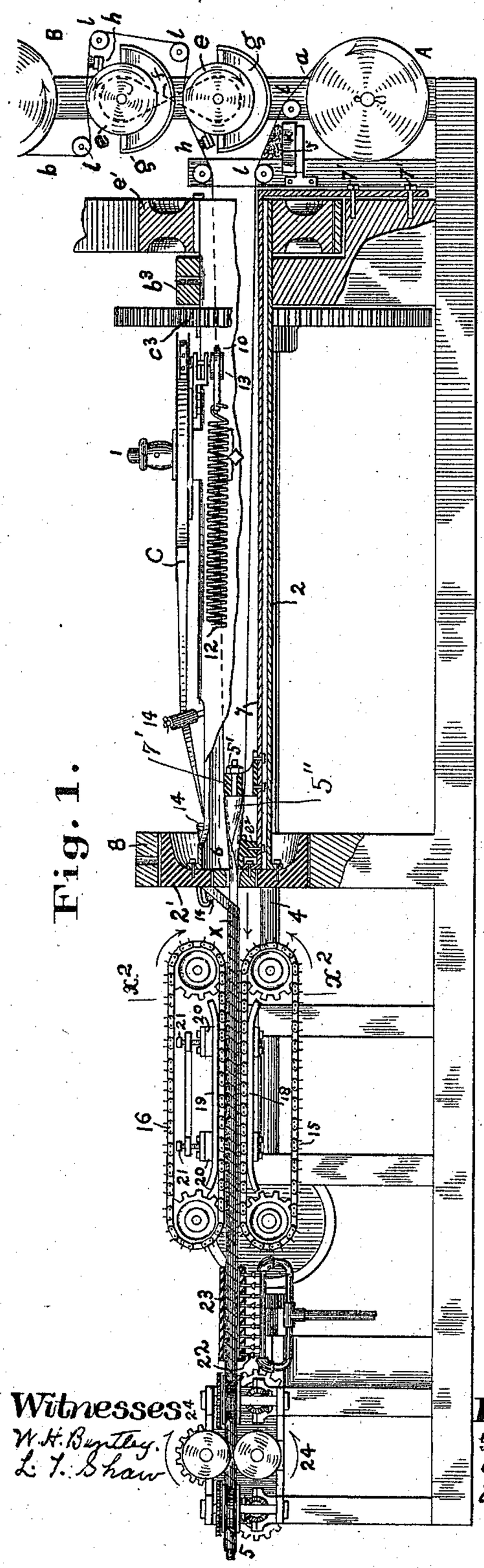

Fig. 1.

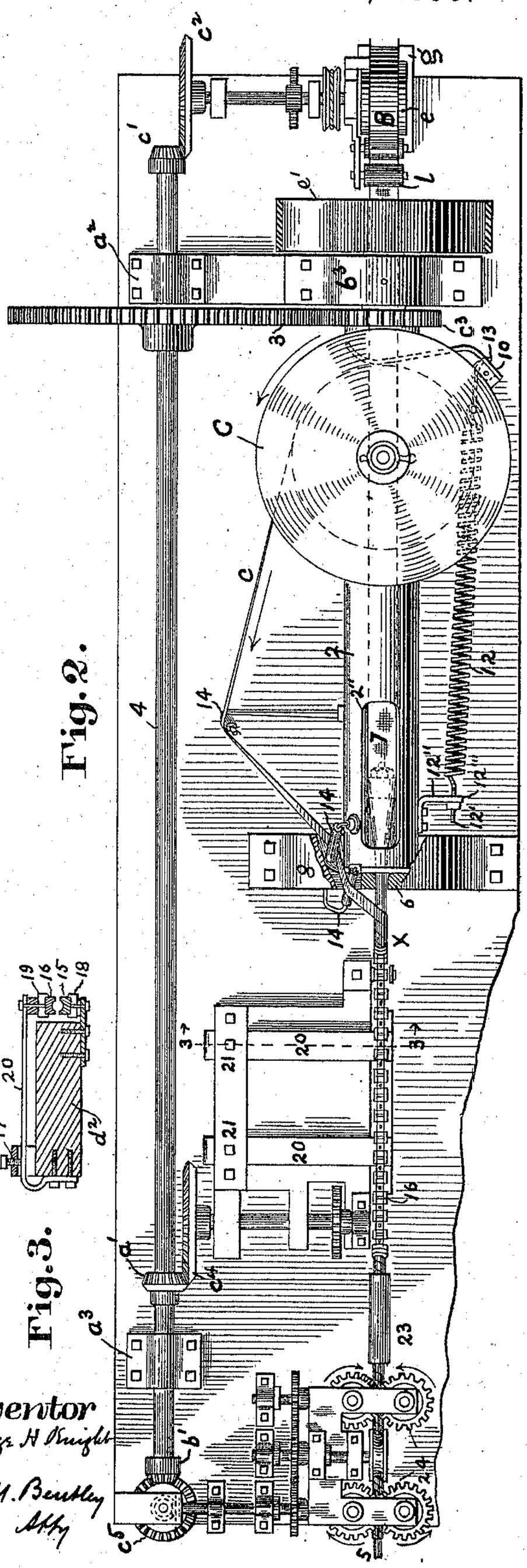

Fig. 2.

Fig. 3.

Witnesses
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L. T. Shaw

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George H. Knight
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.) 3 Sheets—Sheet 2.

G. H. KNIGHT.

PAPER TUBE MACHINE.

No. 574,034. Patented Dec. 29, 1896.

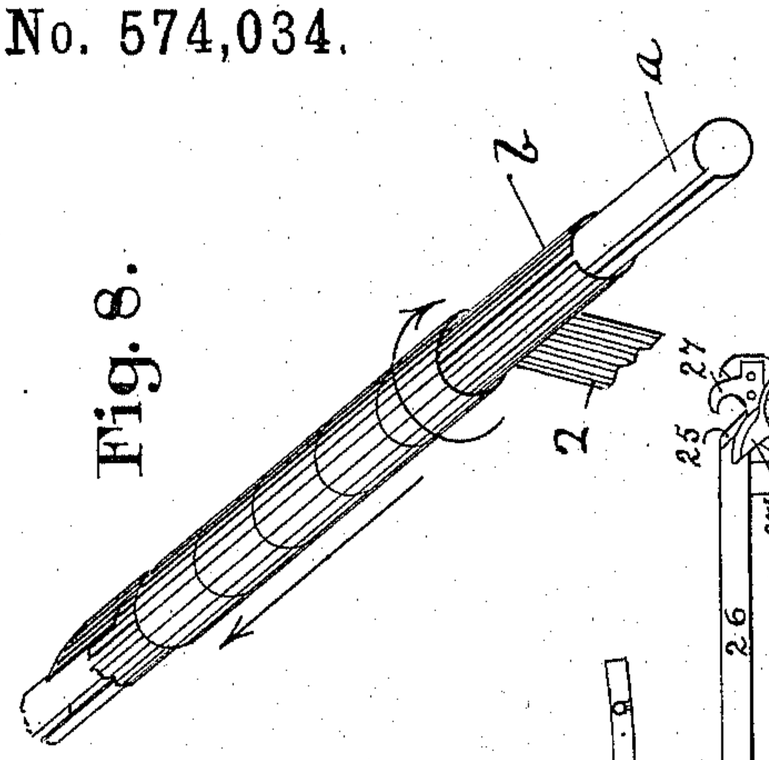


Fig. 8.

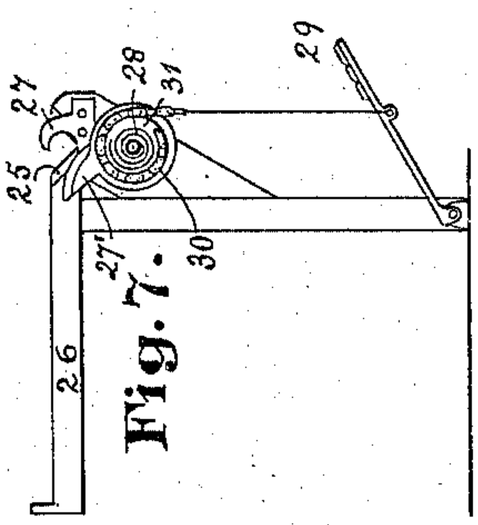
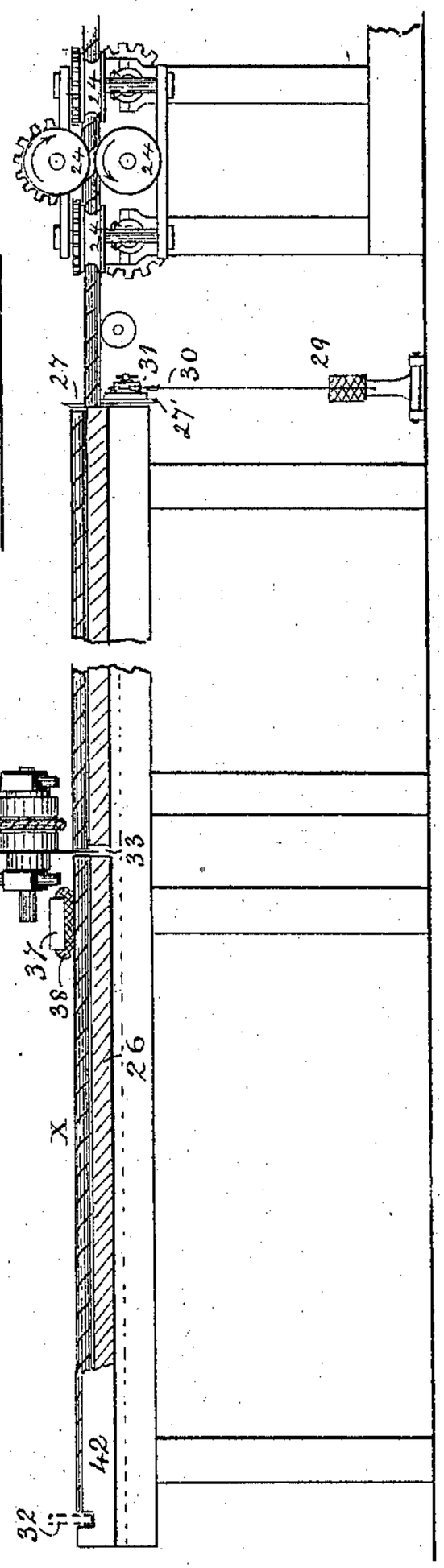


Fig. 7.



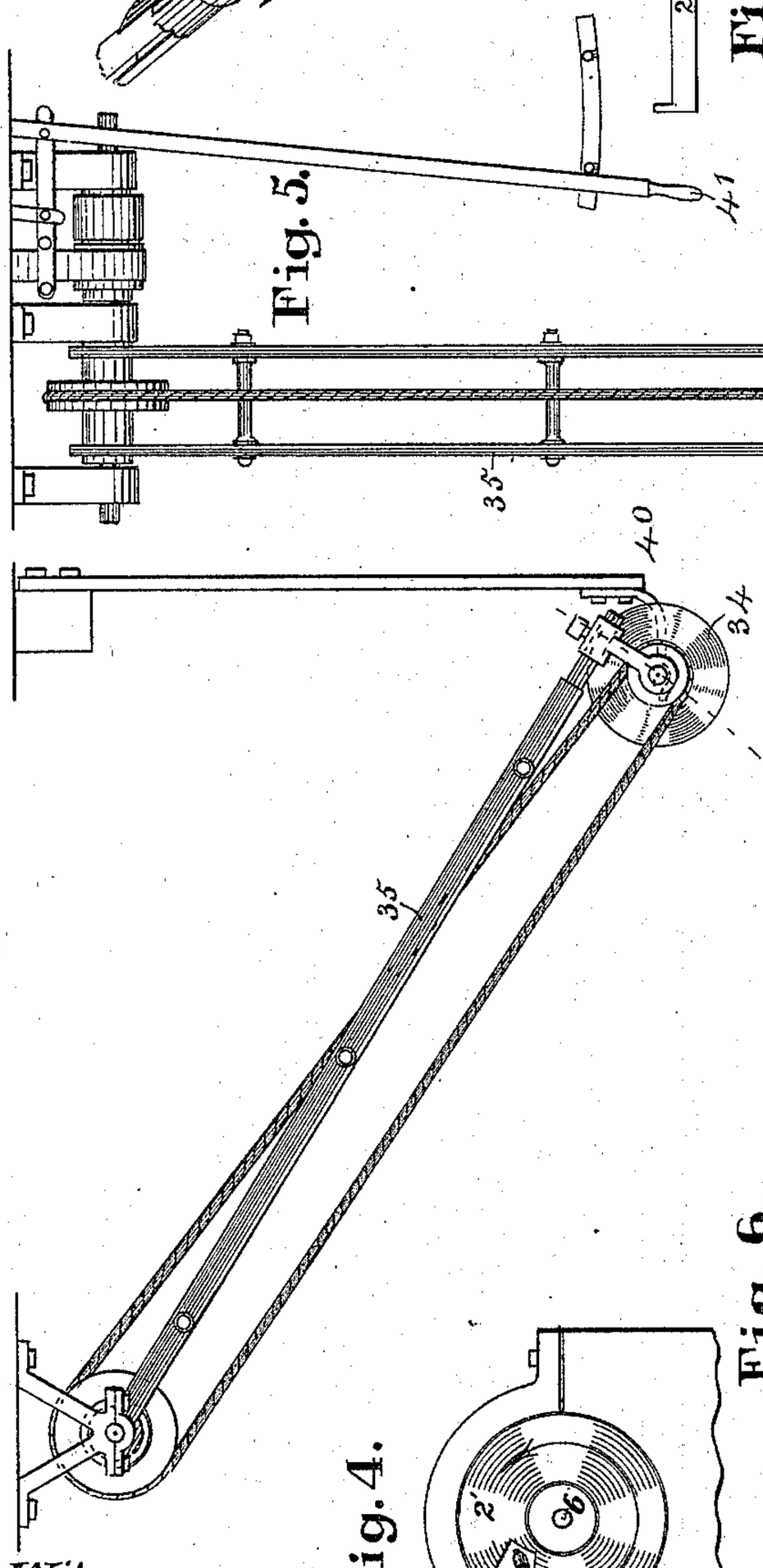


Fig. 5.

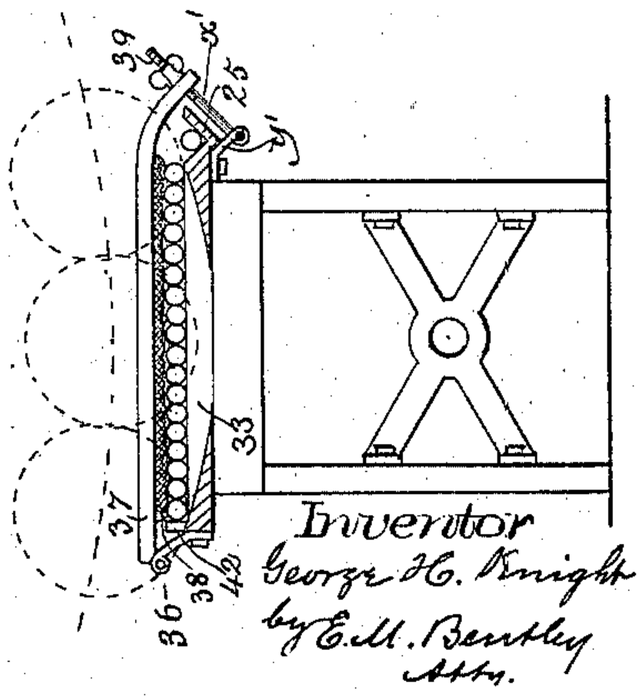


Fig. 6.

Fig. 4.

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(No Model.) 3 Sheets—Sheet 3.

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FIG. 9.

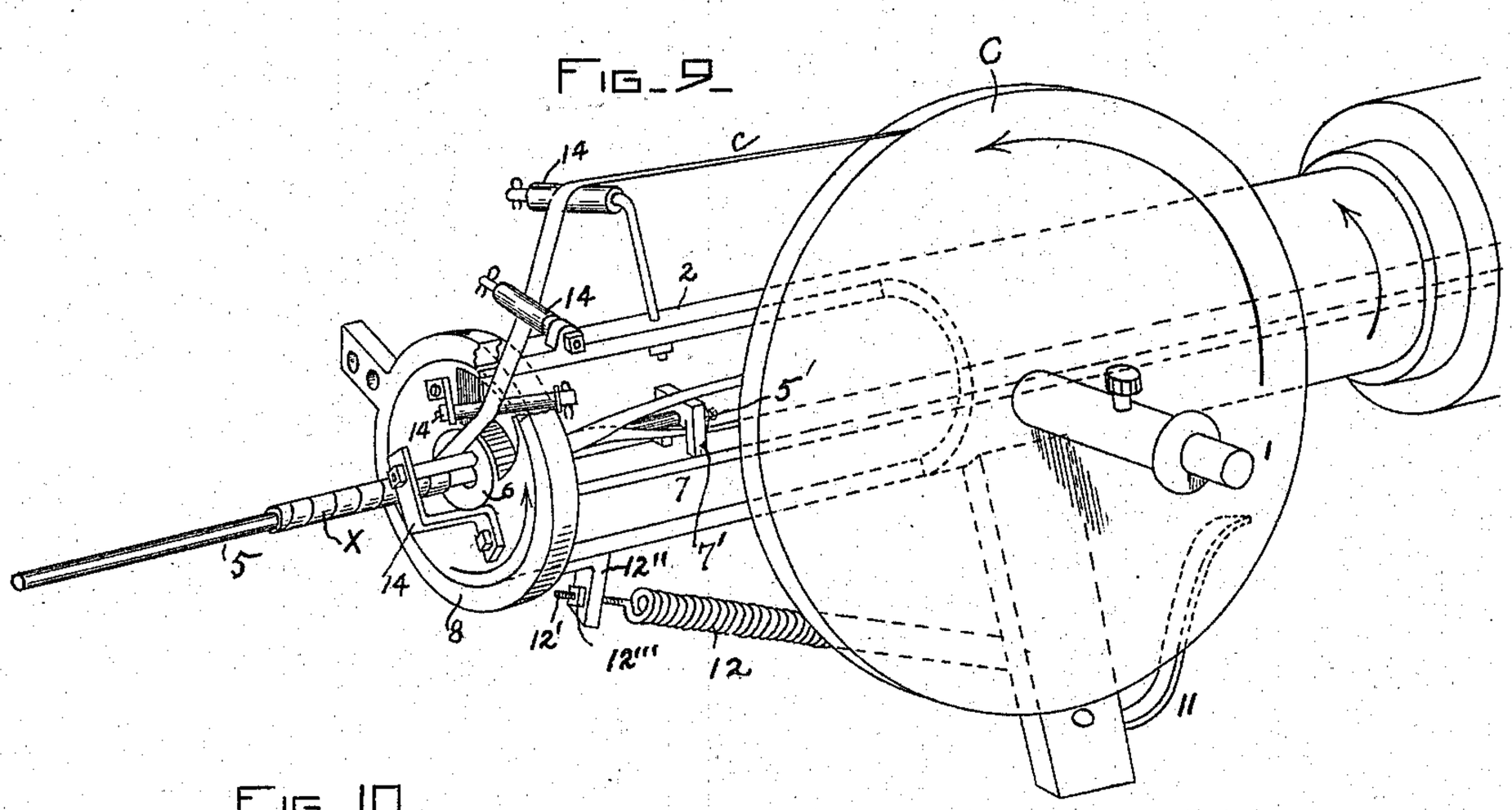


FIG. 10.

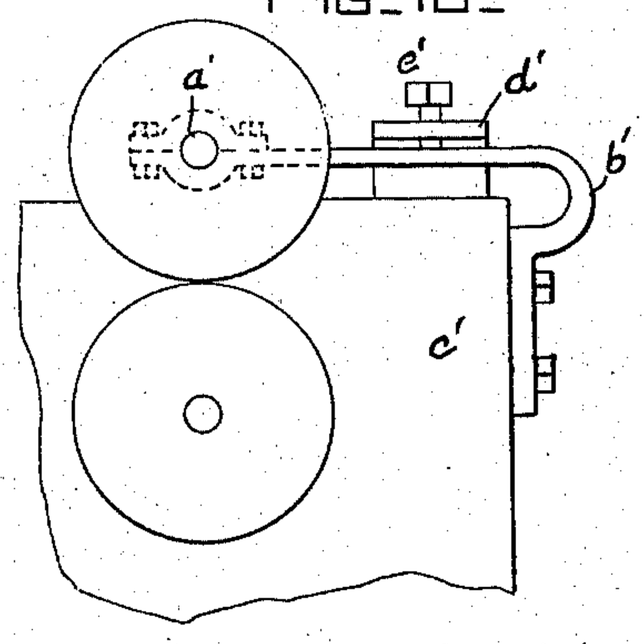


FIG. 14.

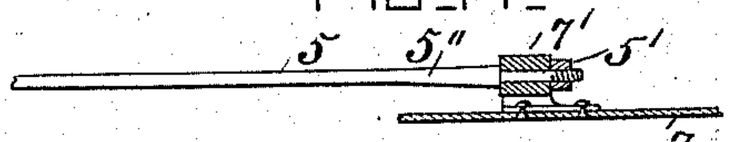


FIG. 13.

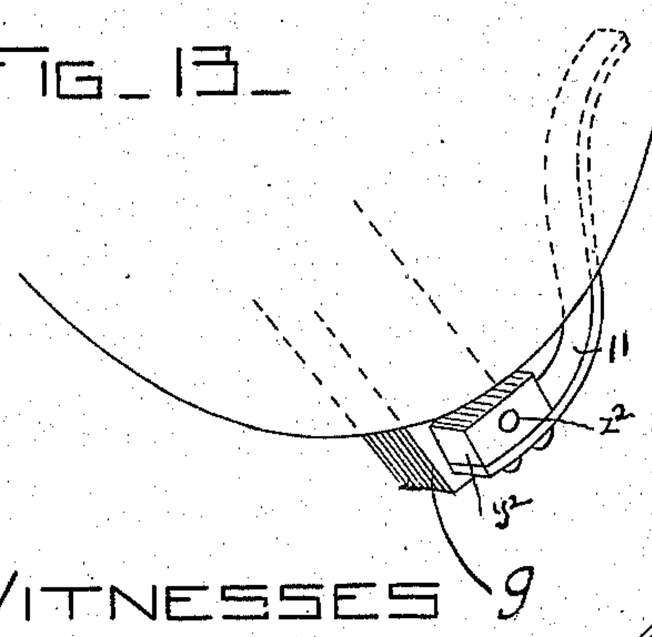
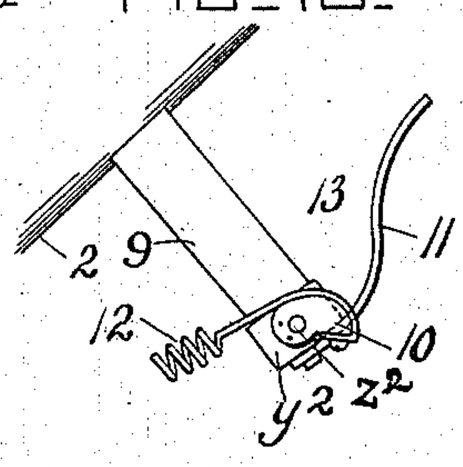


FIG. 15.



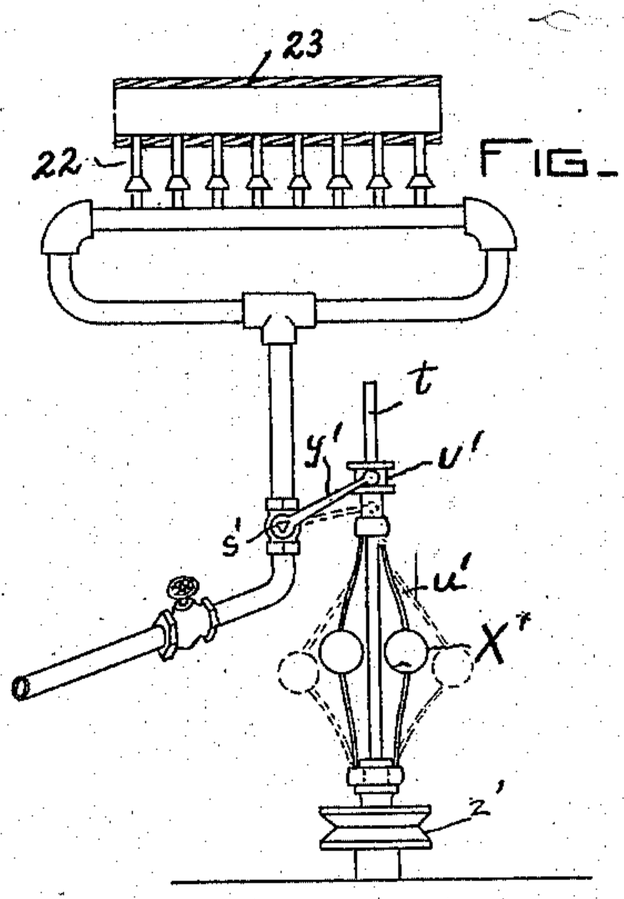


FIG. 11.

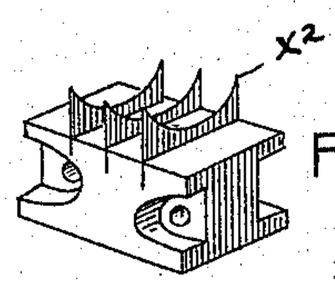


FIG. 12.

WITNESSES

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UNITED STATES PATENT OFFICE.

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PAPER-TUBE MACHINE.

SPECIFICATION forming part of Letters Patent No. 574,034, dated December 29, 1896.

Application filed February 1, 1895. Serial No. 536,920. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. KNIGHT, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented a certain new and useful Improvement in Paper-Tube Machinery, of which the following is a specification.

My invention relates to paper-tube machinery; and it consists in a machine for forming paper tubing by combination, with two longitudinal interior strips, of one exterior wrapping-strip.

Certain details not claimed herein are features of construction which are not of my invention.

My invention is especially directed to the manufacture of a compact and uniform cylindrical tube composed of three layers of paper tape by application of interior-forming and of exterior-forming and feeding devices continuously from the point of application of the component tapes to that of their delivery in tubular form.

Figure 1 is an elevation, partly in section. Fig. 2 is a top plan view. Fig. 3 is a section on line 3 3, Fig. 2. Fig. 4 is an inner end view of the rotatable sleeve. Fig. 5 is an elevation, partly in section, of the receiving-bench and saw. Fig. 6 is a sectional view of the table at point 33, Fig. 5. Fig. 7 is an inner end view of the table, showing the shear. Fig. 8 is an elevation showing the different layers composing the tubing. Fig. 9 is a perspective of the inner end of the sleeve slightly modified. Fig. 10 illustrates details for varying the pressure of the shaping-rolls. Fig. 11 shows the device for regulating the drying-flame. Fig. 12 illustrates details of chain construction, and Fig. 13 shows the method of attaching the spring-pressed tongue. Fig. 14 is a vertical section which shows the attachment of the mandrel to its supporting-tongue. Fig. 15 represents the fusee connection of the roll-pressing tongue with its actuating-spring.

In the drawings, 4 is a shaft carrying the the gear-wheels c', 3, a', and b', meshing, respectively, with wheels c^2, c^3, c^4, and c^5. The shaft 4 rotates in bearings a^2 and a^3. The wheel c^3 is mounted on a sleeve or cage 2, (preferably cylindrical,) which rotates in bearings 8 and b^3. One or more openings 2″, cut in the sleeve 2 afford convenient access to the parts within the sleeve. The inner end of the sleeve is provided with a bushing 2′, centrally perforated, and the outer end carries the driving-pulley e'. Securely fastened to the standard which supports bearing b^3 by bolts 7′ is a stiff-metal tongue 7, which extends from the outer to the inner end of the sleeve 2 within the sleeve, but free from contact therewith. By means of a lug e^2, secured to the inner end of the tongue 7, a perforated disk 6 is supported concentrically within the opening in the bushing 2′. The disk is therefore stationary, while the bushing 2′ is free to rotate about it. The opening in the disk is funnel-shaped, with its larger opening directed toward the tape-rolls, so as to freely admit the tapes.

The tongue 7 has a perforated lug or sleeve 7′, which, together with a nut 5′, supports one end of the mandrel 5, which mandrel is tapered, as at 5″, for a short distance from the point of attachment to the lug 7′ and then has a uniform diameter to its other extremity beyond the rolls 24.

Of the two longitudinal tapes which enter into the composition of the tubing one is fed to the mandrel from a roll on the reel A and is designated as tape a in the drawings. This is the innermost of the three tapes composing the tube. Before entering the sleeve 2 to be applied to the mandrel it passes over guide-rolls l, and instead of being pasted is merely moistened with water supplied to the sponge j in a cup k. The moistening of the tape increases its lateral flexibility, and it therefore readily accommodates itself to the shape of the mandrel. When it is afterward dried, it acquires a new set corresponding to the cylindrical surface of the mandrel.

Tape b from reel B, by means of guide-rolls l, is caused to pass over the surface of the paste-rolls e, partially immersed in paste contained in the vessels g, in such a way that paste is applied to both sides of the tape. Brushes h serve to remove the excess of paste. I have found that a very even distribution of the paste may be effected by arranging the two rolls so that they will be positively rotated against the tape b in a direction opposite to

the line of travel of the tape. This may be done by means of the shafting and wheels and belt *f*, as shown. By moistening the tape *a*, which is the only one directly in contact with the mandrel, and pasting both sides of tape *b* sufficient paste is provided to unite tapes *a* and *b* and tape *b* with tape *c*, called the "wrapper," which is fed from the roll within the reel C. By this arrangement no paste comes in contact with the mandrel and all danger of the tubing adhering to the mandrel is avoided.

The reel C has a compound rotation, that is to say, it is so journaled on a stud 1, that projects radially from the rotary sleeve 2, that, besides sharing in the rotation of said sleeve, it has an independent capacity for rotation parallel to said sleeve's axis. Suitable fair-leaders or guide-rolls 14 are provided to conduct the tape *c* so that it will be applied about the two longitudinal tapes *a* and *b* at a point beyond the inner extremity of the sleeve 2. All the guides are mounted on studs which, like the stud 1, rotate with sleeve 2.

Journaled in a lug 9, that projects from the rotating sleeve 2, is a fusee or eccentric 10. A rigid tongue 11 on the fusee is caused to press forcibly against the periphery of the paper roll on reel C by a spring 12, which has a flexible connection 13 with the periphery of the fusee. The eccentricity of the fusee is such as to maintain a uniform spring-pressure upon the paper roll whether the roll is full or partially full. The other end 12′ of the spring 12 is threaded and is attached to a lug 12″, through which the end passes. A nut 12‴ allows adjustment of the spring-tension. Attachment of the pressure-tongue 11 to the fusee 10 may be by means of a block y^2 and a pin z^2, journaled in a lug or projection 9 of the sleeve 2, as shown in Figs. 13 and 15.

Suitably-mounted sprocket-wheels driven by shafting operated by wheel c^4 carry chains 15 and 16, one below and one above the mandrel 5. Teeth or projections x^2 on the links of the chain grip the tubing formed on the mandrel, and as the chains adjacent to the tubing both move in the same direction their combined action serves to carry along the tubing X away from the sleeve 2 and shaping and compacting the several component plies about said mandrel.

In Fig. 3 is shown the device which performs three separate functions—viz., first, to feed or drag the tubing forward; second, to compact the component plies or tapes firmly together; third, to contribute to the uniform and cylindrical shaping of the tubing about the mandrel. A suitable projection d^2 of the frame carries a supporting-guide 18.

Pressure-guide 19 is supported at the extremity of springs 20, which pass under the bridge 17, and between these two guides the said feed-chains 15 and 16 pass. Screws 21 in the bridge are used to vary the tension of springs 20. As the tension of the springs is varied the pressure of the guide 19 on chain 16 is also varied, and the chain therefore bears with greater or less pressure on the tubing formed about the mandrel 5, either generally or relatively with respect to the receiving and delivering ends of said feed.

23 is a metal shell or trough through which the mandrel passes. The shell is supported by a frame which also supports a number of Bunsen burners. When lighted, the flame from the burners 22 enters the shell and is uniformly distributed about the tubing.

The gear-wheel c^5 operates shafting carrying a series of grooved shaping-rolls 24 in sets of two. Each one of a set coacts with its fellow to compress the tubing and shape it on the mandrel. But three sets are shown, though in practice any number of sets may be used, being arranged alternately to bear vertically and longitudinally on the tubing. Being situated in close proximity to the shell 23, they receive considerable heat from the tubing before it has had time to cool, and they have therefore the added function of retaining heat to assist in drying the paste.

In Fig. 10 is shown an arrangement whereby one of each of the sets of shaping-rolls 24 is made adjustable, so that its pressure upon the tubing may be varied. The shaft *a*′ for the rolls 24 may be mounted in bearings secured to one extremity of spring *b*′, the other extremity being rigidly attached to framework *c*′. The bridge *d*′, through which the spring *b*′ passes, is provided with an adjusting-screw *e*′, which is used to vary the tension of the spring, thereby varying the pressure of rolls 24 on the tubing.

The operation is as follows: The inner two tapes *a* and *b* from stationary reels A and B are led in through the outer open end of the cylindrical sleeve 2 and conducted onto the tapered mandrel 5 in such a manner as to "break joints." The outside tape from reel C is then given a few turns about the mandrel over the inner tapes near the inner end of the casing, secured by an adhesive ribbon, and the machine started. The rotation of the sleeve to which the reel C is attached causes the tape from that reel to be wound spirally about the inner two tapes, so as to completely cover the same without overlapping. As fast as the tubing is thus formed it is carried along on the mandrel by the chains 15 and 16 and passes through the shell 23, which confines and distributes the heat from the Bunsen burners, where the drying of the tubing is begun. The shaping-rollers 24 then compact, smooth out, and shape the tubing, after which it runs off the end of the mandrel. It may then be cut into proper lengths.

It is, of course, understood that all the parts of the machine are relatively proportioned, and the speed of the chains 15 and 16 is so adjusted that the tubing is drawn away from the sleeve no faster than it is formed. All mechanism being geared directly or indirectly to the rotating sleeve 2, the movements of the

tube-forming and the tube-delivering mechanism are synchronous.

The bushing 2′ is perforated, as shown in Fig. 4, to allow the paper *c* to pass out and reach its place upon the longitudinal tapes. The reel C rotates with the sleeve 2, and therefore has a twofold rotation—viz., on its own stud or spindle and about the axis of rotation of the sleeve 2.

After leaving the shaping-rolls 24 the completely-formed tubing is pushed along in the grooved extension 25 of the table 26. Attached to the end of the table, near the rolls 24, is a shear having a rotatable jaw 27′, coacting with the stationary jaw 27. In its normal position the jaw 27′ is out of contact with the tubing, the tension of the coiled spring 28, which is attached to the pivot on which 27′ rotates, serving to retain it in the position shown. A shoulder is cut in the outer face of 27′ and one end of the chain 30 is pinned thereto, the other end passing over the shoulder and being connected to the treadle 29. Pressure of the operator's foot upon the treadle unwinds the chain, the jaw 27′ being thereby turned over toward 27 to coact with it in severing the tubing. When the foot is taken from the treadle, the tension of spring 28 returns the jaw 27′ to its normal position. By means of the shear the tubing is severed when it has extended the full length of the groove or trough 25, a gage plate or stop 32 being provided at end of the groove 25 to facilitate cutting the tubes of uniform length. The trough being of V form serves a useful purpose in maintaining the rectilinarity of the tubing until complete consolidation. After being severed the tube is rolled up out of the trough onto the table 26, which is formed with a flange 42 for retaining the tubes thereon. The table is provided with the padded clamp 37, hinged at 36 to a lug. A threaded bolt *x*′, provided with the thumb-screw 39, is hinged to a second lug *y*′ on the other side of the table and serves to retain the clamp 37 when it is brought over and placed over the tubing X, previously cut off in suitable lengths, and laid adjacent to each other on the table. The clamp 37 is provided with the cushion 38 to prevent undue pressure on the tubes.

When the surface of the table has been covered with a full bank of tubing secured by the clamp 37, a swinging saw 34, adapted to enter the groove 33 in the table 26, is brought down into contact with the tubes, severing them at the point where they cross the groove 33. When not in use, the saw-frame 35 is thrown upward and secured by the hooked extremity of the depending strip 40. A belt-shifting lever 41 is arranged conveniently near. Several saws might thus be arranged, so that more than one cut could be made without disturbing the tubing. Two saws thus arranged could be used to cut thirty-feet lengths of tube into three sets of merchantable lengths of, say, ten feet.

In Fig. 11, X′ represents a governor for controlling the flow of gas to the Bunsen burners, and the solid lines indicate the normal or cut-off or nearly cut-off position of the valve-handle *y*′. The governor is provided with the grooved pulley *z*′, adapted to receive a belt driven from some part of the rotating tube-forming machinery at a rate of speed sufficient to cause the springs *u*′ to be thrown out to the position shown in dotted lines. The end of the handle *y*′ rests in a carrier *v*′, to which the said springs are connected, and the carrier is perforated to receive the spindle *t*, upon which it is adapted to slide in a vertical direction. With the governor shown in the position represented by dotted lines the carrier is drawn down, carrying the handle *y*′ with it and opening the valve *s*′. This position is maintained so long as the tube-forming mechanism is in operation. Any slackening of the feed is accompanied by a corresponding collapse of the springs *u*′ and partial closure of the valve *s*′. Upon cessation of the feed movement from any cause the collapse of the governor pushes up the handle *y*′ and extinguishes or nearly extinguishes the burner-flames. Some such automatic regulation is rendered necessary by the fact that the tubing is charred and rendered worthless, when no longer in motion, by even a brief contact with the flame.

Fig. 12 shows the manner in which steel teeth x^2 are attached to the sections of the chains 15 16 for gripping the tubing. The said teeth (which are driven into slots cut in the said sections) are formed concave on their edges, so as to grasp the tubing and to coact with the mandrel in imparting the desired cylindrical shape to said tubing.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a machine for the manufacture of tubing out of two or more plies of paper tape; the combination with a fixed central former or mandrel, of a pair of toothed, synchronously-propelled feeding and forming chains and independently-adjustable pressure-springs at the receiving and delivering points of said feeding and forming chains; substantially as set forth.

2. In a machine for making paper tubing from three paper tapes or ribbons; the combination of a rotatable sleeve or cage, an included stationary mandrel, a tongue which extends within said sleeve and supports said mandrel on a line coincident with the axis of said sleeve a reel which carries the wrapping-tape and which partakes of the rotation of said sleeve and also revolves about its own axis a pair of toothed and synchronously-propelled feeding and forming chains and independently-adjustable pressure-springs at the receiving and delivering points of said chains respectively; for the purpose set forth.

3. In a machine for making paper tubing, the combination of a rotatable sleeve or cage, a compound rotating reel carried thereupon,

a stationary mandrel which enters the delivery end of said sleeve, a support for the mandrel within said sleeve, and, attached to said support, and a disk whose funnel-formed orifice encircles, without touching, said mandrel at the point where the mandrel enters the sleeve, substantially as described.

4. In a paper-tube machine; the combination of a rotatable sleeve, a stationary mandrel which enters one end of said sleeve, a perforated disk concentric to but out of contact with said mandrel, and a bushing attached to and revolving with said sleeve and which surrounds said disk; substantially as described.

5. In a machine for making paper tubing; the combination of a rotatable sleeve or cage, a stationary mandrel which enters said sleeve at its delivering end, a support for said mandrel which enters said sleeve at its receiving end, a perforated disk which surrounds without touching said mandrel at its point of entrance into said sleeve and a concentric rotatable bushing which embraces said disk; substantially as set forth.

6. In a paper-tube-forming mechanism, the combination of a mandrel about which the tubing is formed, a rotating sleeve or cage, a compound rotating reel carried thereby a pair of toothed positively-acting feeding and forming chains which are caused to travel synchronously with the tube-wrapping mechanism and independently-adjustable pressure-springs at the receiving and delivering parts of said chains respectively; substantially as described.

7. In a paper-tube-forming mechanism; the combination of a stationary mandrel about which the tubing is formed, a rotatable sleeve or cage, a compound rotating reel carried thereby, a pair of toothed positively-acting feeding and forming chains that are caused to travel synchronously with the tube-wrapping mechanism and means for varying the pressure of said feeding and forming chains upon the tubing at the places of reception and delivery; substantially as set forth.

8. In a paper-tube-forming mechanism having a mandrel about which the tubing is formed and having a rotating sleeve or cage; a pair of positively-actuated chains (which are caused to travel synchronously with the tube-wrapping mechanism) for drawing the tube along the mandrel and forming and compacting said tube, and means for varying the tube-pressure at the points of feed entry and delivery respectively which consist of two springs supporting a guide to one of said chains and of means for varying the tension of the respective springs; substantially as set forth.

9. In a paper-tube machine, the combination of a rotatable sleeve or cage, a stationary mandrel therein, a reel supported by and revolving with said sleeve and having an independent rotation and supplying paper tape spirally for the tubing, two reels which supply as many concentric longitudinal tapes, and means for applying paste to the outer and moisture to the inner longitudinal tape; substantially as set forth.

10. In a paper-tube machine using three superposed paper tapes drawn from as many reels; the combination of a pair of drums or cylinders partially immersed in paste and caused to rotate in contact with the respective sides of the intermediate tape *b* and in the opposite direction to its line of travel and a moistening device which consists of a sponge partially immersed in water and against which the innermost tape *a* is drawn.

11. In a paper-tube machine; the combination with a stationary forming-mandrel, of the inclosing rotary sleeve or cage 2 that supports and carries around with it in its rotation, a radially-extending stud or spindle 1, a reel C adapted to revolve thereon and to contain the roll of winding-tape *c*, a fusee 10, a tongue 11 that projects therefrom, a spring 12 which has a flexible connection 13 with said fusee's periphery and a means 12‴ for regulating the spring-tension; substantially as set forth.

12. In a machine for making paper tubes; the combination of one or more Bunsen burners 22, a gas-regulating cock or valve *s'* and a governor connected therewith and with some moving part or member of the machine, substantially as and for the purposes set forth.

In testimony whereof I have hereto set my hand this 31st day of December, 1894.

GEORGE H. KNIGHT.

Witnesses:
GEORGE H. KNIGHT, Jr.,
CHARLES W. GEER.