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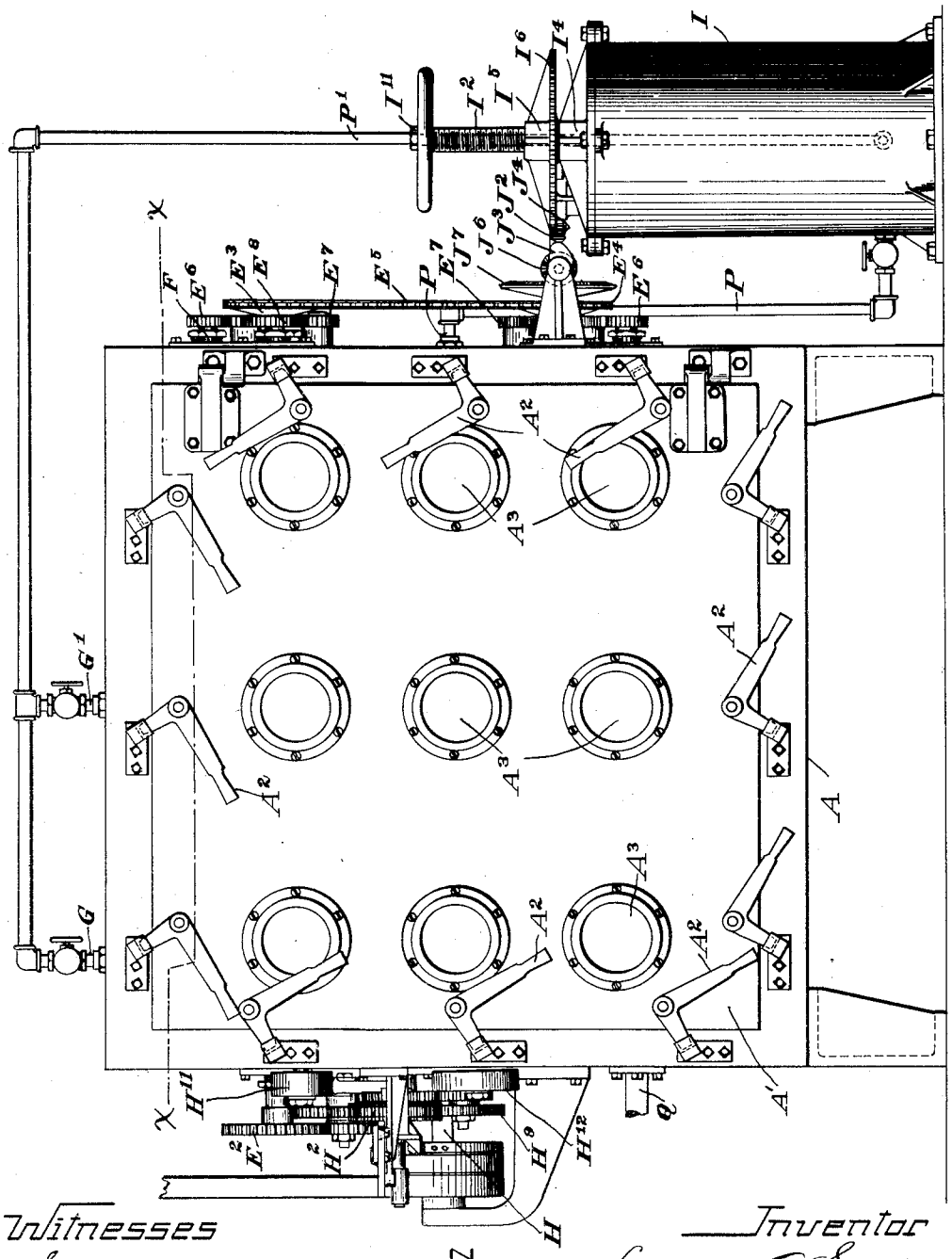
MACHINE FOR CONSTRUCTING LAMINATED-COHESIVE-INTERWOUND BANDS HAVING VARYING LIMITS OF ELASTICITY.

APPLICATION FILED OCT. 7, 1914.

1,209,903.

Patented Dec. 26, 1916.

11 SHEETS—SHEET 1.



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Fig. 1

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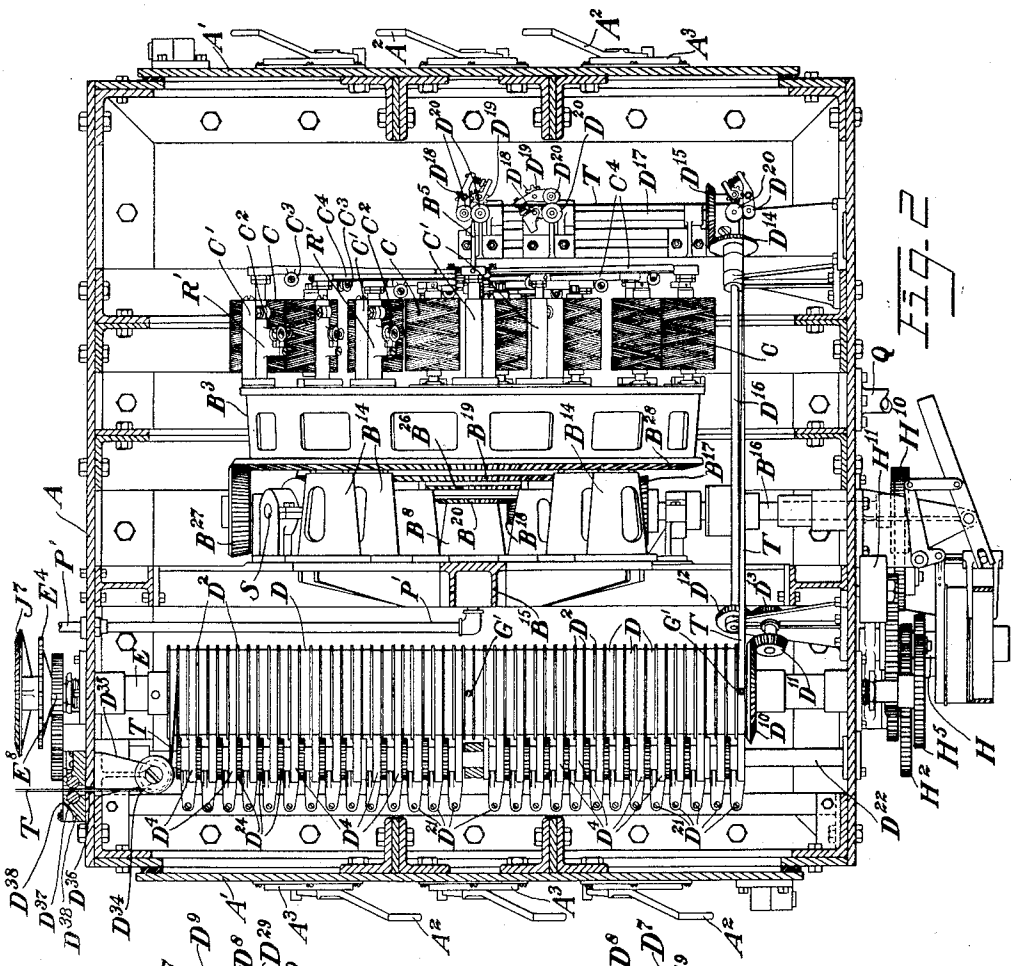


FIG. 2

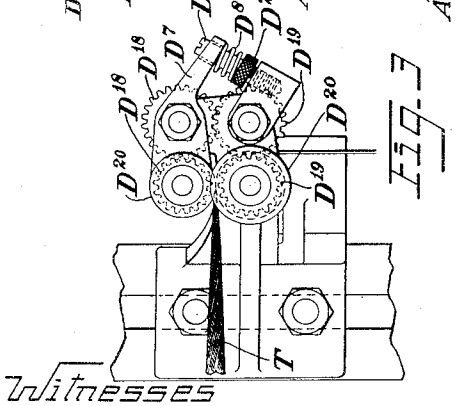


FIG. 3

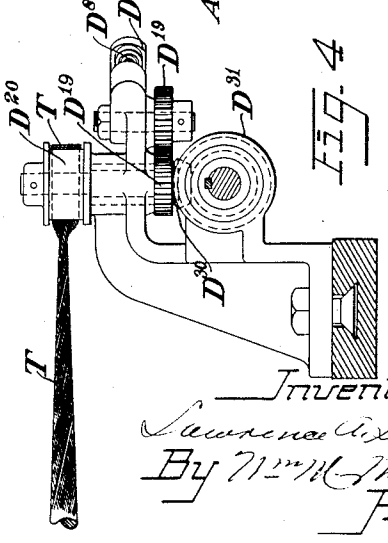


FIG. 4

Witnesses

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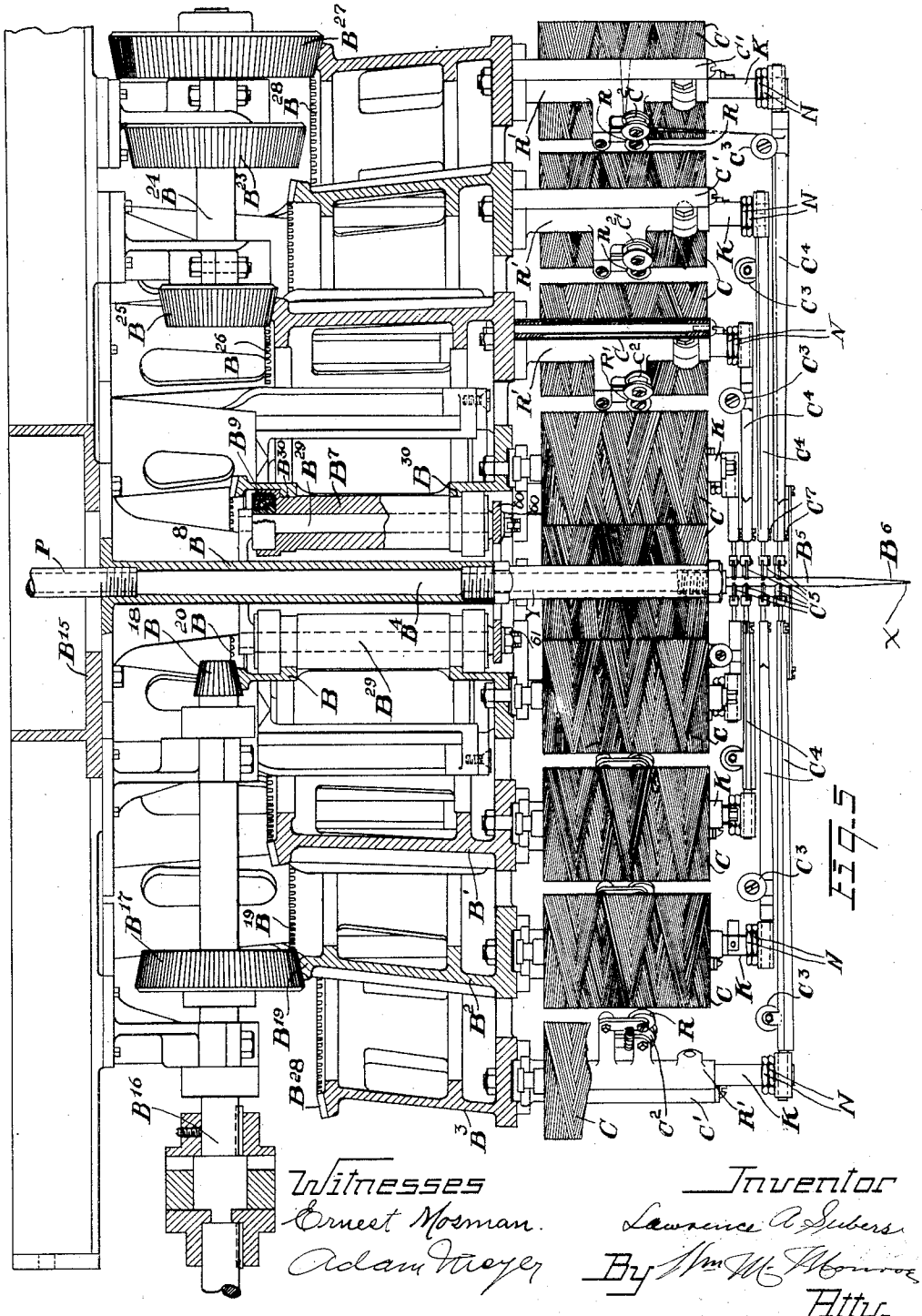


FIG. 5

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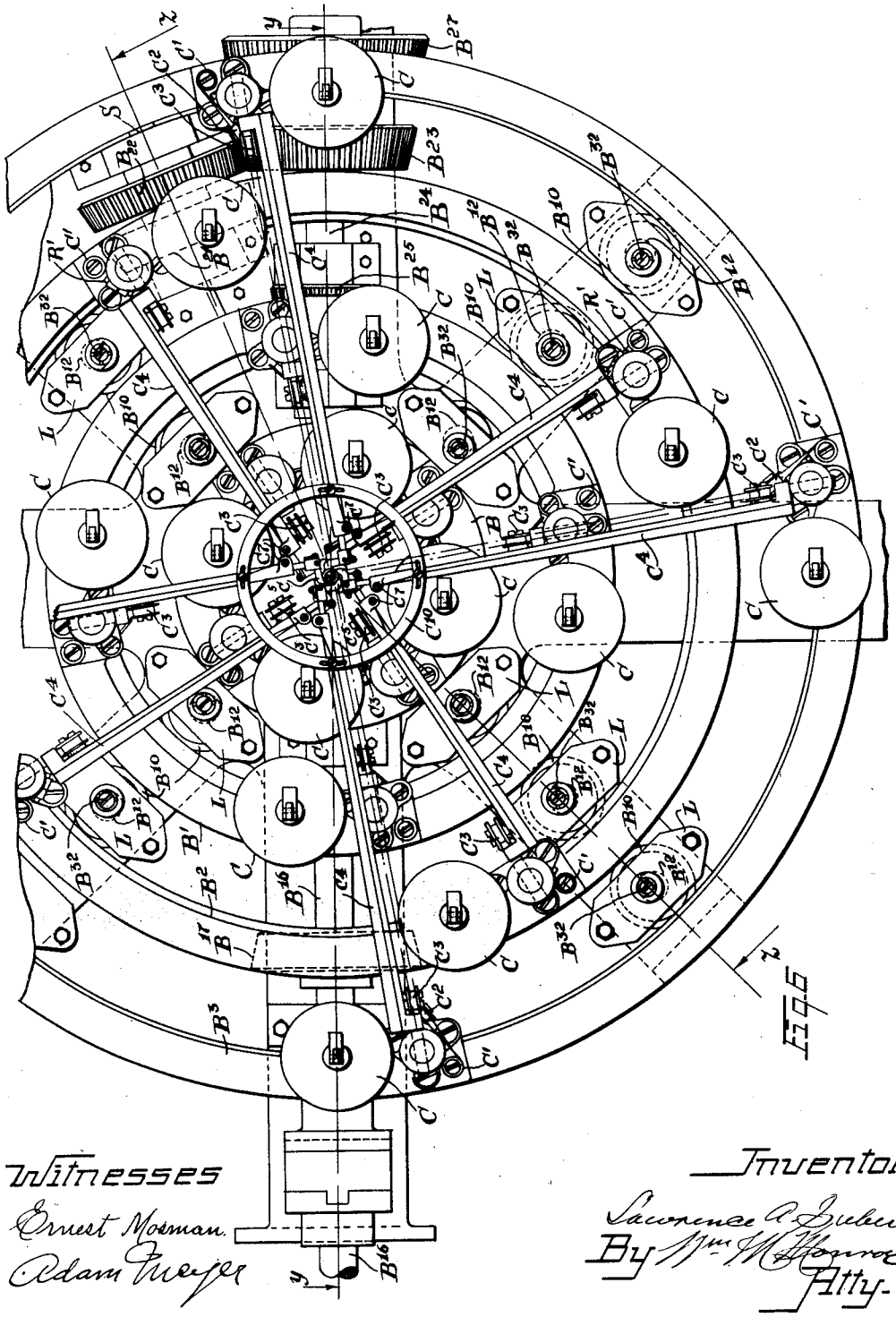


FIG 5

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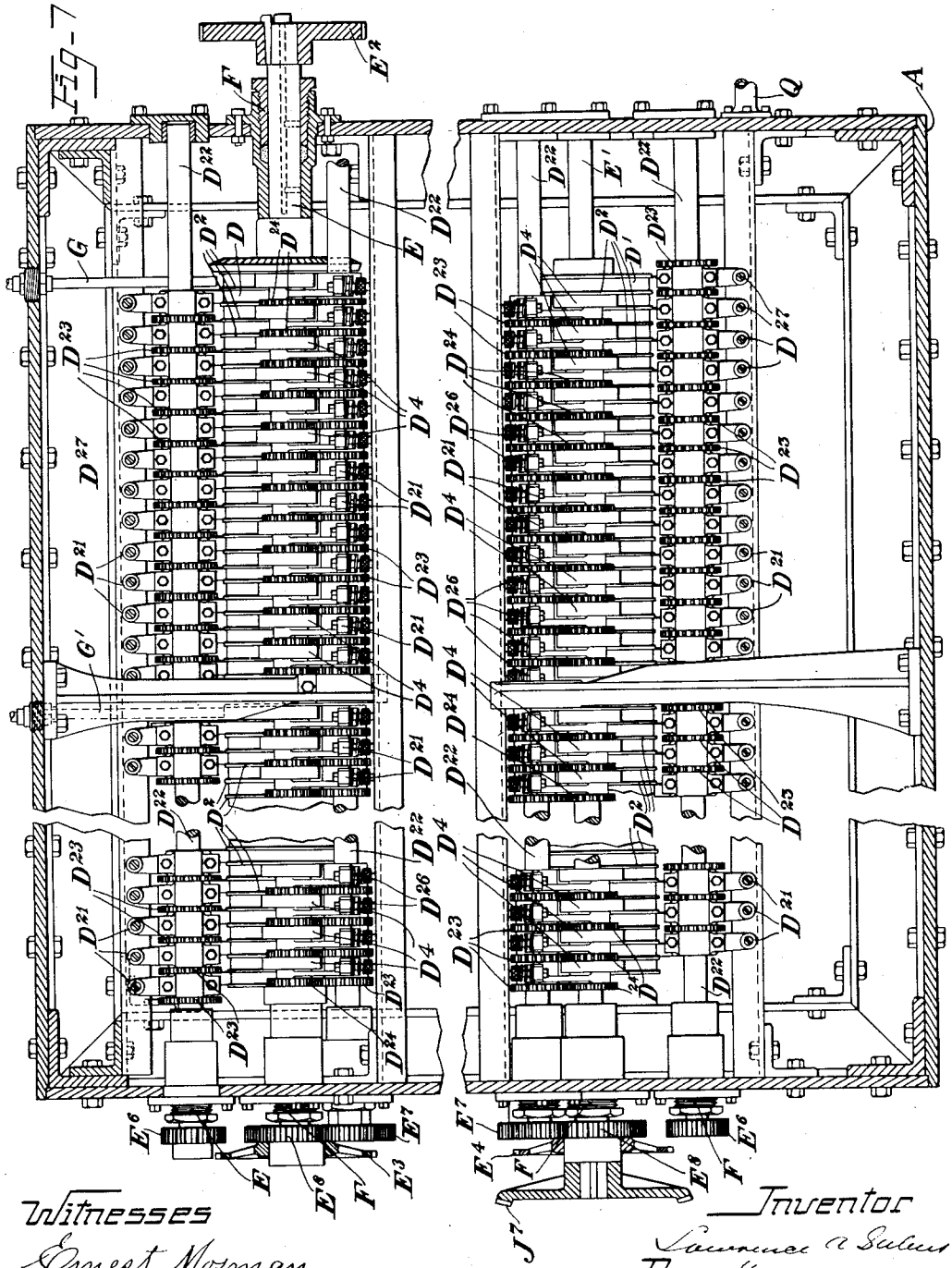
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11 SHEETS—SHEET 5.

Fig. 7



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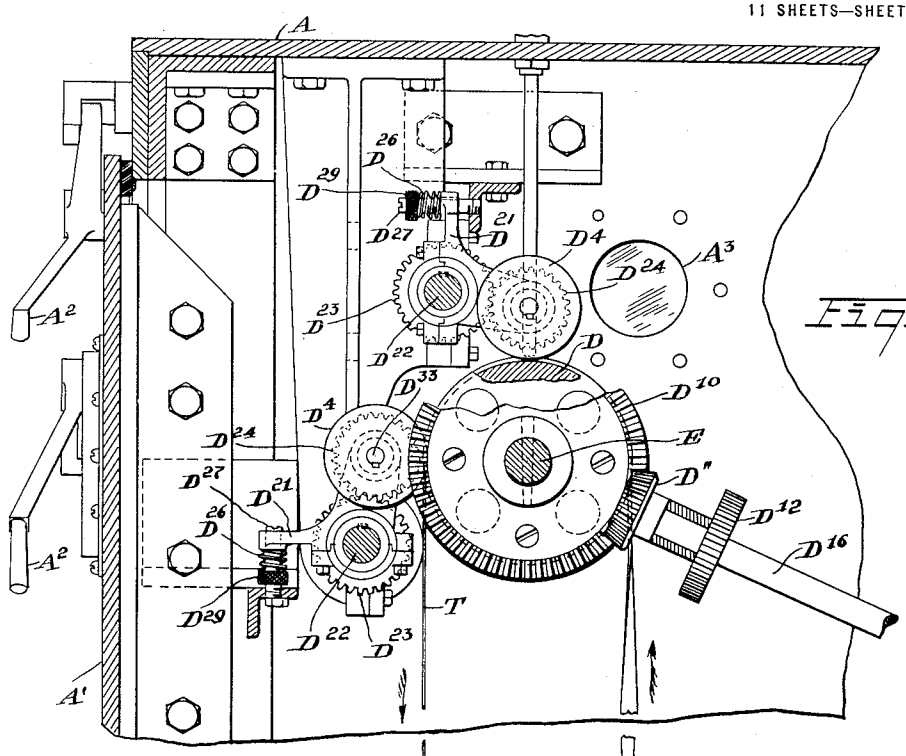


Fig. 8

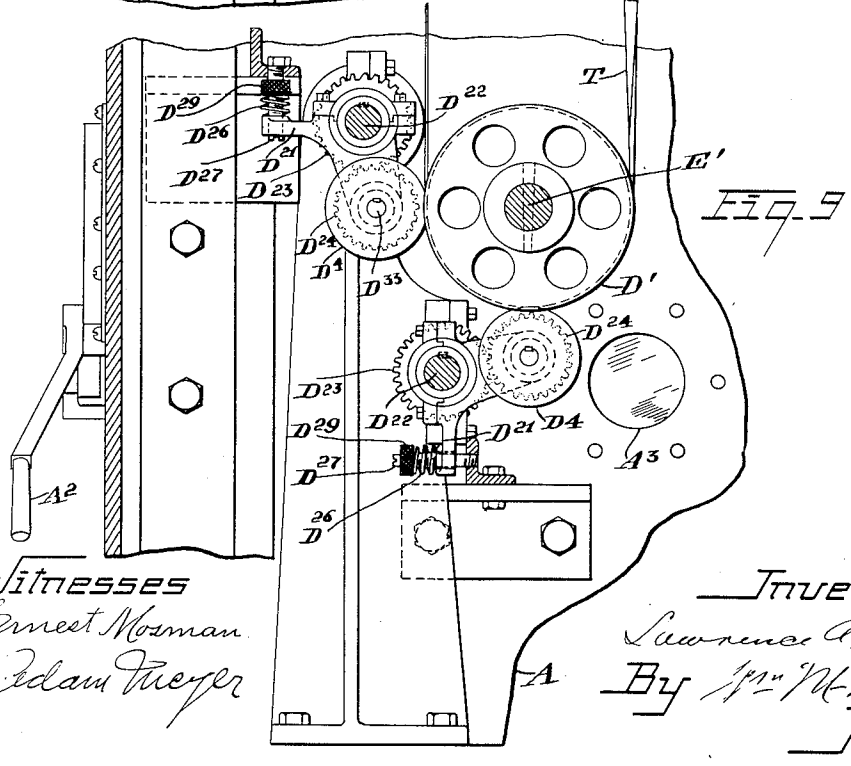


Fig. 9

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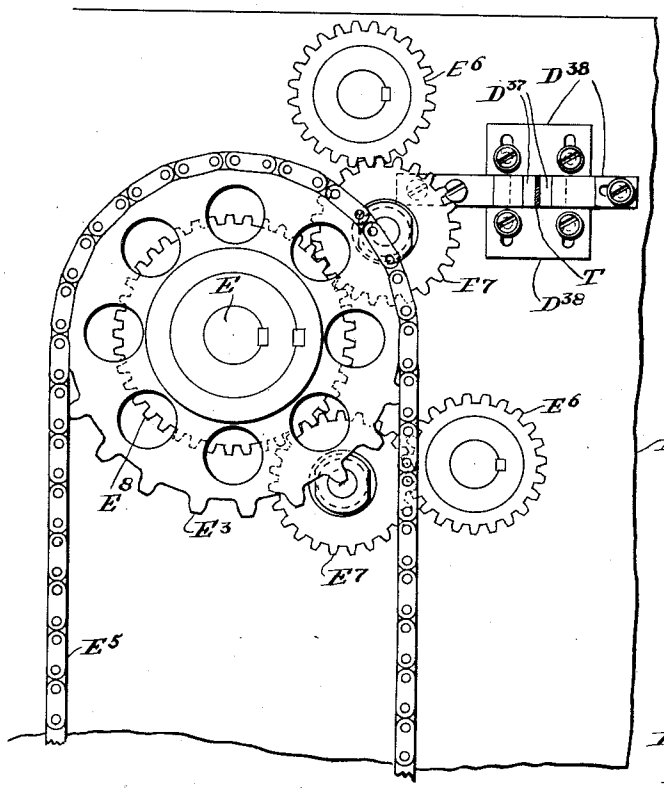


Fig. 10

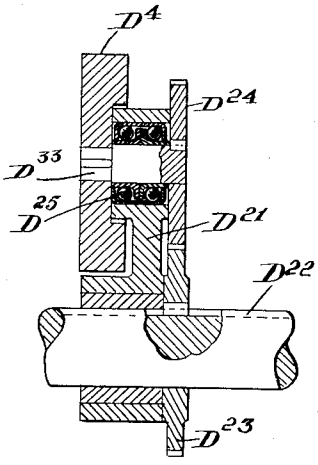


Fig. 12

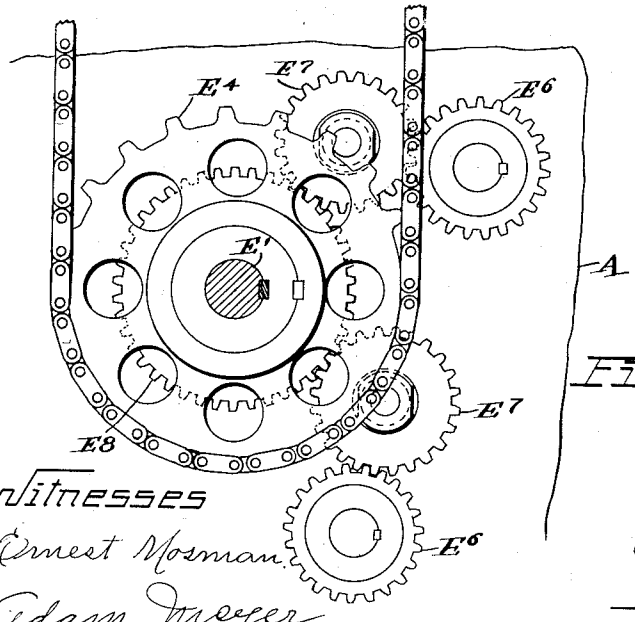


Fig. 11

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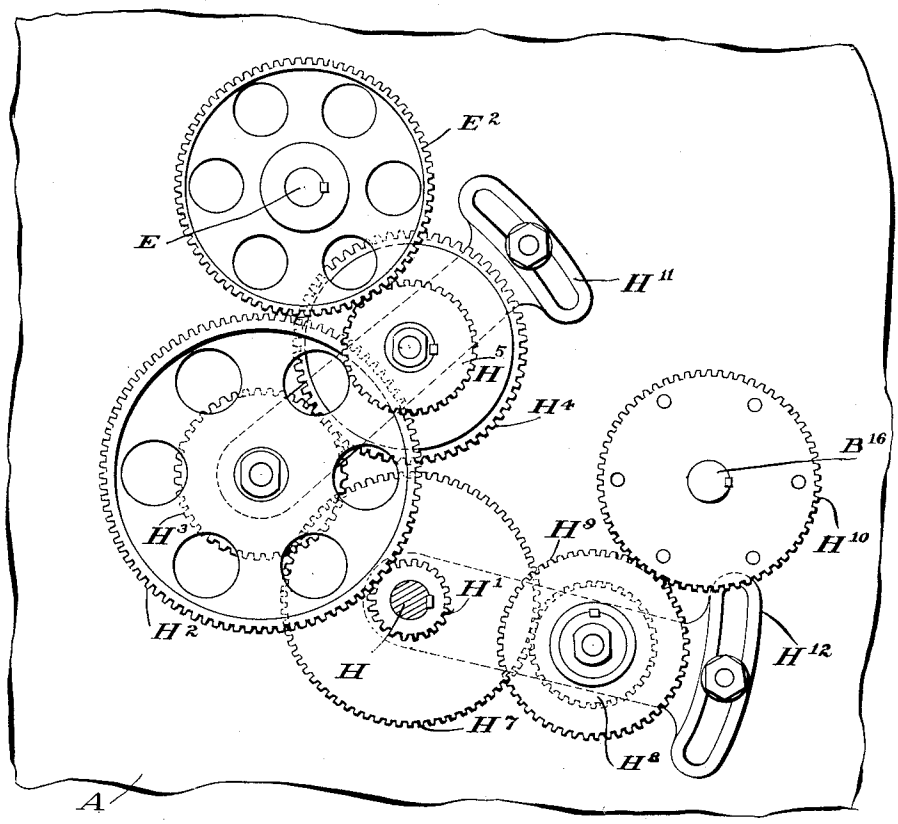


Fig. 13

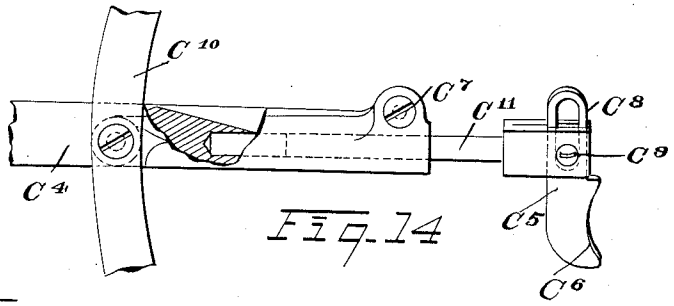


Fig. 14

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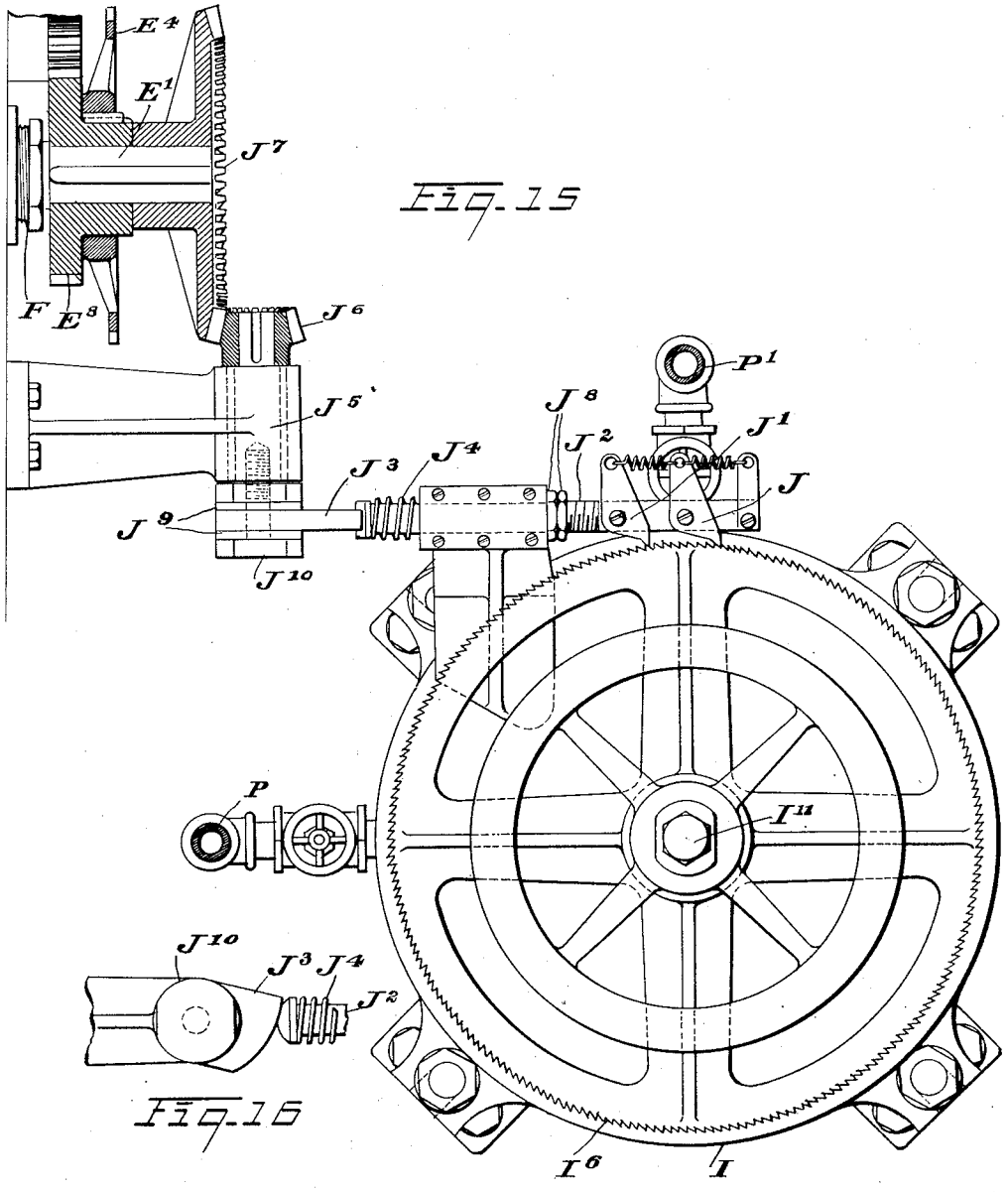


Fig. 15

Fig. 16

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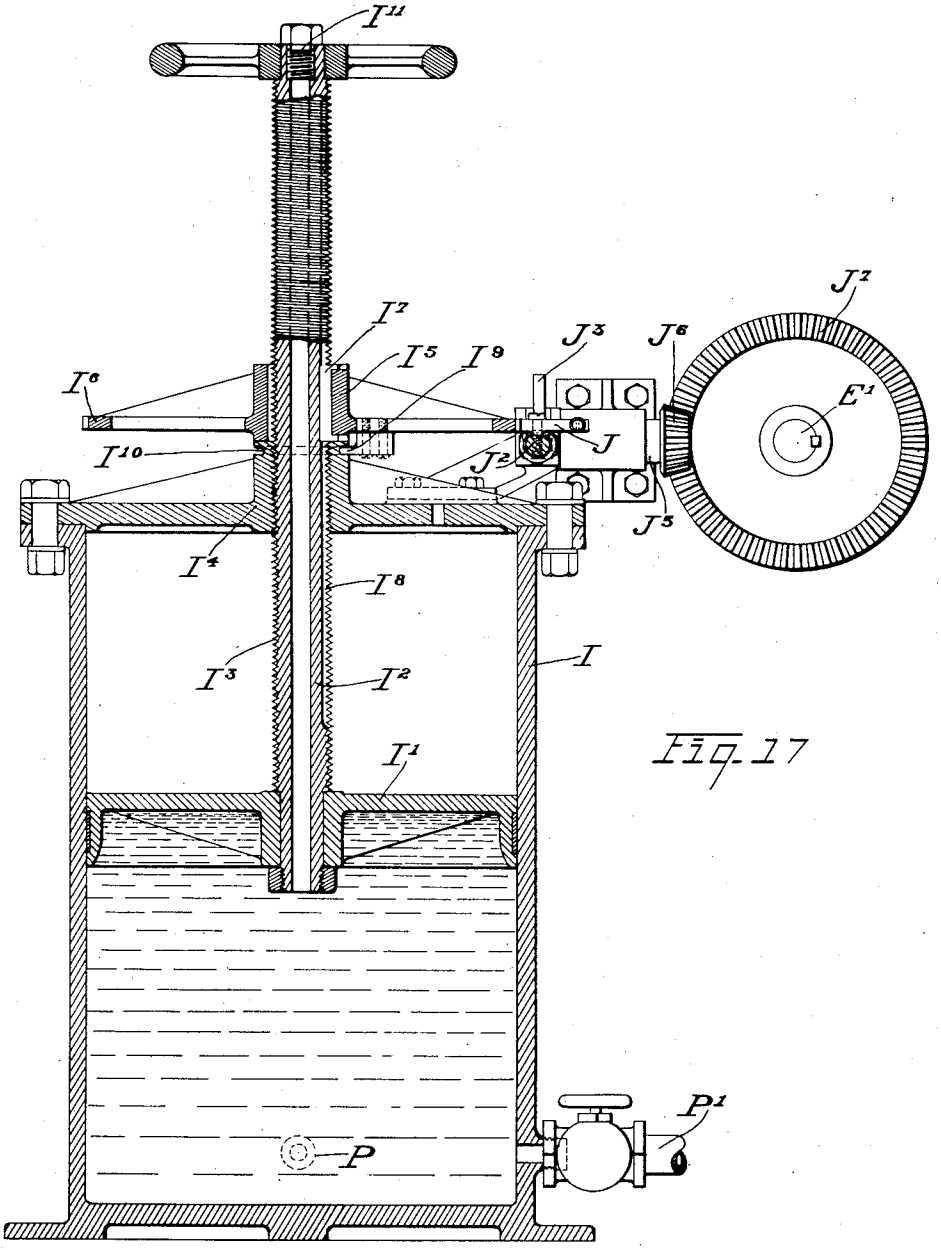


Fig. 17

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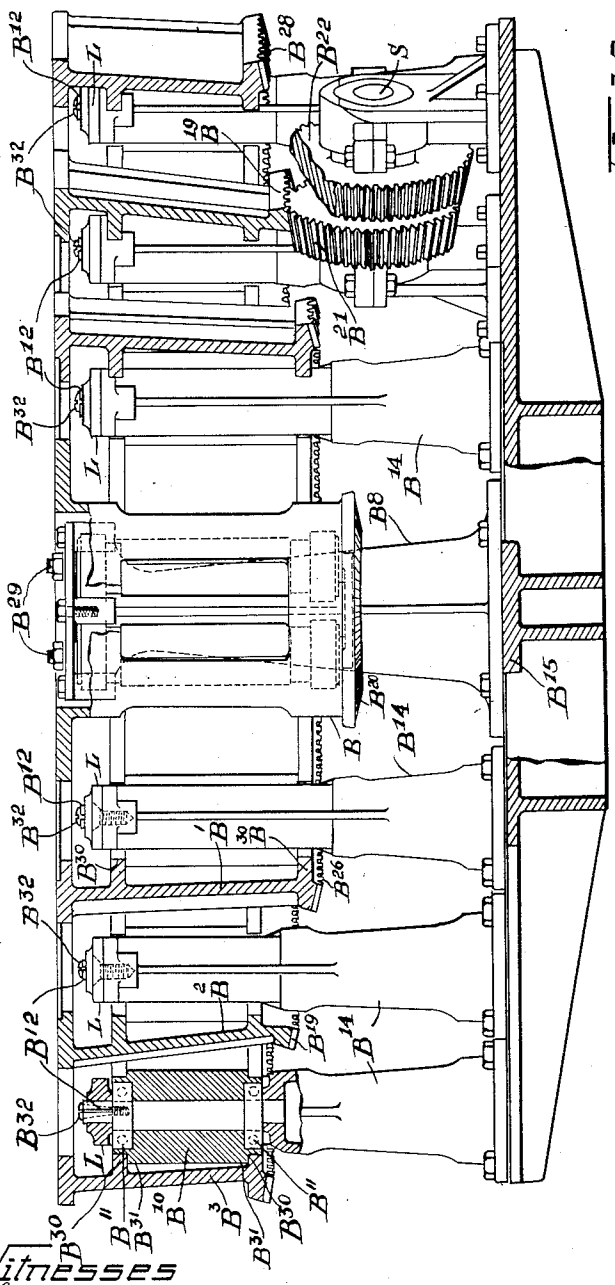


FIG. 18.

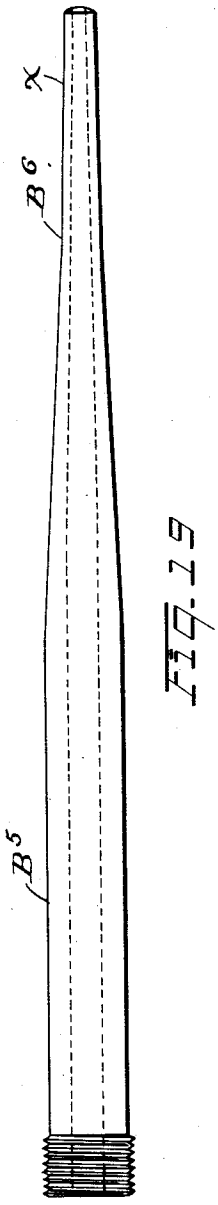


FIG. 19.

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UNITED STATES PATENT OFFICE.

LAWRENCE A. SUBERS, OF EAST CLEVELAND, OHIO.

MACHINE FOR CONSTRUCTING LAMINATED-COHESIVE-INTERWOUND BANDS HAVING VARYING LIMITS OF ELASTICITY.

1,209,903. Specification of Letters Patent. Patented Dec. 26, 1916.

Substitute for application Serial No. 725,100, filed October 10, 1912. This application filed October 7, 1914. Serial No. 865,535.

To all whom it may concern:

Be it known that I, LAWRENCE A. SUBERS, a citizen of the United States, and resident of East Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Machines for Constructing Laminated-Cohesive-Interwound Bands Having Varying Limits of Elasticity, of which I hereby declare the following to be a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

The objects of the invention are to provide an automatically operating machine for the manufacture of a tubular cotton fabric band composed of laminated-cohesive-interwound fabric members and is also an improvement upon an automatic machine for manufacturing bands, filed December 31, 1910, bearing Serial No. 600315, the subject matter of which is now in my co-pending application No. 857071, and also upon the machine for stretching and coating the same filed December 31, 1910, bearing Serial No. 600314, the subject matter of which is now in my co-pending case No. 857072. Moreover, this present application is a substitute for my prior application No. 725100, which was a renewal of an original application No. 634982.

The subject of this application is a machine embodying the modes of operation and arrangement and construction of parts required for the manufacture of the tubular flattened fabric and also embodies means for applying liquid rubber to each side of the band, means to coat the interior of the tube, means for drying the same, means for compressing and flattening the tube to form the flattened band, and to incorporate the liquid rubber thoroughly throughout the same by pressure.

The invention has reference also to means for laying the fibrous elements or yarns at a small angle to the side of the band to lessen the capacity for stretching therein, and for varying the relative speeds of the pulling and winding devices whereby the angle at which the elements are wound can be varied at pleasure to permit of the use of the bands for the manufacture of certain fabrics such as hose or tubing having layers of variable expansibility.

The machine herein described is shown inclosed in a vacuum chamber to assist in the immediate evaporation of the naphtha or other solvent in the rubber, so as to enable the material to be quickly dried and handled and thereby to expedite the manufacture of the band.

The invention further comprises the combination of reels rotated in opposite directions and having tubes of yarns or threads thereon, guiding rolls, rubber applying means, and annular ribbed flattening drums over which the band is passed until the coating thereon is dried, devices to guide the band from the drum through the wall of the chamber to any suitable winding device, devices adjustably arranged to guide the coated band elements to the mandrel or forming tube in predetermined order, adjustable compressing devices for the band, a peculiar form of hollow forming tube and automatically acting means for operating the various parts, as hereinafter more fully described, shown in the accompanying drawings, and specifically pointed out in the claims.

In the accompanying drawings Figure 1 is a front elevation of the vacuum chamber in which the principal operating parts of the machine are inclosed; Fig. 2 is a horizontal section of the machine taken inside the upper wall of the chamber on line $x \ldots x$ Fig. 1, showing the upper pulling drum, the pressure rolls therefor, the reels and spools thereon, the guide rolls and the guides, and the operating means for the various parts; Fig. 3 is a plan view of the first guiding and flattening rolls which receive the tubular fabric as it comes off from the forming tube; and also the pressure applying means therefor; Fig. 4 is a side elevation of the same showing the flattened band in cross section; Fig. 5 is an enlarged horizontal central section of the reels on line Y, Y, Fig. 6,

showing the spools thereon, the rollers on which the inner reel is mounted, the driving gears for all the reels, the central tubular forming tube and its tapered extremity and also the flanged guide rolls for the flexible elements or groups of yarns to be wound on the forming tube and of which the band is constructed. A section is also shown of one of the long guide rollers to keep the yarns in alinement with the first guide roll. In this view the standard and radial roll on which the guide rolls are mounted are shown and the guide fingers which apply the yarn to the mandrel; Fig. 6 is a front elevation of the reels showing the spools and the several guides, and the gears which operate the second and fourth reels, these gears being driven by the third reel; Fig. 7 is a vertical transverse section of the vacuum chamber showing the pulling drums and compression rollers, and pipes for applying the liquid rubber. It also shows the air tight bearing for the drum shaft, the main driving gear, the sprocket wheels for driving the lower drum and gears for driving the compression roll shafts, and the inside supports therefor; Fig. 8 is a vertical section taken transversely of the upper pulling drum and shows the upper pulling drum, the compression rolls, and the adjusting means therefor and rubber applying tube; Fig. 9 is a similar view of the lower drum and compression rolls; Fig. 10 is a side elevation of the compression roll drive for the rolls that engage the upper drum, and also shows the air tight aperture through the wall for the band; Fig. 11 is a similar view of the lower drum; Fig. 12 is a section of the compression roll arm showing the compression roll and the driving gears therefor, and the inclosed roller bearing; Fig. 13 is a side elevation of the reel and pulling drum driving mechanism and change gears for varying their speed; Fig. 14 is a front elevation of one of the adjustable yarn guiding fingers permitting of horizontal transverse and angular adjustment; Fig. 15 shows a plan view of the rubber storing and supplying device and ratchet feeding mechanism therefor; Fig. 16 is a side elevation of the operating cam therefor; Fig. 17 is a vertical central section of the receptacle for liquid rubber showing the rubber feed mechanism, the hollow stem for filling, and the sliding key for the ratchet wheel; Fig. 18 is a section on line Z, Z Fig. 6 showing the reels and rollers therefor and reversing gears for the second and fourth reels and the short shaft therefor; Fig. 19 is a side elevation of the tubular mandrel on which the band is formed.

In these views A is an air tight casing of a chamber from which the air has been withdrawn, leaving as complete a vacuum as possible, having air tight doors, A′, A′, and secured by levers A^2, A^2. Glazed peek holes A^3, A^3 are shown through which the operation of the machine within can be witnessed.

Q is the opening through which the air in the chamber is exhausted.

B, B′, B^2 and B^3 are four reels arranged to rotate, one within the other, about a central stationary standard B^8 having a tubular passage for fluid rubber. Upon the outer extremity of this standard is secured the tube Y, and upon this the forming tube or mandrel B^5, having a tapered extremity B^6 terminating in a cylindrical portion of less diameter X. The inner reel B is mounted upon the rollers B^7 secured in the arms of a standard B^8 mounted upon the frame B^{15}. Within the roller are secured the roller or ball bearings B^9 to eliminate friction as much as possible since it would be difficult to introduce oil therein for lubrication. The rollers are mounted on spindles B^{29}. The other reels are mounted upon larger rollers B^{10}, B^{10} shown in Fig. 18 upon ball bearings B^{11}, and the central spindles B^{12} are mounted upon the brackets B^{14} upon the fixed head or flange of the frame B^{15}.

A reel operating shaft B^{16} is shown in Figs. 2, 5 and 6 which is provided with two bevel gears B^{17} and B^{18} which engage the marginal gears B^{19} and B^{20} on the respective third and first reels, and revolve them in the same direction. The other reels, viz., the fourth and second, are revolved in the reverse direction by means of the bevel gear B^{21} on the short shaft S engaging the gear B^{19} on the third reel B^2, the intermediate bevel gear B^{22} and the bevel gear B^{23} on the short shaft B^{24}. Upon this shaft is mounted the bevel gear B^{25} which engages the gear B^{26} on the inner rim of the second reel, and also the bevel gear B^{27} which engages the gear B^{28} on the inner rim of the fourth or outer reel B^3.

The roller spindles B^{12}, B^{12}, and B^{29}, B^{29}, upon which the rollers B^{10}, B^{10}, and B^7, B^7, rotate, are eccentrically mounted to permit of fine adjustment of the reels so that they will operate in concentric paths. This adjusting means also permits of bringing the rollers B^7, B^7 and B^{10}, B^{10} into and out of engagement with the reels so that the reels can be easily put in place or removed when desired. When the rollers and reels are in engagement the flanges B^{30} on the reels engage shoulders B^{31} on the rollers and the reels cannot be removed until the eccentric spindles are turned. Taper plugs B^{32} screwed into the split ends of the eccentric spindles B^{12}, B^{12} clamp them so that they cannot turn when the machine is in operation. Plates L secure these outer ends of the spindles B^{12}.

As is clearly shown in Fig. 6, the ends of the members B^{12} extend through the plates L, the plugs B^{32} normally expanding the ends against the edges of the apertures in the plates L. However, when it is desired to adjust the position of the members B^{12}, it may be done by unscrewing the plugs B^{32} and turning the ends of the members B^{12} by hand. The mounting of spindles B^{29} is best shown in Fig. 5 and differs somewhat from the mounting of spindles B^{12}. One end of the spindles B^{29} being mounted in bracket B^8, as previously mentioned, the other ends extend through a ring 60 and are threaded to receive nuts 61 by which they can be clamped against ring 60. Upon loosening the nuts 61, spindles B^{29} can be turned by hand.

The central tube Y is stationary and adjustably secured to the standard B^8 which has a passage B^4 therethrough and through it the liquid rubber is fed to the tubular mandrel B^5 which projects beyond the reels at B^6.

Upon each reel is mounted a predetermined number of rotatable spools C, C upon which the elements composing the band are stored for use. These elements in the fabric described are preferably flat strips composed of groups of loose yarns lying parallel to each other and of a predetermined number and are applied to the mandrel as the reels revolve about it, all the spools being filled with similar flattened strips of loose yarns equal in the number of yarns so that all the elements which compose the band will be exactly alike. The spools are detachably secured to the reels in the manner described in my former applications previously mentioned and are spaced thereon in such a manner as to apply the strips of yarns in equally spaced rows upon the mandrel, to form the laminated-cohesive-interwound band described in my previous application.

Elongated guide rollers C′, C′ first receive the yarn strips from the spools and guide them between pairs of flanged and spring pressed guide rollers C^2, C^2 and R, R, and thence to the flanged guide roller C^3, C^3 rotatably mounted upon the radial rods C^4, C^4 upon the inner ends of which are adjustably mounted the guide fingers C^5, C^5, which are provided with curved edges C^6 which can be brought as close to the mandrel as required, and can be adjusted angularly to accommodate the angle of winding by means of the split end of rod C^4, the pin C^{11}, and clamping screw C^7, and also transversely to the mandrel by means of the sliding end C^8 and clamping screw C^9. These rods C^4 are radially, angularly and laterally adjustable, being mounted in pins K which in turn are secured in split clamping supports R′, R′ on which the rollers C^2, C^2 and R, R, are mounted. Lock nuts N, N, secure the rods C^4 in place. The curved edges C^6 are of the exact shape to bring the separate yarns composing the band elements into close relation to each other without overlapping and retain them in position.

The rods C^4 extend across the faces of the reels and are spaced out from the faces of the reels so as not to interfere with each other as the reels revolve in opposite directions. For convenience in gaining access to the spools the rods C^4 are set substantially directly over each other and the spacing of the fibrous elements of the band on the mandrel is controllable by the predetermined space preserved between the rods on the reels going in the same direction.

If the rods are too far apart or not far enough apart the fibrous elements will overlap, depending upon the width of said elements and the diameter of the mandrel or forming tube.

A ring C^{10} supports and spaces the inner ends of the outer rods C^4, C^4 and prevents vibration of their inner ends. This is not required for the shorter rods. The tapered end of the mandrel permits of reducing the diameter of the tubular band after it has been first open wound in a laminated form under slight tension upon the larger diameter and also permits of forming the band of elements at a wider angle upon the larger diameter of the mandrel, and then pulling the band over the smaller diameter which has the effect of reducing the diameter and simultaneously drawing the strands to a narrower angle, thus overcoming the difficulty found in winding at so small an angle on a very small mandrel which might not sustain the necessary pressure without undue deflection. As the band is drawn off the mandrel the rubber that is forced through the latter coats the interior of the band before it passes through the flattening rolls D^{20}, D^{20}. In this manner, for example, strands wound and laminated at an angle of approximately 15° upon the larger diameter with open spaces can be drawn out to a compact form having the strands assume an angle of approximately 8° with the side of the completed band and without any spaces between the composing elements.

The winding of the yarns upon a smooth polished mandrel at a small angle is extremely difficult since they easily slide out of their proper positions, especially when passing yarns wound previously thereon in the opposite direction. By winding the yarns on the large diameter of the mandrel a sufficiently small angle may be chosen to facilitate speed of production and at the same time large enough to overcome the difficulties

attendant upon winding at a small angle. The small angle of the yarns in the band is essential as the amount of stretch in the finished band decreases with the decrease in size of the angle.

The pulling drums by means of which the tubular band is drawn off the mandrel are seen in Figs. 2, 7, 8 and 9 at D and D'. D is the upper drum which first receives the band and the band is repeatedly passed over both the drums, guided by the series of annular ribs D^2, D^2 thereon, until the liquid rubber has been applied to both outer sides thereof, and has had time to become perfectly dry.

The band T after leaving the last groove of the drum D passes around a guide roll D^{34} rotatably mounted on the bracket D^{35} and thence through an aperture D^{36} in the wall of the chamber A, air being prevented from reaching the aperture D^{36} and passing therethrough into the chamber A by means of the adjustable blocks D^{38}, D^{38}, and the rolls D^{37}, D^{37} which coöperate for this purpose. There are four of the blocks D^{38}, two of which engage the ends of the rolls D^{37} and are adjustable axially of the rolls D^{37} and longitudinally of the aperture D^{36} while the other two blocks D^{38} are mounted between the first mentioned blocks D^{38} and fit closely around the cylindrical surfaces of the rolls D^{37}. The last mentioned blocks D^{38} are also adjustable, but in a direction at right angles to the adjustment of the first mentioned blocks D^{38}, the adjustment of the intermediate blocks D^{38} being also transverse to the aperture D^{36} instead of longitudinally thereof. The rolls D^{37} are of the same length as the aperture D^{36} and the band T and the outer blocks D^{38} fit closely against the ends of the rolls D^{37} so that they also fit closely against the edges of the band T and air is prevented from entering along the edges, while the pressure of the rolls D^{37} against the sides of the band prevents air from entering at the sides.

The band T when passing off from the mandrel is received between the rotating flattening rollers D^{20}, D^{20} having a surface speed equal to the speed of movement of the band, so as not to disarrange in any way the fabric, and for convenience a second pair of guide and flattening rollers D^{20}, D^{20} guide the flattened band to the upper drum. If desirable a series of these guide and flattening rollers may be inserted at intervals between the mandrel B^5 and the pulling drum D. In Figs. 2, 3, and 4 these guide rollers are seen and adjustable pressure is applied by means of the rock arm D^7 in which one roller is mounted, by the spring D^8, screw threaded rod D^9 and adjusting nut D^{29}.

The movement of the rollers is controlled from the upper drum shaft by means of bevel gears D^{10}, D^{11}, intermediate gears, D^{12}, D^{13}, D^{14}, and D^{15}, shafts D^{16}, and D^{17}, and local gears for the rollers, D^{18}, D^{19}, D^{30}, and D^{31}. Between the annular ribs of the pulling drums are stationed the pressure rollers D^4, D^4, one for each groove, each groove comprising preferably two pairs of rollers. Each roller is mounted as seen in Figs. 8, 9 and 12, on a shaft D^{33} in a spring pressed rock arm D^{21} loosely sleeved over the actuating shaft D^{22}. Gears D^{23} and D^{24} rotate the pressure rollers. A double ball bearing D^{25} is used to eliminate the friction as far as possible. A continued succession of these pressure rollers flatten the band and cause the liquid rubber to coat both sides of the band, the entire fabric thus being impregnated, since the interior has already been coated. The rollers are placed under adjustable pressure by means of the springs D^{26} which engage the rock arms D^{21} and are mounted on screw threaded rods D^{27} and are adjusted by the nuts D^{29}.

The arms D^{21} are mounted upon shafts D^{22}, two shafts for each drum, and the rolls D^4 are rotated by means of gears D^{23} and D^{24} one pair for each roller.

The means for rotating the pressure rollers are shown in Figs. 10 and 11 where E and E' are the shafts for the drums. E^2 is the main driving gear mounted on the upper drum shaft (Fig. 13). E^3 and E^4 are sprocket wheels on the drum shafts and E^5 is the sprocket chain connecting the sprocket wheels.

The shafts D^{22} of the pressure rollers are operatively connected with the driven shafts E and E' by means of gears E^6 and idlers E^7 and gear E^8 upon the drum shaft. For convenience of access this gearing is placed exterior to the chamber. A stuffing box F is employed for each shaft which passes through the wall of the vacuum chamber. Two tubes G and G' are employed to apply liquid rubber to the band as it passes over the upper drum. The tube G applies it as it lies on the first groove and at substantially the center of the drum the band is twisted as shown in Figs. 8 and 9, and the tube G' then applies the liquid rubber to the other side.

Gear mechanism for driving the reels and pulling drums at their desired relative rates of speed so as to determine the relative winding and pulling speeds is clearly shown in the enlarged Fig. 13, where the main driving shaft H is shown operatively connected with the upper pulling drum shaft E by means of speed changing gears H', H^2, H^3, H^4, H^5, and E^2 and with the reel driving shaft B^{16} by means of speed changing gears H^7, H^8, H^9 and H^{10}. The intermediate gears H^5 and H^4, H^8 and H^9 are respectively mounted on adjustable arms H^{11} and H^{12} so that changes in gear and corresponding changes in speed can be employed.

In Figs. 15, 16, and 17 are shown the tank for liquid rubber and the pressure applying means for forcing the fluid into a tube communicating with the mandrel. Here I is a cylindrical tank, I′ a piston therein, I^2 is the piston stem screw threaded at I^3 to screw into the cover I^4 and a ratchet gear I^6 is provided with a hub I^5 which is loosely sleeved over the screw I^3 and is rotatably attached to the hub of the cover I^4 by means of lug I^9 moving in an annular slot I^{10} in the hub of the cover. The hub I^5 is provided with a key I^7 for turning the stem, and the key moves in the slot I^8 in the stem. The stem is tubular so as to permit of filling the tank and closed at the upper end by means of the closure I^{11} when in use. Valved outlet pipes P and P′ also are provided leading from the tank I to the hollow mandrel and to the coating means respectively. The ratchet gear is automatically turned half a tooth or more at a time by means of the spring pressed pawls J, J′ one engaging while the other is half a tooth out of engagement. These pawls are pivoted upon an adjustably slidable rod J^2 engaged by a cam J^3 and returned by the spring J^4. The cam is automatically operated by means of the short shaft J^5 and bevel gears J^6 and J^7, the gear J^7 being upon the lower drum shaft E′ so that all movements of the machine coördinate and the relative speeds of the various operating parts are constantly maintained. Friction washers J^9, one on each side of the cam, permit of slipping in case of some obstruction to prevent breaking. A screw J^{10} secures the cam on the shaft J^5 and regulates the amount of pressure on the washers.

One pipe leading from the tank supplies the tubular mandrel and another pipe leads to the tubes which supply the exterior coating for the band.

The rod J^2 is adjustable longitudinally by means of nuts J^8, J^8, so that the throw of the cam can be varied to vary the distance traveled by the pawls J and J′ so as to increase or decrease the amount of movement of the piston I′ in the receptacle I.

In Fig. 19 is shown the tubular forming tube or mandrel, having a portion B^5 of large diameter upon which the flexible elements are wound, a tapered portion B^6 which facilitates the drawing off of the band and assists in retaining the proper formation thereof, and a smaller cylindrical portion X which determines the final diameter of the band and hence its width when passed through the flattening rolls D^{20}, D^{20}.

It is obvious that the machine may be so constructed that the number of layers of yarns or elements on the mandrel may be increased or decreased and that any adhesive substance may be utilized therewith in forming a laminated-cohesive-interwound band without departing from the spirit of the invention or the scope of the claims.

Having described the invention, what I claim as new and desire to secure by Letters Patent is:

1. In a machine for the manufacture of an interwound fabric tube composed of fibrous elements and for flattening the same to form a band, the combination with a closed vacuum chamber, of a series of concentrically arranged reels therein, spools spaced on said reels, a central tubular mandrel or forming tube about which said reels are revoluble, alternate reels revolving in opposite directions, an elongated guide roller for each fibrous element as it is fed from its respective spool, flanged guide rolls and a guiding finger for each fibrous element, automatically acting means for pulling the completed band off from the mandrel, said mandrel having a tapered portion and cylindrical outer extremity of smaller diameter, means for injecting fluid rubber into the tubular fabric, means for compressing the tubular fabric to form a band, and means for coating both sides of the compressed band with liquid rubber or other adhesive material.

2. In combination in an automatically acting machine for the manufacture of a flattened tubular band composed of flexible fabric elements, the combination with a stationary tubular mandrel having a preferably tapered extremity, of means for winding said fabric elements on said mandrel, one series thereof in one direction and another series in an opposite direction, means for pulling said tubular fabric from said mandrel and for flattening the same, means for injecting liquid rubber through said tubular mandrel into said tubular fabric, means for compressing and flattening said fabric to incorporate the liquid rubber therein, means for coating said flattened band on both sides with liquid rubber, a vacuum chamber inclosing said mandrel, and winding, pulling and compressing devices for said band.

3. In combination, in an automatically acting machine for the manufacture of a flattened tubular band composed of laminated-cohesive-interwound flexible fabric elements, an inclosing vacuum chamber, a tubular mandrel, a series of co-axially arranged reels and spaced spools thereon, said reels rotatable about said mandrel, alternate reels moving in opposite directions, means for injecting liquid rubber into the interior of said tubular band, means for flattening said band, means for operating said reels, means for pulling said band at relative predetermined rates of speed, and means for coating the exterior surfaces of the band.

4. In combination, in an automatically operating machine for the manufacture of a flat-

tened tubular band composed of laminated-cohesive-interwound flexible fabric elements, a vacuum chamber, a series of concentrical reels and spools spaced thereon inclosed in said chamber, a frame on which said reels are rotatably mounted, a central tubular mandrel, or forming tube, said mandrel having a tapered portion, the said reels arranged to wind said flexible band elements upon the larger diameter of said mandrel, pulling and compressing devices for the band, said tubular mandrel adapted to convey liquid rubber to the interior of said tubular band, and rollers on which said reels are mounted, said rollers mounted upon said frame.

5. In an automatic machine for the purpose described, a frame, rollers mounted on said frame, a series of co-axially arranged reels mounted on said rollers, spools on said reels, means for revolving alternate reels in opposite directions on said rollers, eccentric spindles for said rollers adjustable in said frame, a stationary central tubular mandrel about which said reels revolve, guide and compression rolls adapted to receive the tubular band as it passes from the mandrel, annular ribbed pulling drums about which said band is passed, pressure rollers adapted to flatten the band as it passes about said pulling drums, said tubular mandrel adapted to inject liquid rubber into said tubular band as it passes from said mandrel, and means for applying rubber to both sides of the flattened band.

6. In an automatic machine for the manufacture of a flattened tubular band from flexible fibrous elements cohering together in the finished band, in combination, a frame, reels rotatable thereon, one series of reels rotatable in one direction and another series in the opposite direction, a central tubular mandrel through which liquid rubber is supplied to the tubular band, annularly ribbed drums over which the band is pulled from the mandrel, spring pressed flattening and guiding rollers arranged to receive said tubular band and guide the same to said pulling drums, spring pressed flattening rollers engaging the band on said drum, tubes arranged to apply liquid rubber to both sides of the flattened band as it passes over the drum, an inclosing vacuum chamber for the reels and drums and mandrel and means for rotating said drums and said reels, at predetermined relative rates of speed and for rotating said pressure rollers at the surface speed at which the band advances.

7. In an automatically acting machine for the manufacture of a flattened tubular band composed of interwound cohering flexible elemets, in combination, an inclosing vacuum chamber, revoluble reels therein, alternate reels revolving in opposite directions, a stationary tubular mandrel, spools thereon, spaced guiding devices adapted to feed the flexible elements from said spools to said mandrel, elongated annularly ribbed pulling drums over which said band is passed as it leaves the mandrel, and over which it is exposed to dry the liquid rubber, tubes for feeding rubber to both sides of the band on said drums, said hollow mandrel adapted to convey liquid rubber to the interior of said band, pressure applying rollers adapted to engage the band between the ribs on said drums, guiding and pressure applying rollers adapted to receive said band as it passes off from said mandrel to said drums, means for rotating said reels, drums and pressure applying rollers at predetermined rates of speed, and automatically acting means for supplying rubber under pressure to said rubber feeding tubes and to said tubular mandrel.

8. In an automatically acting machine for the manufacture of a flattened tubular band composed of interwound cohering flexible elements, in combination, a closed vacuum chamber, a frame therein, a series of reels rotatable in one direction mounted on said frame, a series of reels concentric therewith and revoluble in the opposite direction, spools spaced on said reels, rollers mounted on said frame, adjustable eccentric spindles therefor, said rollers having shoulders and said reels provided with flanges engaging said rollers, a central tubular mandrel about which said reels revolve, guide fingers, supporting rods therefor in which said guide fingers are angularly and transversely and longitudinally adjustable, said guide rods adjustably secured to said reels, elongated guide rolls for said flexible elements on said reels, and flanged guide rolls for said flexible elements on said finger supporting rods.

9. The combination with concentric reels, of a frame on which they are rotatable, a central tubular mandrel, spools on said reels adapted to contain parallel lying yarns of a predetermined number wound as a unit thereon, split standards on said reels, rods radially secured to said standards at their outer ends and adjustable thereon, guiding fingers adjustably secured to the inner ends of said rods, elongated guide rollers on said reels, pressure guide rollers on said standard, and flanged guide rollers on said rods.

10. In a tubular fabric forming machine, in combination, a series of concentric reels rotatable alternately in opposite directions, a stationary central mandrel, a tapered portion and reduced outer cylindrical extremity therefor, spools on which flexible band elements are stored, means for guiding said flexible elements to said mandrel, means for rotating said reels to wind said flexible ele-

ments on said mandrel, and means for pulling said band over the reduced extremity of said mandrel.

11. In a machine for first forming a tubular band of laminated-cohesive-interwound flexible elements in an open, equally spaced manner, and afterward reducing the diameter thereof until the openings therein are closed or drawn together, in combination, a mandrel having a tapered portion and reduced cylindrical outer extremity, concentric reels revoluble about said mandrel, alternate reels revolving in opposite directions, spools thereon on which said flexible elements are stored, means for guiding said flexible elements and for rotating said reels to wind said flexible elements on said mandrel and means for pulling said open wound band over said tapered and reduced portions of said mandrel.

12. The combination with a rotatable reel and an axially placed mandrel, a spool upon said reel upon which a flexible element is stored, a standard on the reel having a clamping extremity, an adjustable pin therein, a radial rod adjustably secured in said pin, a finger adjustably secured in the lower end of said rod, adjacent to said mandrel, a guide roller on said reel, guide and pressure rolls on said standard and guide rolls on said rod.

13. The combination with a rotatable reel and mandrel, of spools upon said reel on which flexible band elements comprising flat strips of parallel yarns of predetermined diameter and number are wound, a guide finger for each band element, a support therefor adjustably secured to said reel, said finger adjustably secured in said support and provided with a curved guiding edge, said curved edge arranged to assemble said parallel yarns closely together.

14. A central stationary mandrel, and means for winding flexible elements on said mandrel to form an interwound band, said means including devices whereby the angle of winding between the flexible elements and the mandrel may be adjusted.

15. In a machine for the manufacture of an interwound fabric tube composed of fibrous elements and for flattening the same to form a band, the combination of a series of coaxially arranged reels, spools carried on said reels, a central tubular mandrel or forming tube about which the reels are revoluble, alternate reels revolving in opposite directions, an elongated guide roller for each fibrous element as it is fed from its respective spool, flanged guide rolls and a guiding finger for each fibrous element, automatically acting means for pulling the completed band off from the mandrel, said mandrel having a tapered portion and cylindrical outer extremity of smaller diameter, means for injecting fluid rubber into the tubular fabric, means for compressing the tubular fabric to form a band, and means for coating both sides of the compressed band with adhesive material.

16. In combination in an automatically acting machine for the manufacture of a flattened tubular band composed of flexible fabric elements, the combination with a stationary tubular mandrel having a reduced extremity, of means for winding said fabric elements on said mandrel, said elements being wound on the mandrel in series, one series in one direction and another series in an opposite direction, means for pulling said tubular band from said mandrel, and for flattening the same, means for injecting liquid adhesive through said tubular mandrel into said tubular band, means for compressing and flattening said band to incorporate the liquid rubber therein, means for coating said flattened band on both sides with liquid adhesive, and winding, pulling and compressing devices for said band.

17. In combination, in an automatically acting machine for the manufacture of a flattened tubular band composed of laminated-cohesive-interwound flexible fabric elements, a tubular mandrel, a series of coaxially arranged reels and spaced spools thereon, said reels rotatable about said mandrel, alternate reels moving in opposite directions, means for injecting liquid rubber into the interior of said tubular band, means for flattening said band, means for operating said reels, means for pulling said band at relative predetermined rates of speed, and means for coating the exterior surfaces of said band.

18. In combination, in an automatically operating machine for the manufacture of a flattened tubular band composed of laminated-cohesive-interwound flexible fabric elements, a series of coaxial reels and spools spaced thereon, a frame on which said reels are rotatably mounted, a central tubular mandrel, said mandrel having a reduced extremity, the said reels being arranged to wind said flexible band elements upon the larger portion of said mandrel, pulling and compressing devices for the band, said mandrel being adapted to convey liquid rubber to the interior of said tubular band, and rollers on which said reels are mounted, said rollers mounted upon said frame.

19. In an automatic machine for the manufacture of a flattened tubular band from flexible fibrous elements cohering together in a finished band, in combination a frame, reels rotatable thereon, one series of reels rotatable in one direction and another series in the opposite direction, a central tubular mandrel through which liquid rubber is supplied to the tubular band, annularly

ribbed drums over which the band is pulled from the mandrel, spring pressed flattening and guiding rollers arranged to receive said tubular band, and guide the same to said pulling drums, spring pressed flattening rollers engaging the band on said drum, tubes arranged to apply liquid rubber to both sides of the flattened band as it passes over the drum, and means for rotating said drums and said reels at predetermined relative rates of speed, and for rotating said flattening rollers at the surface speed at which the band advances.

20. In an automatically acting machine for the manufacture of a flattened tubular band composed of interwound cohering flexible elements, in combination, revoluble reels, alternate reels revolving in opposite directions, a stationary tubular mandrel, spools thereon, spaced guiding devices adapted to feed the flexible elements from said spools to said mandrel, elongated annularly ribbed pulling drums over which said band is passed as it leaves the mandrel, and over which it is exposed to dry the liquid rubber, tubes for feeding rubber to both sides of the band on said drums, said hollow mandrel adapted to convey liquid rubber to the interior of said band, pressure applying rollers adapted to engage the band between the ribs on said drums, guiding and pressure applying rollers adapted to receive said band as it passes off from said mandrel to said drums, means for rotating said reels, drums and pressure applying rollers at predetermined rates of speed, and automatically acting means for supplying rubber under pressure to said rubber feeding tubes and to said tubular mandrel.

21. In an automatically acting machine for the manufacture of a flattened tubular band composed of interwound cohering flexible elements, in combination, a frame, a series of reels rotatable in one direction, mounted on said frame, a series of reels concentric with said first mentioned series mounted on said frame and revoluble in the opposite direction, spools spaced on said reels, rollers mounted on said frame, adjustable eccentric spindles for said rollers, said rollers having shoulders and said reels provided with flanges engaging said rollers, a central tubular mandrel about which said reels revolve, guide fingers, supporting rods therefor in which said guide fingers are angularly and transversely and longitudinally adjustable, said guide rods adjustably secured to said reels, elongated guide rolls for said flexible elements on said reels, and flanged guide rolls for said flexible elements on said finger supporting rods.

22. In a machine for the manufacture of an interwound fabric tube composed of fibrous elements and for flattening the same to form a band, the combination of a series of coaxially arranged reels, spools spaced on said reels, a central tubular mandrel or forming tube about which said reels are revoluble, alternate reels revolving in opposite directions, an elongated guide roller for each fibrous element as it is fed from its respective spools, flanged guide rolls and a guiding finger for each fibrous element, automatically acting means for pulling the completed band off from the mandrel, means for injecting fluid rubber into the tubular fabric, means for compressing the tubular fabric to form a band, and means for coating both sides of the compressed band with liquid rubber or other adhesive material.

23. In a machine for interwinding flexible elements on a mandrel, in combination, a reel, a central mandrel around which said reel revolves, spools for flexible elements carried on said reel, radial arms carried by said reel, and guide fingers on the inner end of said arms for guiding the flexible elements to the mandrel, said guide fingers being adjustably mounted on the said arms whereby the angular relation of the fingers with respect to the axis of rotation of the reel may be varied.

24. In a machine for interwinding flexible elements on a mandrel, in combination, a reel, a central mandrel about which said reel revolves, spools for carrying flexible elements mounted on said reels, guide rolls on said reels over which said flexible elements run immediately after leaving said spools, said guide rolls being at least of a length equal to that of the spools, and means for feeding said flexible elements from said guide rolls to said mandrel.

25. In a machine for interwinding flexible elements on a mandrel, in combination, a series of concentrically mounted winding reels, rollers on which said reels are mounted and which bear against the inner faces of the reels, and spindles for said rollers, said spindles being eccentrically mounted whereby the rollers can be removed from engagement with the reels.

26. In an automatic machine for the purpose described a frame, a series of coaxially arranged reels mounted to revolve on said frame, spools on said reels, means for revolving alternate reels in opposite directions on said rollers, a stationary central tubular mandrel about which said reels revolve, guide and compression rolls arranged to receive the tubular band as it passes from the mandrel, annular ribbed pulling drums about which said band is passed, pressure rollers adapted to flatten the band as it passes about said pulling drums, said tubular mandrel being adapted to inject liquid

rubber into said tubular band as it passes from said mandrel, and means for applying rubber to both sides of the flattened band.

27. The combination with a mandrel of apparatus for winding fibrous elements thereon to form a tubular band, means for pulling said band from said mandrel and flattening it, means for coating said flattened band, a vacuum chamber inclosing said apparatus, and both of said means, said chamber having an aperture through which said band passes, and means for preventing the entrance of air through said aperture.

In testimony whereof, I hereunto set my hand this third day of October 1914.

LAWRENCE A. SUBERS.

In presence of—
ERNEST MOSMAN,
ADAM MEYER.