J. F. PIERCE.

APPARATUS FOR FORMING TUBES.

APPLICATION FILED MAR. 30, 1917.

1,345,459.

Patented July 6, 1920.

8 SHEETS—SHEET 1.

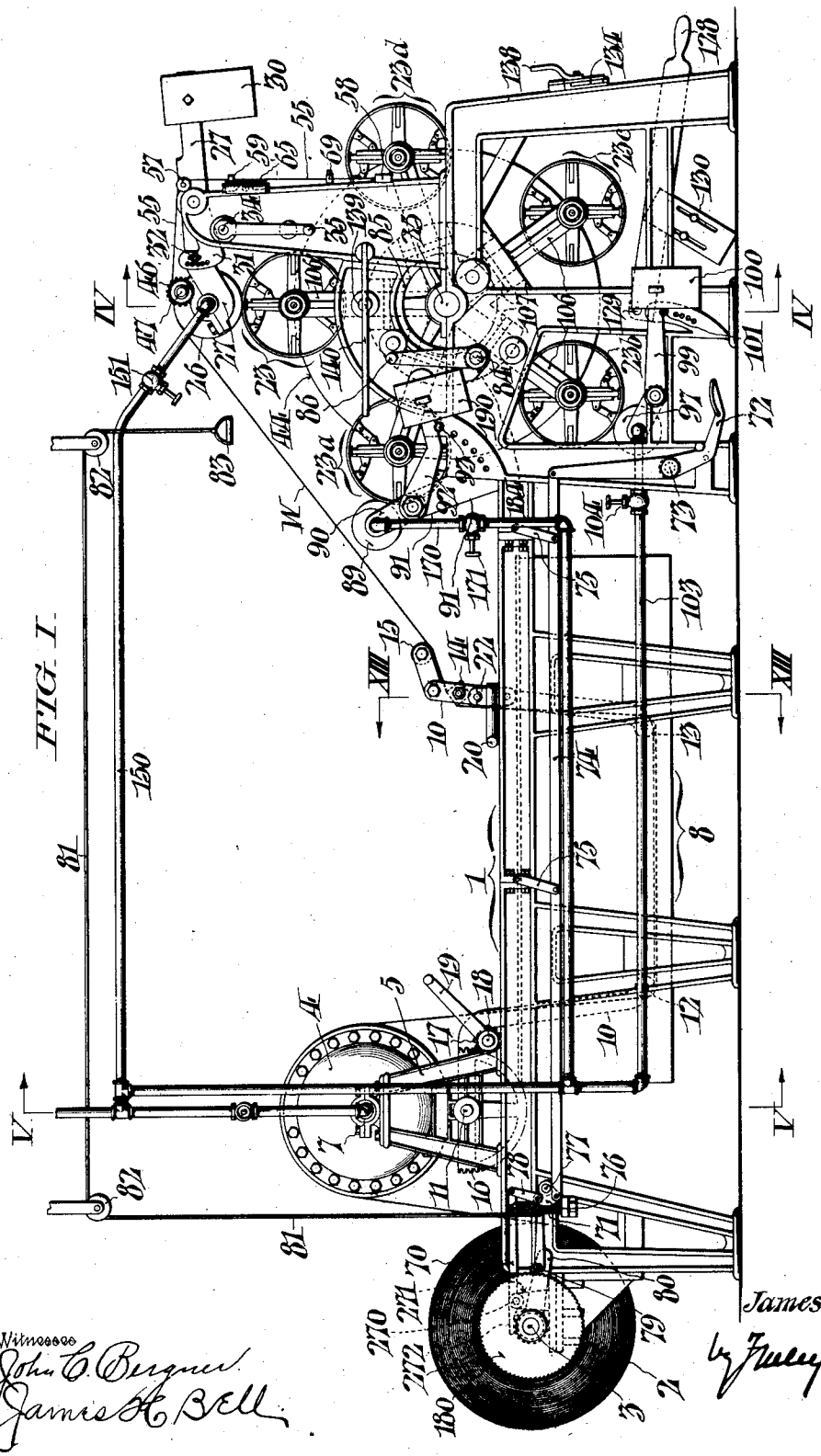

FIG. 1.

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8 SHEETS—SHEET 2.

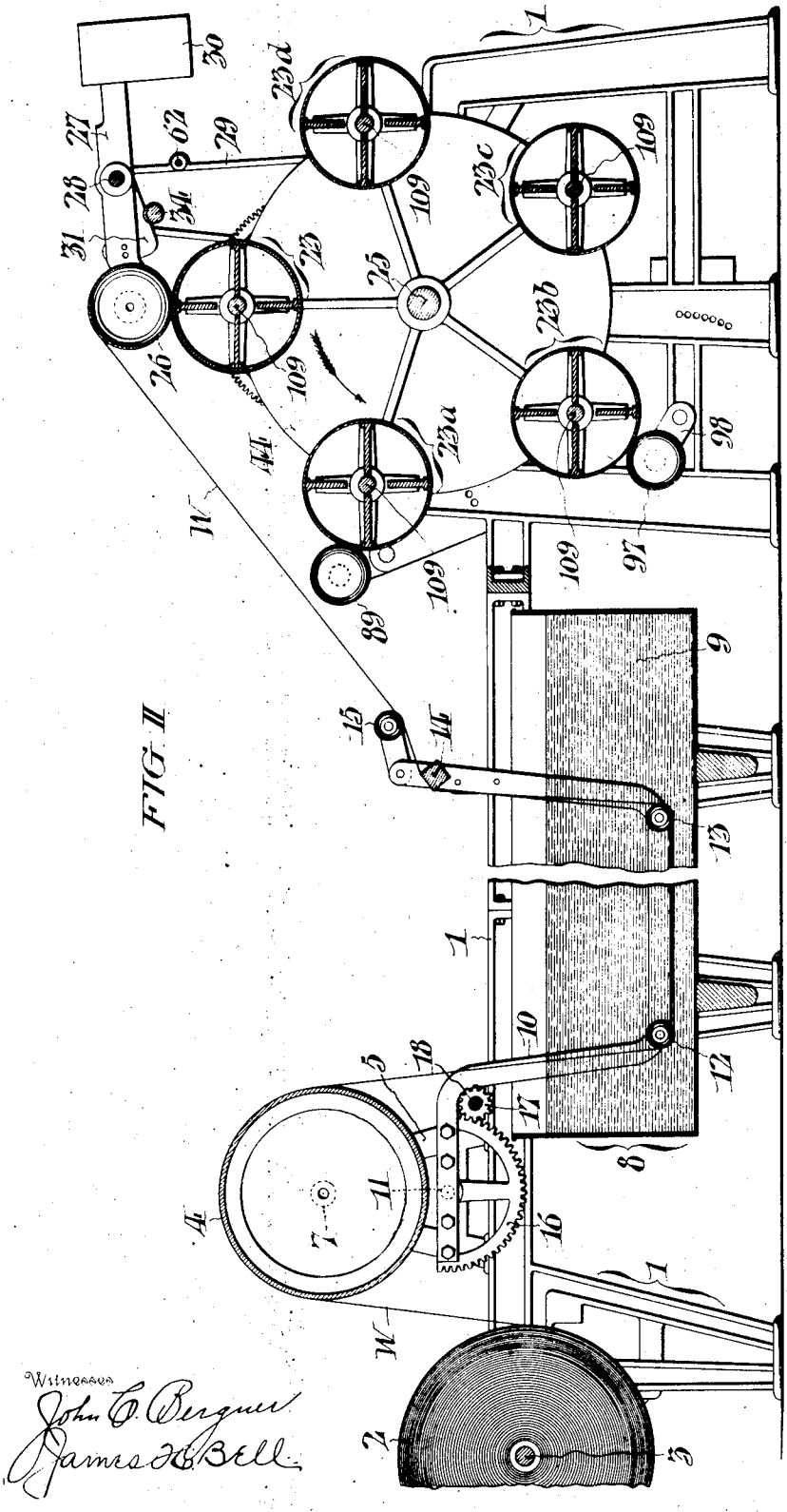

FIG. II

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8 SHEETS—SHEET 3.

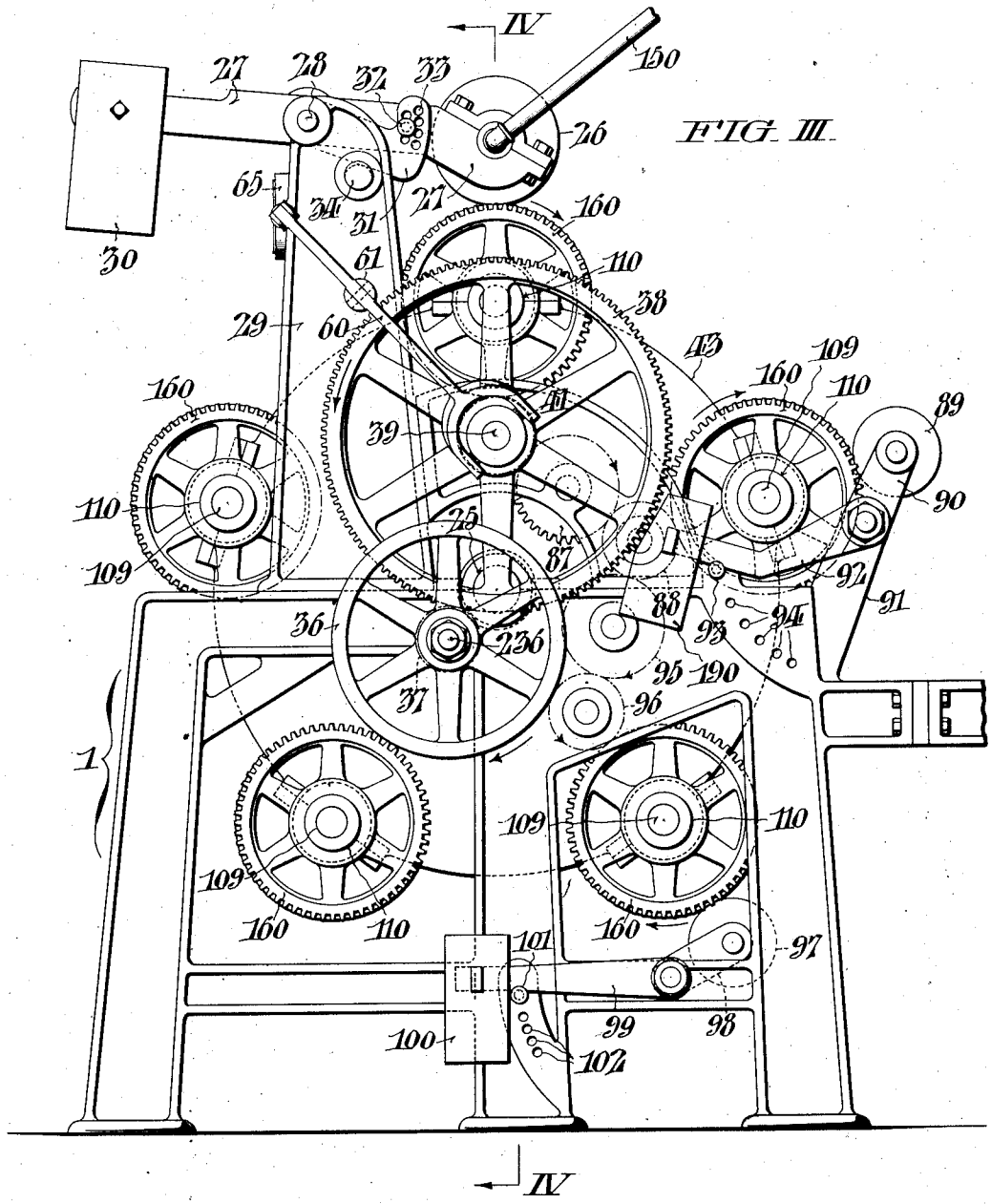

FIG. III.

Witnesses
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1,345,459.

Patented July 6, 1920.

8 SHEETS—SHEET 4.

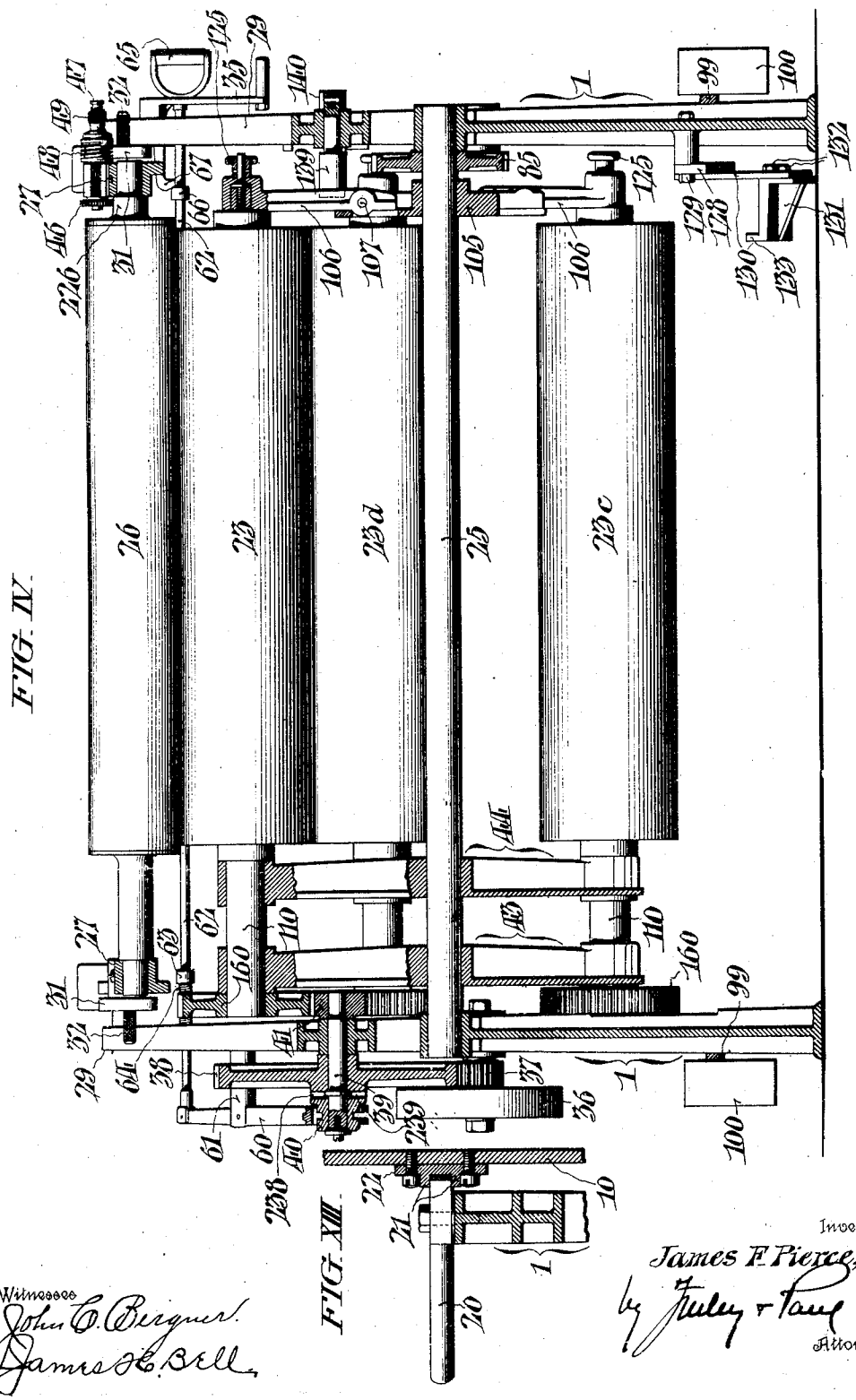

FIG. IV.

FIG. XIII.

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8 SHEETS—SHEET 5.

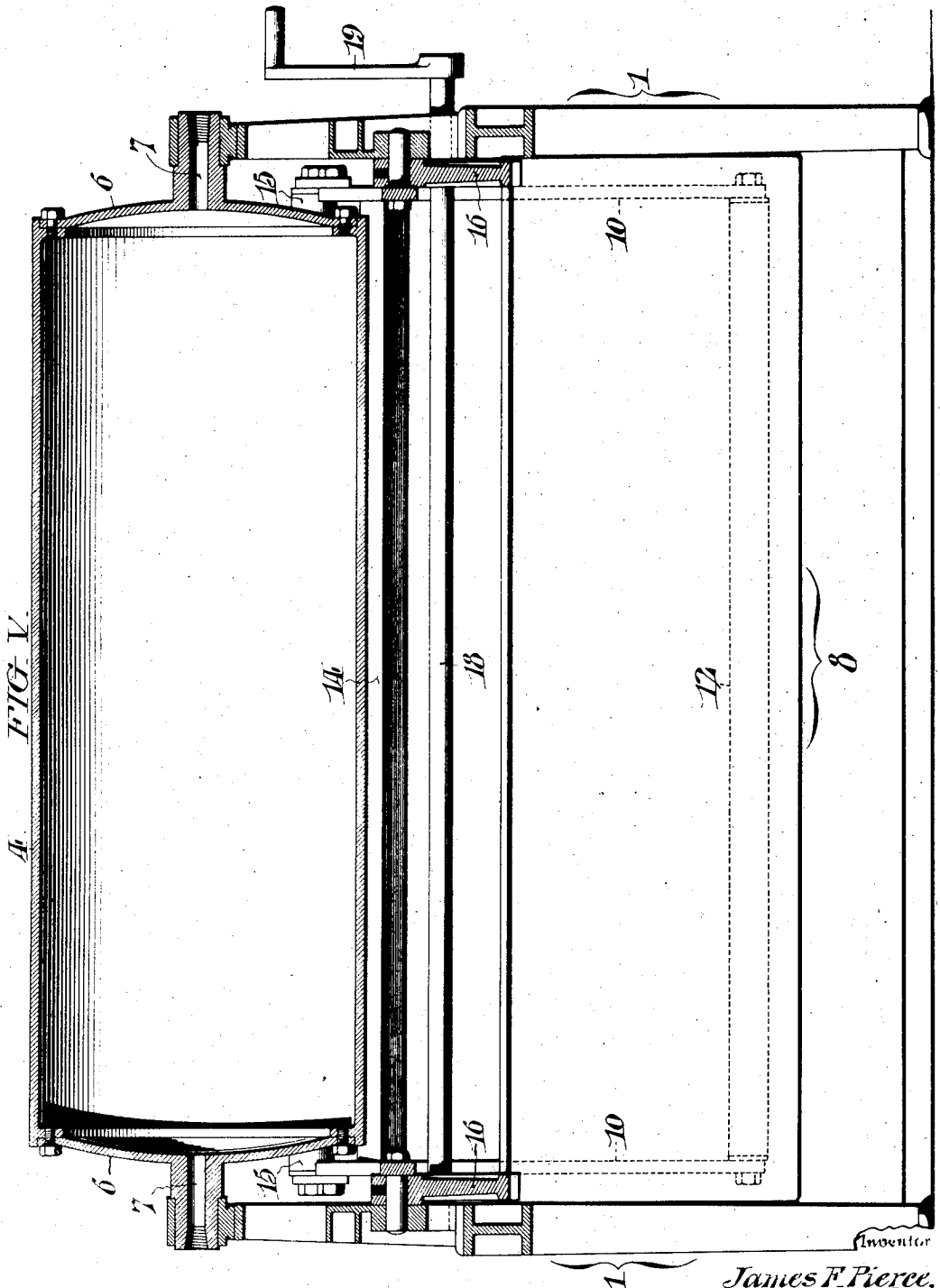

FIG. V.

Witnesses:
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8 SHEETS—SHEET 6.

FIG. VI.

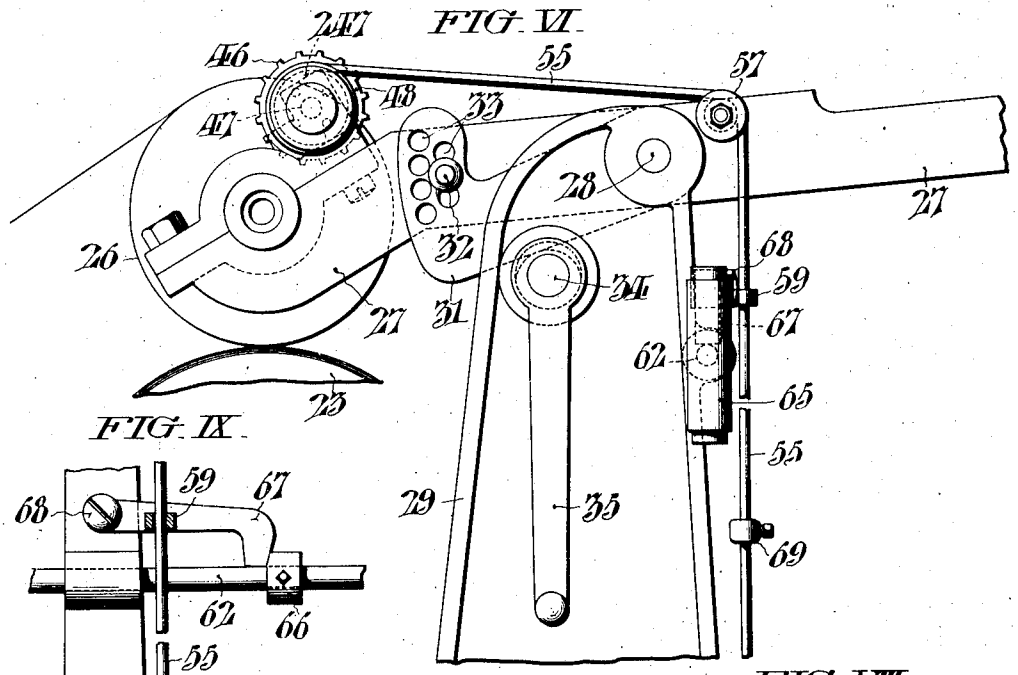

FIG. IX.

FIG. VIII.

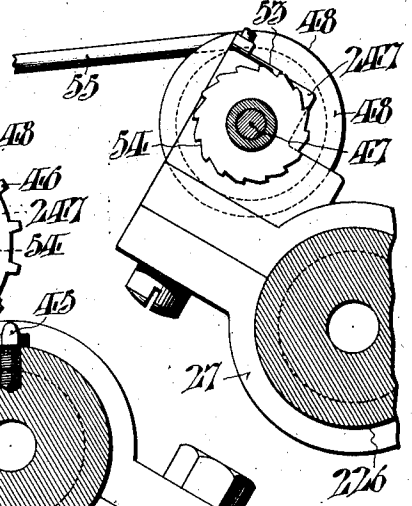

FIG. VII.

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8 SHEETS—SHEET 7.

FIG. X.

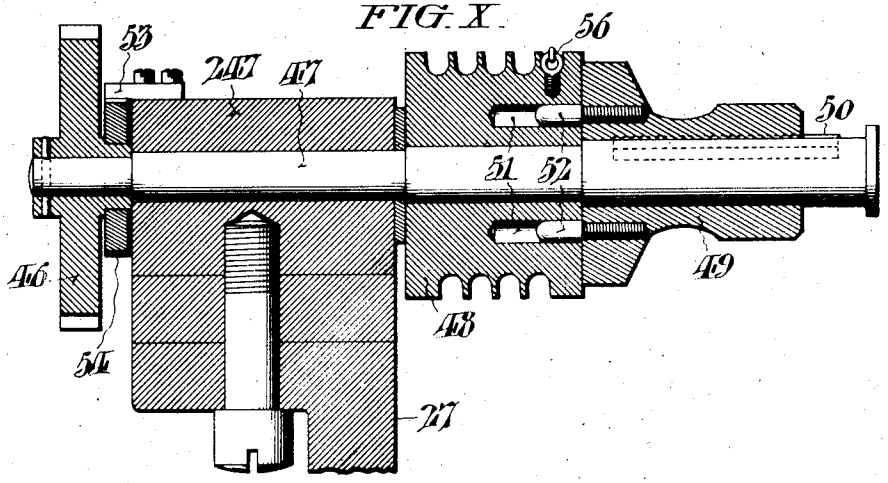


FIG. XI

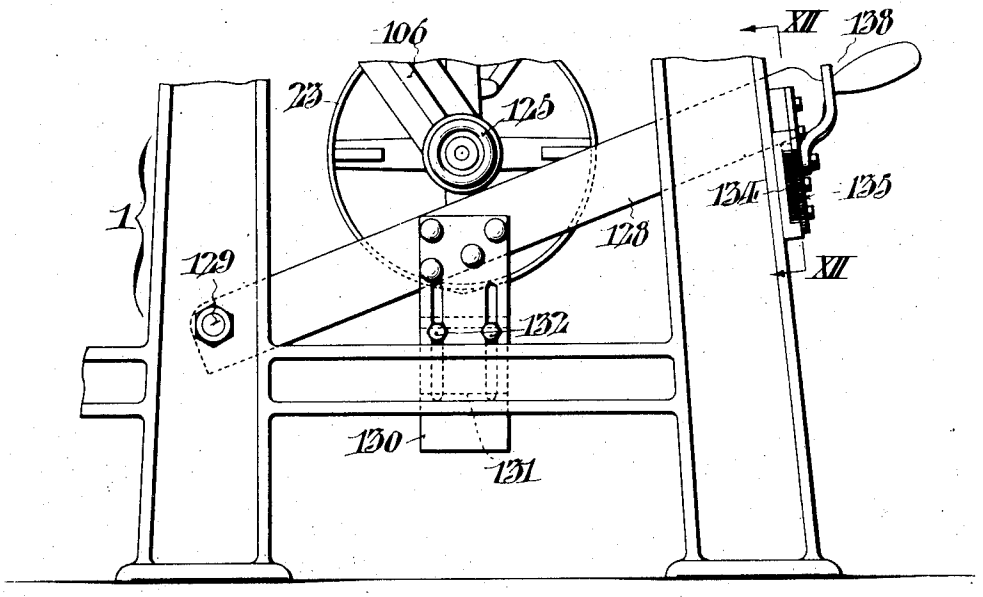
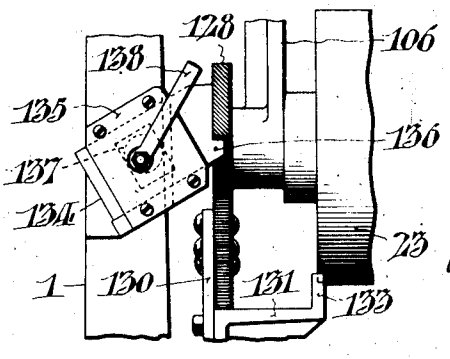


FIG. XII



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Patented July 6, 1920.

8 SHEETS—SHEET 8.

FIG. XIV.

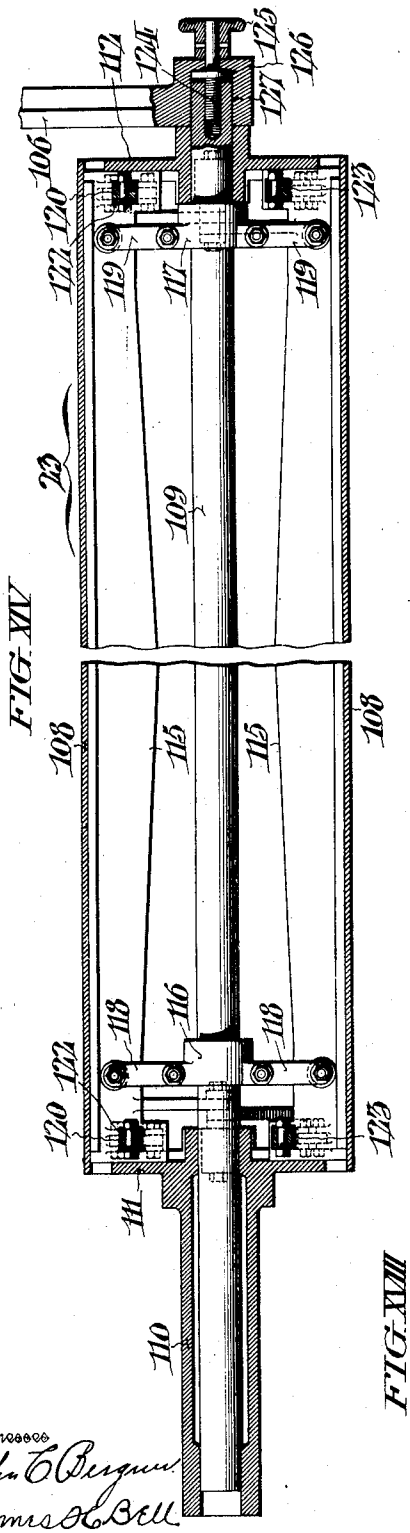


FIG. XVI.

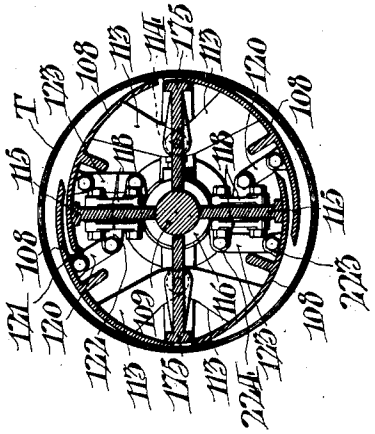


FIG. XVII.

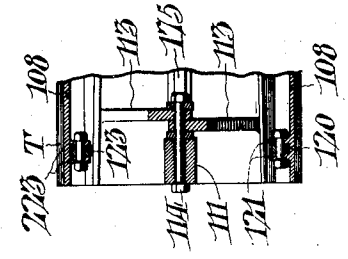


FIG. XV.

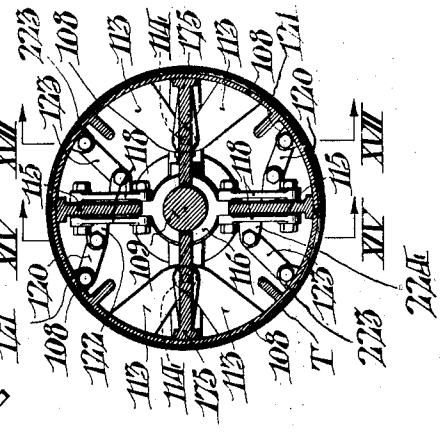
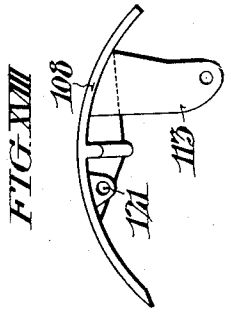


FIG. XVIII.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR FORMING TUBES.

1,345,459. Specification of Letters Patent. Patented July 6, 1920.

Application filed March 30, 1917. Serial No. 158,770.

To all whom it may concern:

Be it known that I, JAMES F. PIERCE, of Glynrich, in the county of New Castle and State of Delaware, have invented certain new and useful Improvements in an Apparatus for Forming Tubes, whereof the following is a specification, reference being had to the accompanying drawings.

The invention relates more particularly to an improved apparatus for forming tubes, wherein a web of fibrous material, such as paper, is first passed through a treating bath and then wound on mandrels to form the tubes.

An object of the invention is to provide an apparatus for winding a web into tubes after it passes through a treating bath, which apparatus is so constructed that the travel of the web through the treating bath may be substantially continuous.

A further object of the invention is to provide an apparatus for forming tubes from a web which includes a series of mandrels which may be brought successively into active position and operated for winding the web thereon.

A still further object of the invention is to provide an apparatus having devices for heating and finishing the tubes on the mandrels after they are moved from the winding position.

A still further object of the invention is to provide means whereby the mandrels may be collapsed to facilitate the withdrawing of the finished tubes therefrom.

These and other objects will in part be obvious, and will in part be hereinafter more fully described.

In the drawings which show by way of illustration one embodiment of the invention, Figure I, is a side elevation of an apparatus embodying my improvements.

Fig. II, is a longitudinal sectional view through the same.

Fig. III, is a side elevation of one end of the apparatus for forming and finishing the tubes, as viewed on the side opposite to that shown in Fig. I.

Fig. IV, is a sectional view on the line IV, IV, of Figs. I, and III.

Fig. V, is a sectional view on the line V, V, of Fig. I.

Fig. VI, is an enlarged detail view in side elevation showing the gaging mechanism for determining the amount of paper formed into a tube, also showing the winding roll and the manner of supporting the same.

Fig. VII, is an enlarged detail partly in section, showing the manner of operating the gaging mechanism from the winding roll.

Fig. VIII, is an enlarged detail partly in section, showing the ratchet device for preventing retrograde movement of the gaging mechanism.

Fig. IX, is an enlarged detail partly in section showing the trip dog for the clutch mechanism and the manner of operating the same.

Fig. X, is a detail in section showing the manner of locking the drum of the gaging mechanism to its operating shaft and of releasing the same so that it may be returned to normal position.

Fig. XI, is a detail in side elevation showing the temporary supporting lever for the mandrel, which lever is employed in supporting the end of the mandrel while disconnecting its bearing preparatory to the removal of a finished tube.

Fig. XII, is a sectional view on the line XII, XII, of Fig. XI.

Fig. XIII, is a sectional view on the line XIII, XIII, of Fig. I.

Fig. XIV, is a longitudinal sectional view through the mandrel, on the line XIV, XIV, of Fig. XV, showing the mechanism for collapsing the same.

Fig. XV, is a transverse central sectional view through the mandrel.

Fig. XVI, is a similar view showing the mandrel collapsed with the tube still on the mandrel.

Fig. XVII, is a fragmentary sectional view on the line XVII, XVII, of Fig. XV.

Fig. XVIII, is an end view of one of the segments of the mandrel.

The invention is directed particularly to an apparatus for forming tubes from fibrous material such as paper and the like, which material is supplied in webs of long lengths. The web is first passed over a suitable heating cylinder, where any inherent moisture is driven from it. The web is then passed through a treating bath wherein it is properly impregnated with zinc chlorid or some similar active solution. The time of treatment in this bath is necessarily limited to avoid impairment of the paper. The present invention is directed particularly to the

devices which receive the web after it leaves the treating bath and form the same into tubes by winding it about mandrels, and subsequently finish the tubes. This part of the apparatus consists of a carrier on which a plurality of mandrels are supported and which is capable of being turned so as to bring one mandrel after another into operative position, where it is ready to receive the web. The mandrel is rotated and the web is wound thereon with the coöperation of a winding roll, which may be heated if desired. After a measured amount of web has been wound upon the mandrel, the clutch of the machine is automatically shifted, so as to stop the rotation of the mandrel. In this position the carrier is rotated, moving the mandrel with its tube out of the winding position, and bringing another mandrel into winding position. This shifting is almost instantaneous, so that a very short interval of time elapses during which the web is not traveling and remains stationary in the treating bath. The mandrel moved out of winding position is then carried to the next station where a suitable heated roll engages the tube on the mandrel and performs its operation thereon. The tube is preferably next presented to a second heated roll and then it is brought to a station where the tube may be removed from the mandrel. In order to facilitate the removal of the tube the mandrel may be collapsed. By having a plurality of mandrels mounted on one carrier, these different operations may be carried on simultaneously, thereby greatly increasing the efficiency of the machine.

Referring more in detail to the drawings, the improved machine consists of a supporting frame 1, which carries the various parts of the apparatus. The fibrous web is supplied from a supply roll 2, which is mounted to rotate about shaft 3. This web is indicated at W, in the drawings, and passes over a heated cylinder 4, which is mounted in suitable brackets 5, carried by the main frame 1, of the machine. The heating cylinder is shown in detail in Fig. V, of the drawings. It is preferably formed of metal and the body portion thereof is carried by the heads 6, 6, each of which has an opening 7, passing through its trunnion, and adapted to receive a steam pipe or other suitable heating means.

Supported on the main frame 1, is a tank 8, containing treating liquor, preferably zinc chlorid, which is indicated at 9. A guiding frame 10, is pivotally supported at 11, by brackets 5. This guiding frame extends down into the treating liquor and is provided with guide rolls 12, and 13. The web after leaving the heating cylinder where the moisture is driven off, is led underneath the guiding roll 12, and then across underneath guiding roll 13, to roll 15. Frame 10, extends upwardly from the tank and carries scraper bar 14, and also guide roll 15. The paper after coming out of the liquor, passes over the scraper bar which removes the surplus liquor from the surface of the paper, but leaves the web thoroughly impregnated with the treating liquor. To facilitate the placing of the web around guiding frame 10, and also to withdraw the guiding frame with the web carried thereby from the treating liquor at the end of a day's operation, said guiding frame is pivotally supported at 11, and its side members are provided with sectors 16, which mesh with pinions 17, carried by shaft 18, which may be turned by suitable crank 19. By turning this crank the frame may be withdrawn from the treating liquor carrying with it the paper supported thereby. When the frame is lowered into the tank, it may be held in its lowered position by a locking lever 20, which is pivoted to frame 1, of the machine, and adapted to engage between suitable ears 21, 21, in plate 22, screwed to the side of the guide frame 10, see Fig. XIII.

The web is wound on the mandrels to form the tubes and the present invention is directed more particularly to the manner of supporting and operating these mandrels, so that one after another is brought to the winding station, where a measured amount of web is wound thereon, after which the mandrel is moved to a rolling station, while another mandrel is brought to the winding station.

In the drawings the mandrels are indicated at 23, 23^a, 23^b, 23^c, and 23^d respectively. These mandrels are mounted in a carrier comprising spiders 43, 44, and 105, which are supported by shaft 25, journaled in suitable bearings in main frame 1. In Fig. II, of the drawings, mandrel 23, is shown in position for the winding of the web thereon, and this is referred to as the winding station.

The web, after leaving the guide roll 15, passes over winding roll 26, and is wound about the mandrel. Winding roll 26, which is hollow and heated by suitable steam pipe connections, is mounted in bearings formed in swinging arms 27. The arms 27, are counterweighted at 30, and fulcrumed about shaft 28, secured in brackets 29, located at each side of the machine and mounted on main frame 1. Also pivotally mounted on brackets 29, are swinging arms 31. Arms 31, project forward beyond their fulcrum 28, and are adjustably connected to arms 27, by pins 32, which are adapted to be inserted through any one of the openings 33, (see Fig. VI), in the end of arm 31, and into a suitable opening in arm 27. The counterweight is so proportioned that the

weight of the winding roll overbalances the counterweight and normally carries downward the end of arms 27, supporting the winding roll. The downward movement of arms 27, however, is limited by stop 34, see Figs. III, and VII, which, as herein shown, is in the form of a shaft having eccentric depressions which engage the said arms. This shaft 34, is journaled in brackets 29, and crank 35, is attached to one end of the same. By turning crank 35, arms 27, may be raised and lowered within the limits of the eccentric depressions.

Winding roll 26, is heated by steam pipe 150, having a suitable controlling valve 151, and this steam pipe is sufficiently flexible to allow limited movement of the winding roll 26. This winding roll is so positioned that when at its lower limit it bears on the mandrel and presses the fiber against the mandrel, as the mandrel is rotated. When, however, the mandrel is moved bodily away from winding roll 26, by the rotation of the carrier, crank 35, is turned so as to lift arms 27, and thus lift winding roll 26, free from the mandrel, thereby permitting the easy turning of the carrier.

The mandrel is turned for winding the fiber web thereon by a belt wheel 36, see Fig. IV, which is driven from any suitable source of power. Belt wheel 36, is mounted to freely rotate upon a stud shaft 236, and carries a pinion 37, which meshes with gear 38. The gear 38, is free on shaft 39, and is provided with a clutch face 238, on the left hand side of the same as viewed in Fig. IV. A clutch collar 40, is splined to shaft 39, and is provided with a corresponding clutch face 239, which is adapted to mesh with the clutch face 238, on gear 38. When gear 38, is clutched to shaft 39, pinion 41, which is formed fast on shaft 39, rotates with gear 38. The mandrel is carried by a sleeve 110, which is journaled at one end in two spaced spiders 43, and 44, attached to shaft 25, of the rotating carrier. On the same end of the sleeve 110, is a gear wheel 160, which meshes with pinion 41, when the mandrel is brought to the winding station. When the clutch parts are in engagement therefore, the mandrel is rotated through the intermediate train of gears between the mandrel shaft and the main operating belt wheel 36. When, however, the carrier is turned to move one mandrel, say mandrel 23, away from the winding station, then the next mandrel indicated at 23^d, in the drawings is brought to the winding station and its gear 160, then meshes with the operating pinion 41, so that the mandrel is driven when the clutch is closed.

It is desirable that the amount of fiber web wound on the mandrel shall be measured so that the same amount of fiber may be used in the formation of each tube. This is accomplished by the following devices: Winding roll 26, is provided with suitable trunnions on which it rotates and the trunnion 226, at one end of the machine is provided with a detent 45, see Fig. VII. This detent is adapted to engage a toothed wheel 46, fast on shaft 47, mounted in a suitable bearing 247, in the end of one of the arms 27. This shaft 47, has loosely mounted thereon a drum 48, see Fig. X, and a collar 49, secured to shaft 47, by means of spline 50, so that the collar may be moved longitudinally on the shaft, but is caused to rotate therewith.

Drum 48, is formed with sockets 51, while collar 49, carries pins 52, which are adapted to engage these sockets 51. When the parts are in the position shown in Fig. X, drum 48, is locked to collar 49, and, therefore, turns with shaft 47. At each rotation of the winding roll 26 the toothed wheel 46 is moved one tooth and this turns the shaft 47 one step. The pawl 53 mounted on an arm 27 engages a ratchet wheel 54 secured to the toothed wheel 46 and prevents retrograde movement of the shaft 47.

A rope or other flexible member 55, is attached at one end to drum 48, by a suitable catch 56. This rope runs over guide roll 57, through eye 59, and carries an adjustable collar 69, held in position by means of a set screw. A suitable weight 58, is attached to the lower end of rope 55, (see Fig. I). It will, therefore, be apparent that as drum 48, is turned through the rotation of winding drum 26, rope 55, is wound onto the drum.

In order to release the driving mechanism of the mandrel when a measured amount of fiber web has been wound thereon, I provide the following mechanism for controlling the clutch:

Clutch collar 40, is shifted by a lever 60, see Fig. IV. This lever is pivoted to post 61, carried by one of the end brackets 29, and rod 62, attached to the lever extends laterally across the machine and through the end bracket to the other end of the machine. A collar 63, is fast on this rod and spring 64, bearing against the collar and against an end bracket normally positions rod 62, to the right, as viewed in Fig. IV, thus releasing the clutch. A handle 65, is secured to the end of rod 62, and serves as a means for pushing the rod to close the clutch. This rod 62, is also provided with a stop collar 66, which coöperates with locking dog 67, pivoted at 68, on one of the end brackets and adapted to drop in rear of stop collar 66, thereby holding rod 62, forced to the left as viewed in Fig. IV, that is, with the clutch closed. The guide eye 59, referred to above, is mounted on this dog 67. Referring now to Fig. IX, it will be apparent that when rope 55, has been wound to a sufficient extent on drum 48, collar 69, engages eye 59, raises

locking dog 67, thus releasing stop collar 66, whereupon spring 64, forces rod 62, to the right, thereby releasing the clutch. This mechanism described above therefore operates automatically to release the driving mechanism for the mandrel when a measured amount of fiber web has been wound thereon. When the rotation of the mandrel has ceased the web is cut on the winding roll, the cutting operation being performed by hand or other suitable means. The mandrel is then moved out of position by a turning movement of the carrier hereinafter described, leaving the end of the web in position to start the next roll.

Tension is placed on shaft 3, of the supply roll by means of lever 70, see Fig. I. This lever 70, is provided with a brake shoe 272, and pivoted at 270, to an extension 271, carried by the bracket which in turn supports the supply roll. Spring 71, operating on the free end of the lever forces brake shoe 272, at the other end thereof against shaft 3, of the supply roll. This brake may be released from shaft 3, by a foot treadle 72, which is pivoted at 73, to the main frame 1, and is connected to lever 70, through link 74, rock plate 76, and link 78. Link 74, is mounted on suspension arms 75, and rock plate 76, is pivoted at 77, to the frame of the machine, and this rock plate in turn is connected to link 78. By depressing treadle 72, the outer end of lever 70, is depressed and the brake lifted from the shaft. Shaft 3, is also provided with turning means consisting of a dog 79, pivoted to arm 80, freely mounted to turn about the center of the shaft 3. The end of dog 79, is connected to a cord 81, running over suitable guiding sheaves 82, 82, to a point where a handle 83, attached to the cord is readily accessible to the operator. A ratchet wheel 180, is mounted fast on shaft 3, and when cord 81, is pulled dog 79, engages ratchet 180, thereby turning shaft 3. By pressing the treadle all tension may be taken off the paper web and by pulling on cord 81, the roll may be turned for a certain distance. This greatly facilitates the starting of the machine after it has stopped without putting undue stress or strain upon the web of paper. It also facilitates the threading of the web through the various devices and the initial loading of the machine with the paper web for operation.

It has been noted that the carrier for the mandrels is capable of being turned in the direction of the arrow shown in Fig. II. This is accomplished by means of a shaft 84, (see Fig. I), which carries a small pinion 184, adapted to mesh with gear 85, attached to shaft 25, supporting the carrier, (see also Fig. IV). Shaft 84, is operated by a crank 86. After the paper is wound on the mandrel, the clutch is automatically released as described and the operator then turns the carrier by means of crank 86, to bring the next mandrel to the winding station, which operation also shifts the mandrel with the formed tube thereon to a rolling station, where the tube is subjected to a heated roll, which drives off the moisture in the fiber.

Meshing with gear 41, which drives the mandrel for winding the fiber web thereon is an idle gear 87, see Fig. III. This gear in turn meshes with the gear 88, which is so positioned on the frame that the gear 160, of the mandrel is brought into mesh therewith, when the mandrel is positioned for rolling at the rolling station, presently to be described.

At the rolling station, roll 89, is mounted in suitable bearings formed in arms 90, which are fulcrumed on brackets 91, carried by the main frame. Movable with arms 90, are arms 92, which are provided with counterweights 190. These counterweights are so positioned as to normally press roll 89, toward the mandrel. A stop pin 93, limits the movement of arm 92, and this stop pin may be placed in any one of a series of holes 94, depending upon the size of the mandrel and the size of the tube being formed. Roll 89, is heated by a steam pipe 170, which is provided with a suitable controlling valve 171, see Fig. I, so that while the mandrel at the winding station is having a web wound thereon, for forming the tube, the formed tube at the next station is being pressed and heated by roll 89, which forms the tube into a homogeneous mass.

Gear 88, also meshes with an idle gear 95, and this in turn meshes with gear 96, journaled in the supporting frame. Gear 96, is so positioned as to engage gear 160, of one of the mandrels when occupying a position presently to be described, at the same time that gear 88, is meshing with gear 160, of another mandrel and winding gear 41, is meshing with the third mandrel. This position of the mandrels where gear 160, meshes with driven gear 96, may be considered the second rolling station. A heated roll 97, is mounted in suitable arms 98, which are pivotally connected to arms 99, each of which carries a counterweight 100. The downward movement of arms 99, is limited by stop pins 101, which are adapted to engage any one of openings 102. This roll 97, is heated by a suitable steam pipe 103, which is controlled by the hand valve 104, see Fig. I.

When the carrier is turned through still another step the mandrel is brought to the position indicated at 23^c, which is the discharge position where the tube is removed from the mandrel. At the next step in the movement of the carrier, the mandrel is carried to the position indicated at 23^d, and then at the next step it comes back again into position to receive another tube. While at

the discharge station, the end support for the mandrel shaft is removed so that the tube may be slipped from the mandrel and the mandrel is collapsed so as to facilitate the slipping of the tube from the same.

Although my invention is not confined to the use of any particular form of mandrel, I have shown in the drawings one form which may conveniently be employed therewith. In the form shown each mandrel is composed of a series of segments 108, see Figs. XVI, and XVIII, while a shaft 109 extends centrally through the mandrel. Sleeve 110, receives this shaft at one end, and carries integral therewith one of the supporting heads 111, of the mandrel. At the other end of the mandrel there is a second supporting head 112, through which shaft 109, extends also. Heads 111, and 112, are rigidly connected to each other by the stay bars 175. Each segment 108, has an inwardly projecting arm 113. The arms of two adjacent segments are fulcrumed on the same pivot bolt 114, and these bolts are carried by heads 111, and 112. Mounted within the mandrel are two supporting webs 115. These webs are mounted to slide radially on heads 111, and 112, respectively. Shaft 109, is provided with two collars 116, and 117. Links 118, connect collar 116, with supporting webs 115, while links 119, connect collar 117, with supporting webs 115. It will be apparent from the above that an endwise movement of shaft 109, will move the webs 115, radially of the heads 111, and 112, respectively. If shaft 109, is moved to the left as viewed in Fig. XIV, webs 115, are drawn in toward the center of shaft 109, and if moved to the right again, webs 115, are again moved outwardly away from the center shaft 109.

The shaft 109, is moved endwise by means of a screw 124. This screw has a hand wheel 125, connected thereto, so that it may be readily turned, and it also has a flange 126, which engages the bottom of the recess 127, which receives the end of the shaft 109. This recess 127, is formed in the end of the supporting arm 106, so that shaft 109, is shifted along recess 127, by turning hand wheel 125.

A link 120, is pivoted to a suitable lug 121, on one of the segments 108, and at its other end to a lug 122, on one of the webs 115. A link 123, is likewise pivoted to a lug 223, on one of the adjacent segments 108, and a lug 224, on one of the webs. Link 120, is, however, much shorter than the link 123, so that when the parts are in the position shown in Fig. XV, link 120, is substantially at right angles to the plane of the web to which it is attached. Link 123, on the other hand, is practically at an angle of 45 degrees to the plane of the web to which it is attached. When shaft 109, is moved endwise, and webs 115, are drawn in toward the center of the shaft, link 123, becomes at once effective to draw in the free end of the segments 108, to which it is attached. After this free end of the segment is moved in slightly, then link 120, becomes effective to draw in the end of the segment to which it is attached. In other words, the positions of links 120, and 123, are such as to give in effect a slight loose movement permitting the end of the segment on the right as viewed in Figs. XV, and XVI, to move in first, and the end of the segment on the left to follow and overlap the first named segment.

As has been explained, by turning hand wheel 125, in the proper direction, shaft 109, is forced along the recess 127, and the mandrel collapsed, that is, the parts moved to the position shown in Fig. XVI. A continued turning of the hand wheel 125, releases the screw from the end of the shaft so that arm 106, which is pivoted at 107, to spider 105, may be swung out of the way of the end of the mandrel and thus allow the tube indicated at T, in Figs. XV, and XVI, to be readily removed from the mandrel. In order to facilitate the disconnection of the end of shaft 109, from arm 106, I have provided a hand lever indicated at 128, in Fig. XI. This hand lever 128, is pivoted at 129, to the frame. A downward extension 130, is attached to the lever, and carries a bracket 131, adjustably attached thereto by means of bolts 132. This bracket extends inwardly from extension 130, and is bent upwardly at 133, so as to engage the end of the mandrel. The operator raises the lever 128, until bracket 131, engages the mandrel and lifts the same slightly, thereby taking the weight off the bearing on the end of the mandrel shaft in arm 106. A supporting plate 134, mounted in suitable guideways 135, in the frame, is adapted to be shifted forward so that lip 136, carried thereby engages lever 128, and holds the same raised. Plate 134, is moved by eccentric 137, and hand lever 138. The carrier is held with the mandrel at the different stations by means of a stop 139. This stop is adapted to engage with arms 106, and is moved by hand lever 140.

In the operation of my device, the roll 2, of material to be formed into tubes is placed on the supporting shaft and threaded through the machine in position to be wound on the mandrel. The guiding frame may be raised from the treating liquor, to facilitate the inserting of the web and after the web is in place. The tension is preferably taken off the supply roll when the clutch is shifted for starting the turning of the mandrel and the winding roll. The mandrel continues to rotate until a measured amount of the web has been wound

thereon, after which it is automatically stopped. The operator then cuts the web, releases the carrier and turns the same so as to bring another mandrel to the winding station. The end of the web is then started on a new mandrel tension again released from the supply roll, the clutch shifted and the winding of a second tube is started.

The interval of time between the automatic stopping of the mandrel and the starting of the next mandrel to form a tube is comparatively small and, therefore, the web which stops during this short interval in the treating liquor is not injured. The mandrel with the tube wound thereon is carried to the first rolling station by the movement of the carrier above described, where the first heated roll presses the paper against the mandrel. After the second tube has been wound the carrier is turned as above and a new tube started, while the mandrel which was at the first rolling station is moved on to the second rolling station and so on until the mandrel finally reaches the discharge station. At this point the operator manipulates the hand lever, raises the end of the mandrel to take the weight from the supporting arms, and then manipulates the hand wheel so as to push the shaft endwise and collapse the mandrel and after the supporting arm has been moved to one side, the finished tube may be withdrawn from the mandrel.

It is obvious that minor changes may be made in the details of construction and the arrangement of the parts, without departing from the spirit of the invention as set forth in the appended claims.

Having thus described my invention, I claim:

1. In an apparatus for forming tubes, the combination of a plurality of mandrels, means for supplying a web of material thereto, means whereby said mandrels are successively shifted into operative position to receive said web, means operating upon a mandrel for rotating the same when in said position, whereby said web is wound on said mandrel, and means for releasing the mandrel from the rotating means when a predetermined amount of the web has been wound thereon.

2. An apparatus for forming tubes, comprising means for supplying a web of material, a treating bath, means for directing said web through the bath, a plurality of mandrels on which the web is wound to form tubes, mechanism operating upon a mandrel for rotating the same, said mechanism tending to tighten the convolutions of the web as wound thereon, means whereby said mandrels may be brought one after another into operative engagement with the mechanism for rotating the mandrels, and means for releasing the mandrels from this winding mechanism, when a measured amount of web has been wound thereon.

3. An apparatus for forming tubes, comprising means for supplying a web of material, a plurality of mandrels on which the web is wound to form tubes, mechanism for rotating a mandrel, means whereby said mandrels may be brought one after another into operative position and operated for winding the web thereon, and means for releasing the mandrels from the winding mechanism when a measured amount of the web has been wound thereon, and means for rolling the formed tubes on one or more mandrels while the web is being wound on another mandrel.

4. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a rotating carrier, a plurality of mandrels supported by said carrier, a winding roll adapted to coöperate with said mandrels, a heated roll adapted to coöperate with said mandrels, and means for turning said carrier whereby the mandrels may be presented in succession to the winding roll and then to the heated roll whereby the formed tubes on one mandrel may be rolled while the web is being wound on another mandrel.

5. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a rotating carrier, a plurality of mandrels supported by said carrier, means for rotating the mandrels for winding the web thereon, a winding roll adapted to coöperate with said mandrels, a heated roll adapted to coöperate with said mandrels, means for turning said carrier whereby the mandrels may be presented in succession first to the winding roll, then to the heating roll, and means for stopping the rotation of the mandrels when a measured amount of web has been wound thereon.

6. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a movable carrier, a plurality of mandrels carried thereby, a winding roll mounted independently of the carrier adapted to engage said mandrels, means for heating the winding roll, and means for rotating a mandrel while in engagement with the winding roll whereby the web is formed into a tube thereon, a heated roll mounted independently of the carrier and disposed so as to engage the formed tube on one mandrel while a tube is being formed on another mandrel.

7. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a movable

carrier, a plurality of collapsible mandrels carried thereby, a winding roll mounted independently of the carrier adapted to engage said mandrels, means for heating the winding roll, means for rotating the mandrel while in engagement with the winding roll to form a tube, and means for disconnecting the mandrels from their rotating mechanism when a measured amount of web has been wound on a mandrel to form a tube.

8. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a mandrel, a winding mechanism adapted to engage the mandrel for rotating the same, said mechanism, including a shiftable clutch, a winding roll, a drum intermittently rotating with the winding roll, a flexible member adapted to be wound on the drum, and means controlled by said flexible member for releasing the clutch for disconnecting the mandrel from its rotating mechanism when a measured amount of web has been wound on the mandrel.

9. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a rotating carrier, a plurality of mandrels carried thereby, means for winding a measured amount of web on said mandrels, means for facilitating the removal of the formed tube from each mandrel, including a removable arm for supporting one end of each mandrel, and means for raising the mandrel for facilitating the disconnection of the arm from the mandrel.

10. An apparatus for forming tubes, comprising means for supplying a web of material, mechanism for forming the web into tubes, said mechanism including a rotating carrier, a plurality of mandrels carried thereby, devices for winding a measured amount of web on said mandrels, each mandrel having a removable arm for supporting one end thereof, means for raising the mandrel for facilitating the disconnection of the arm from the mandrel, and means whereby the mandrel may be collapsed to facilitate the withdrawing of the finished tube therefrom.

11. An apparatus for forming tubes, comprising means for supplying a web of material, a treating bath, a frame having guide rolls for directing the web through the bath, and means for forming the web into tubes, after it leaves the bath, said means including a plurality of mandrels on which the web is wound to form tubes, mechanism for rotating a mandrel, means whereby said mandrels may be brought one after another into operative position and operated for winding the web thereon, and means for releasing a mandrel from the winding mechanism when a measured amount of the web has been wound thereon, and means for rolling the formed tubes on one or more mandrels while the web is being wound on another mandrel, all of said means operating substantially continuously on the web.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this nineteenth day of March, 1917.

JAMES F. PIERCE.

Witnesses:
WILLIAM EVES, 3rd,
JAMES H. BELL.