L. A. SUBERS.

FABRIC AND HOSE MAKING MACHINE.

APPLICATION FILED FEB. 21, 1914.

1,220,288.

Patented Mar. 27, 1917.

5 SHEETS—SHEET 1.

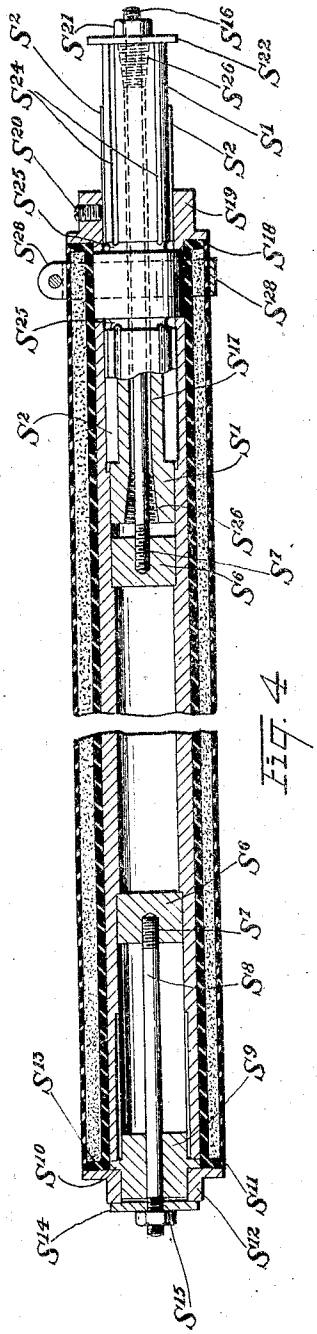

Fig. 4

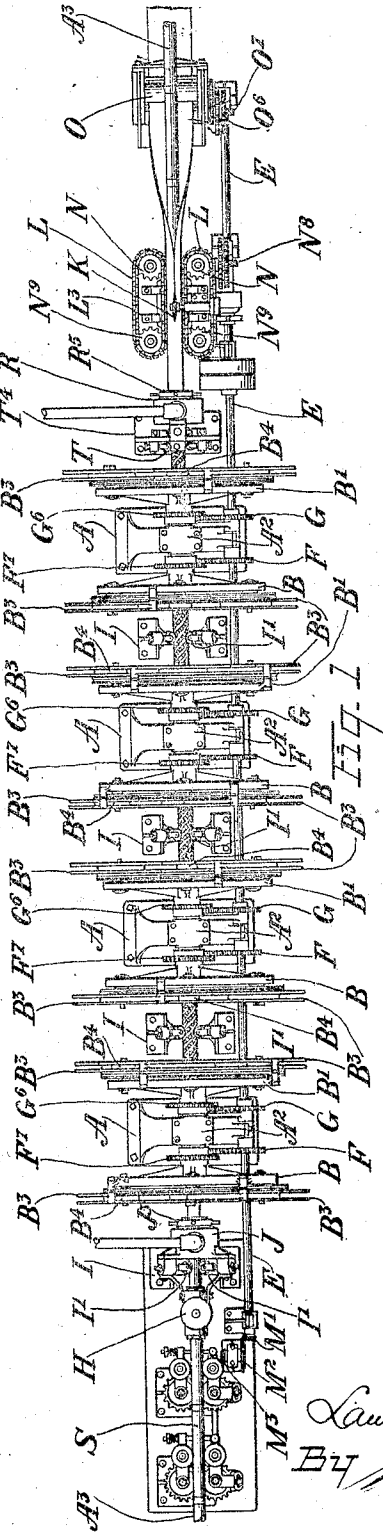

Fig. 1

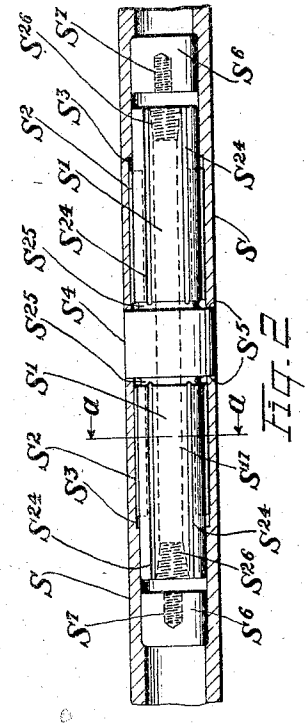

Fig. 2

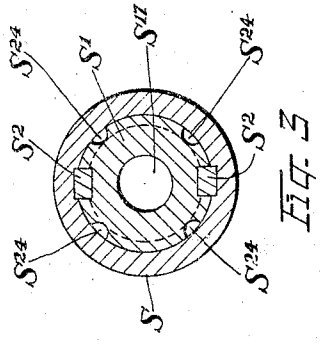

Fig. 3

Witnesses

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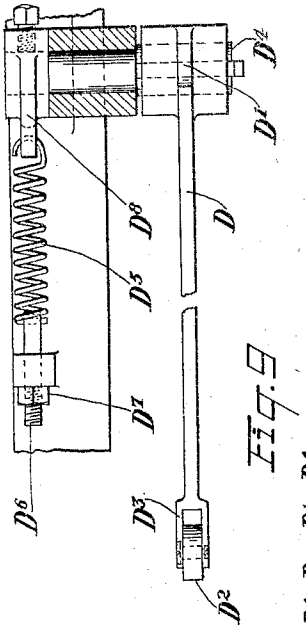

Fig. 9

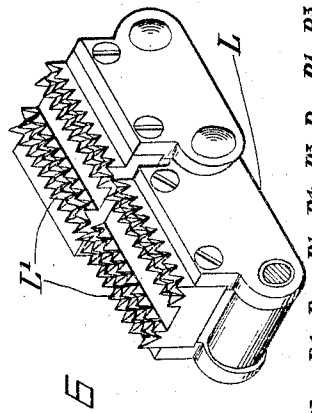

Fig. 6

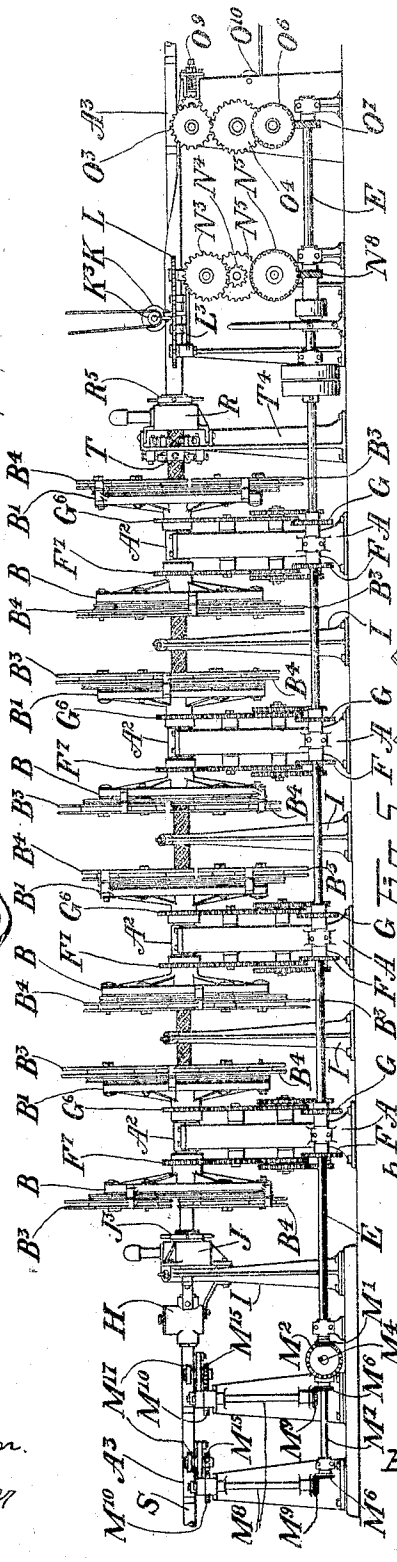

Fig. 5

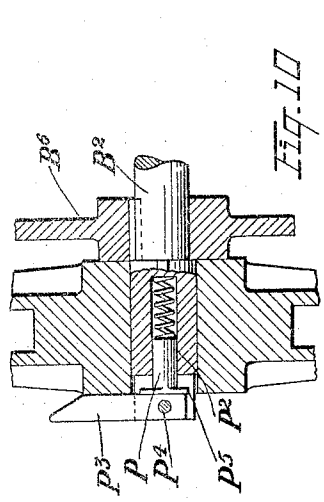

Fig. 10

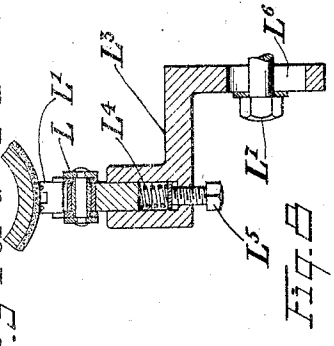

Fig. 8

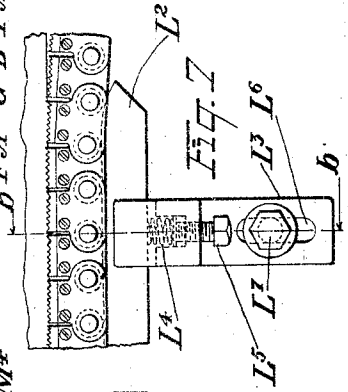

Fig. 7

Witnesses

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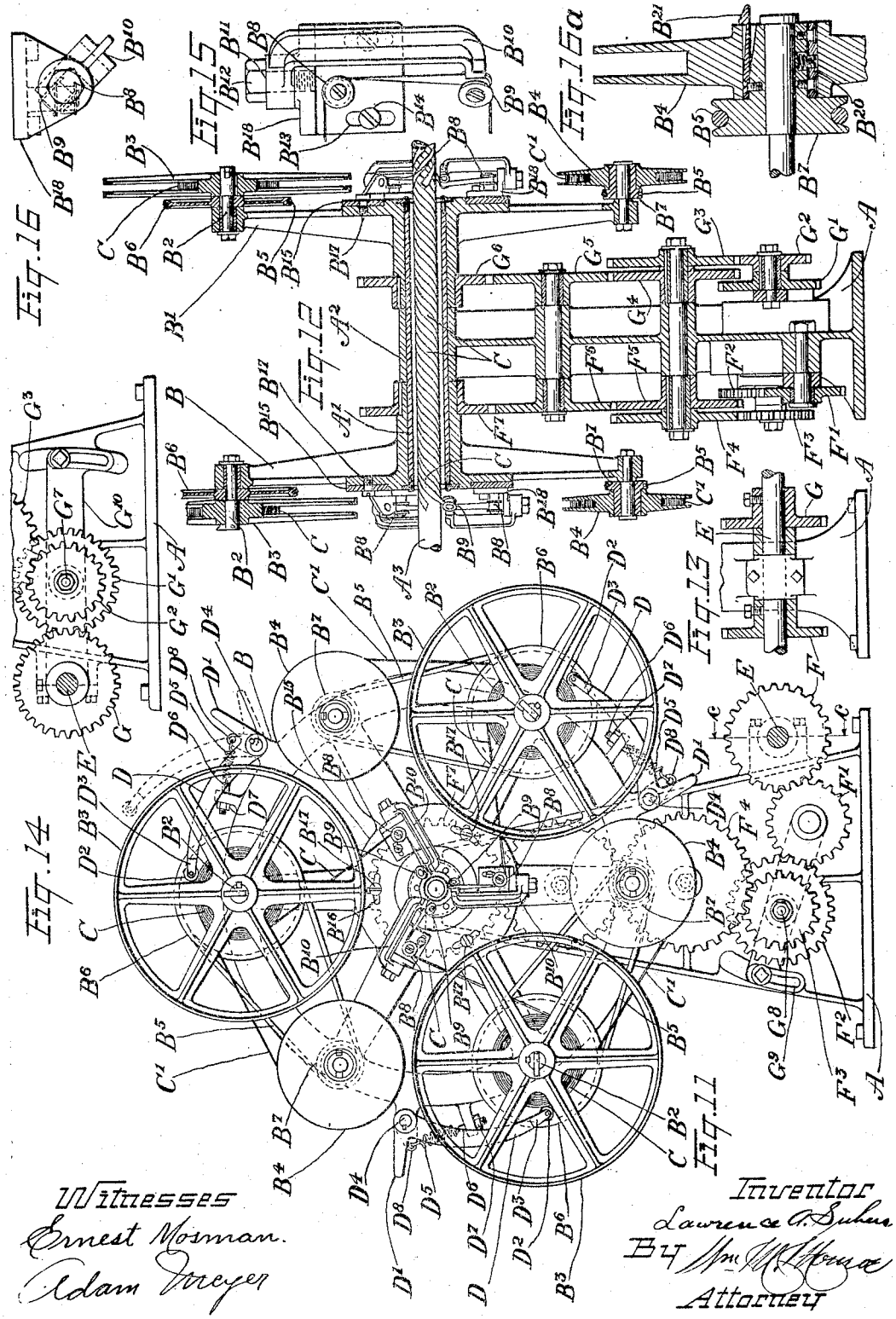

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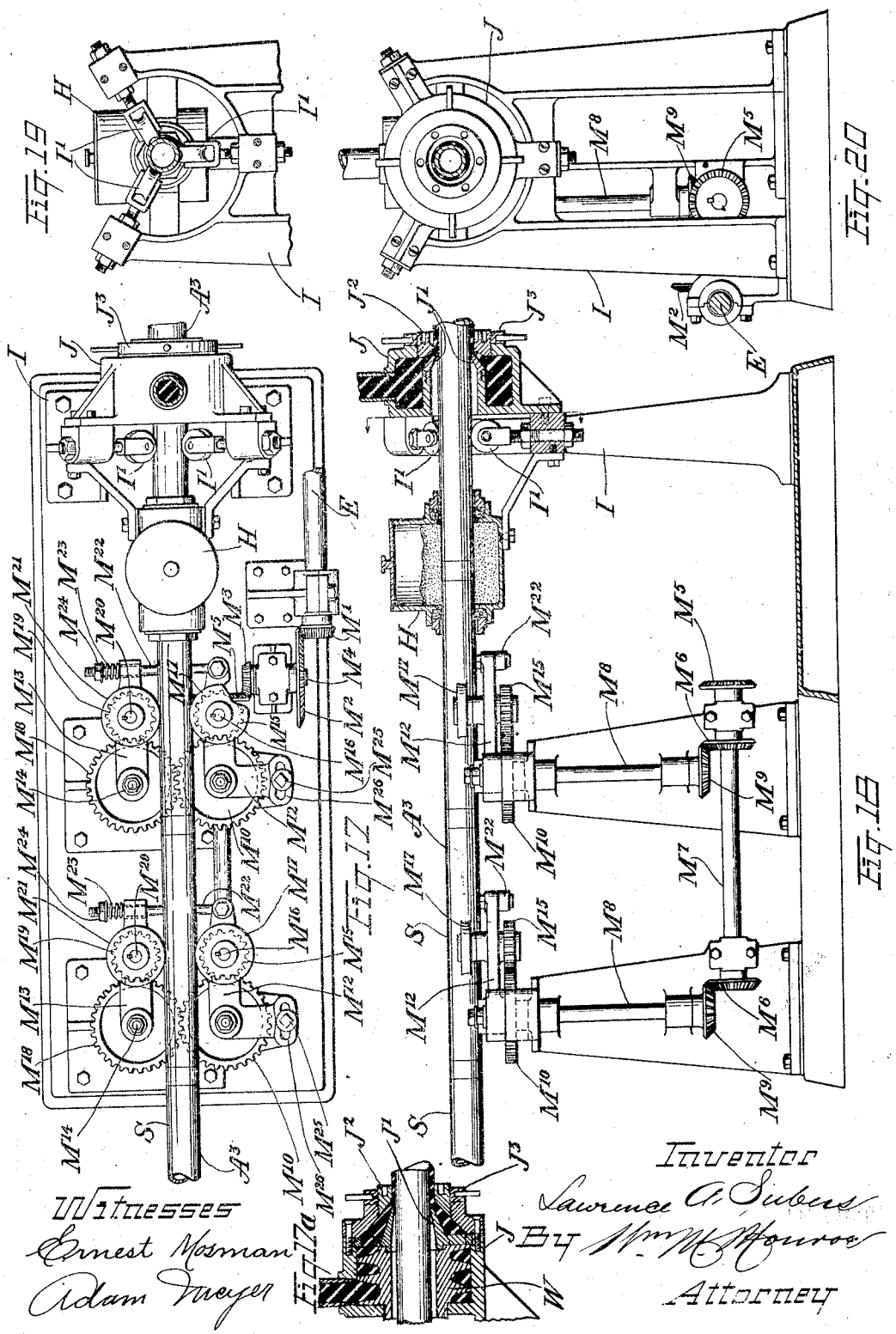

Fig. 19

Fig. 20

Fig. 18

Fig. 17

Fig. 17a

Witnesses

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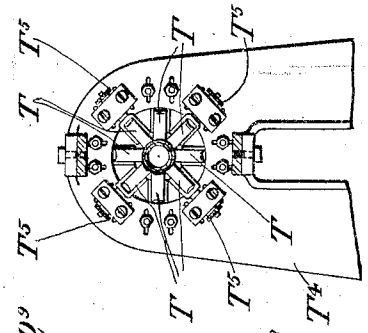

Fig. 21.

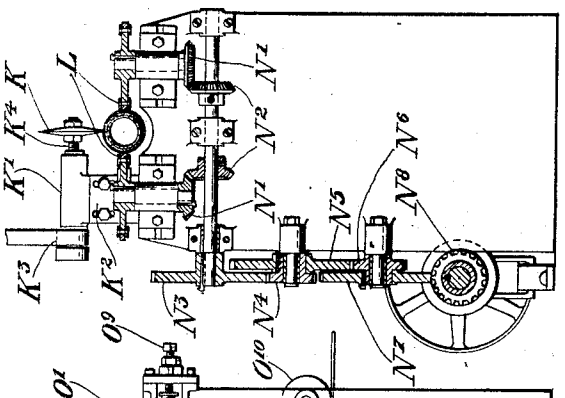

Fig. 24.

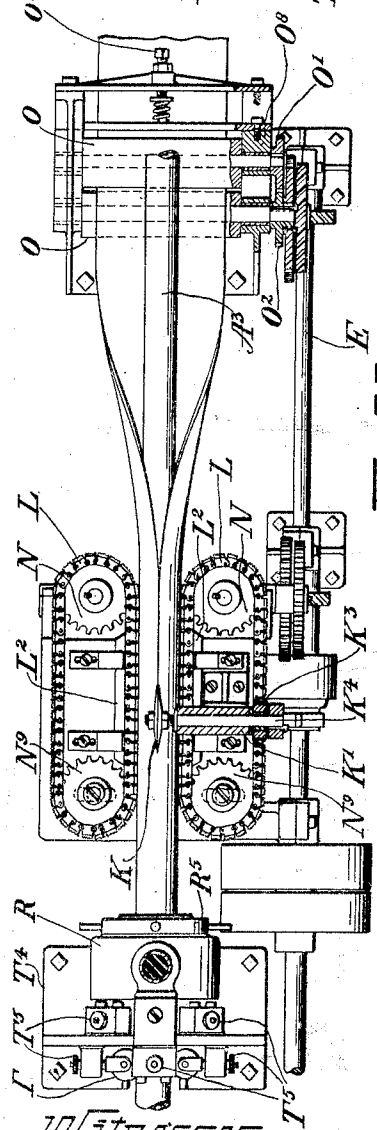

Fig. 22.

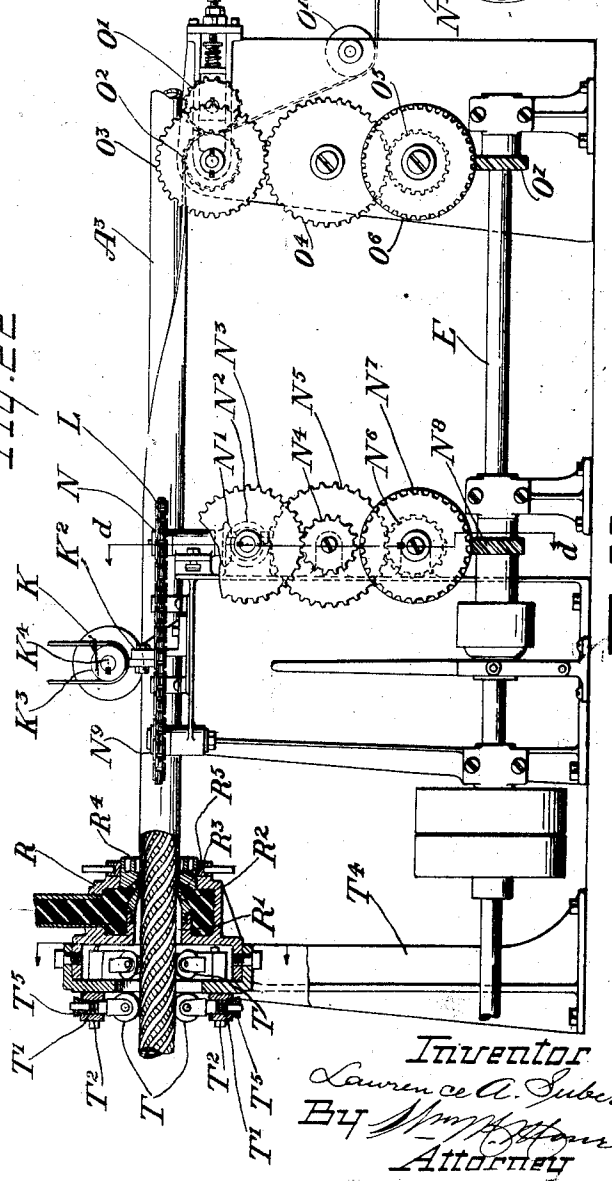

Fig. 23.

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BEST AVAILABLE COPY

UNITED STATES PATENT OFFICE.

LAWRENCE A. SUBERS, OF EAST CLEVELAND, OHIO.

FABRIC AND HOSE MAKING MACHINE.

1,220,288. Specification of Letters Patent. Patented Mar. 27, 1917.

Application filed February 21, 1914. Serial No. 820,131.

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 Fabric and Hose Making Machines, 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 a machine for constructing a laminated-cohesive-interwound tubular fabric such as is described in Letters Patent No. 1,021,014, granted to me on March 26th, 1912, the fabric being composed of parallel equally spaced fabric bands previously treated with a binding material of adhesive vulcanizable substance such as india rubber, or such other adhesive material as may be predetermined, and which are described in Letters Patent No. 1,017,271, granted Feb. 13th, 1912, a series of such bands being wound upon a mandrel and alternating with a series of similar crossing bands wound at the reverse angle thereto, the subsequently wound bands being so interlaid or wound as to overlap and become pressed into the spaces between the formerly laid and regularly spaced series of parallel bands, this fabric being composed of as many layers so constructed as may be desired.

The fabric is not woven, interlocked, or braided in any manner and the cohesive material or substance incorporated therewith alone holds the bands in their respective positions.

This machine is designed to produce continuously a tubular laminated fabric or a sheet fabric of single thickness with raw edges. The tubular fabrics are made of different diameters and widths according to the diameter of the mandrel employed in making them, and are used in various ways respectively for conduits, for pneumatic tire fabrics, or for inner linings for the same.

By interwinding and laminating a predetermined number of layers of fabric bands of predetermined width, thickness, strength, and at predetermined angular positions, a resultant tubular laminated fabric is constructed suitable for fire hose or analogous tubing, and in which the diametral expansion, the elongation, and the torsional twist are practically controlled as desired. By the action of the machine the fabric is first constructed in tubular form and may be used as such, or it may be cut longitudinally through on one side and then flattened to produce a sheet of fabric.

The invention comprises a longitudinally movable mandrel preferably composed of a series of sections which can be added to each other one at a time and a series of reels rotatable about the mandrel, upon which spools containing the fabric bands are mounted.

These reels rotate alternately in opposite directions and are provided with means for holding the fabric bands and with guiding devices which apply the fabric bands to the moving mandrel at predetermined angles and at predetermined intervals to form a continuous fabric.

It also includes means for propelling the mandrel and for rotating the reels on which the band spools are mounted about the mandrel at a predetermined rate of speed relative to the speed at which the mandrel is propelled and relative to the speeds of each other. It also includes specific means for adjusting the angular relation of the several fabric bands to the mandrel, and means for operating the various moving parts conjointly to construct the fabric and obtain the maximum strength and adjustability in the finished product.

It includes means for supporting and guiding the mandrel and resilient means for compressing the fabric thereon.

It also provides means for forming a tube on the mandrel of plastic rubber or other adhesive material upon which the tubular fabric is constructed, thereby forming a lining therefor, and also means for applying an exterior coating of adhesive material to the fabric.

It also provides means for slitting the tubular fabric and for flattening and compressing the same by rotating compression rolls when a sheet of fabric is to be produced. It also provides a set of longitudinally moving chains carrying serrated shoes to engage the fabric on the mandrel and to assist the rotating compression rolls in pulling the fabric from the mandrel.

It also includes spools upon the reels for receiving strips of practically non-adhesive substance such as Holland cloth, aluminum or other suitable substance, which is wound between the spirally wound layers of coated fibrous bands on the band holding spools,

and these additional spools are operated to withdraw the cloth bands from the fibrous bands as the latter are being interwound and laminated upon the mandrel.

It also includes the construction of a sectional mandrel composed of a series of joined mandrel portions, which are added in turn as the mandrel progresses through the machine; means for controlling the rate of speed of the same, relative to the speed of rotation of the band applying reels, means for adjusting the mandrel propelling mechanism to mandrels of different diameters and means for the support and guidance of the mandrel.

The invention also comprises the combination and arrangement of the various parts and construction of the various operating and adjusting means and other details, as hereinafter described, shown in the accompanying drawings, and specifically pointed out in the claims.

In the accompanying drawings Figure 1 is a plan view of the complete machine; Fig. 2 is a longitudinal section of portions of the mandrel showing them attached together, and one of the attaching plugs fitted into two adjoining portions of the mandrel to secure them together; Fig. 3 is an enlarged transverse section on line *a*—*a* Fig. 2; Fig. 4 is a longitudinal section of a completed fabric tube upon a mandrel ready for vulcanizing; Fig. 5 is a side elevation of the complete machine; Fig. 6 is a detail showing two links of the serrated chain employed in propelling the fabric on the mandrel when it is intended to slit the tube preparatory to flattening the same; Fig. 7 is a side elevation of part of one of the compression guides for the said chain; Fig. 8 is a transverse section on line *b*—*b* Fig. 7; Fig. 9 is a horizontal section of the bearing on the band storing reel for the compression lever arranged to equalize the tension on the fabric band as it is wound upon the mandrel; Fig. 10 is a longitudinal central section showing the manner of removably attaching each spool to its respective reel; Fig. 11 is a face view of one of the frames upon which two reels are rotatably mounted and show the train of operating gears therefor, the storage spools for the fabric bands, the guiding devices therefor and the spools for the non-adhesive bands; Fig. 12 is a vertical section of the same taken on the center line of Fig. 11; Fig. 13 is a vertical section on line *c*—*c* Fig. 11; Fig. 14 is a side elevation of the changeable speed gearing employed to drive the reel upon the opposite side of the frame shown in Fig. 11; Fig. 15 is a side elevation of one of the radially adjustable and rotatable supports for the roller which guides one of the bands to the mandrel; Fig. 16 is a plan view thereof; Fig. 16[a] is a central vertical section through the friction bearing of one of the spools which carry non-adhesive bands; Fig. 17 is a plan view showing the sectional mandrel and the horizontal pressure rollers for propelling the same, the receptacle for powdered soapstone through which the mandrel passes, the radially adjustable rollers for supporting and guiding the mandrel, and the first receptacle for adhesive coating material; Fig. 17[a] is a longitudinal section of a modified receptacle; Fig. 18 is a longitudinal section of the same; Fig. 19 is a transverse section of the mandrel showing supporting rollers therefor; Fig. 20 is a similar section showing a face view of the receptacle for adhesive material; Fig. 21 is an end view showing the arrangement of the rollers which compress the fabric upon the mandrel preparatory to coating the fabric with adhesive material; Fig. 22 is a partial plan view of the machine showing the rolls for compressing the fabric on the mandrel, the adhesive coating chamber, the slitting device, the fabric propelling chains, and the fabric compressing rolls; Fig. 23 is a side elevation of the same; Fig. 24 is a transverse section taken on line *d*—*d* Fig. 23.

In the views A, A, are a series of upright frames rigidly mounted upon a common level, and regularly spaced apart. Upon each of these frames is securely clamped a horizontal tube or sleeve A′ by means of a suitable cap A^2 bolted upon the frame. The mandrel A^3 passes through this sleeve without touching.

Upon the opposite ends of each sleeve A′ are journaled the reels B, B′, which rotate in opposite directions, and upon these reels, rotatably mounted upon shafts B^2, B^2, are the spools B^3, B^3, B^3, on which the fabric bands C are stored for use.

The spools (three in number) are regularly spaced upon the reels, and since the fabric bands stored thereon are coated with adhesive material the coils are separated by means of a ribbon C′ of Holland cloth or aluminum, or other substance to which the coating will not readily adhere, and when the bands are unwound from the spools, the non-adhesive bands are wound up upon separate spools B^4, B^4, pivotally mounted upon the reel and operated to wind up the non-adhesive bands as fast as they are unwound from contact with the fabric bands by means of the belts B^5, B^5, and pulleys B^6, B^7, upon the respective spool shafts.

The fabric bands pass over pivoted guiding rollers B^8, B^8, and over adjustably mounted inner guide rollers B^9, B^9, to the mandrel A^3, and as the mandrel advances, they are laid at a predetermined angle thereon, the movement of the bands serving to rotate the spools B^3 and thereby the spools B^4 so long as any part of the bands remain on the spools.

In practice the spools on each reel are provided with a sufficient amount of material to form a predetermined length of completed tubing, so that there will be no break therein.

Since the angle at which the fabric bands are applied to the mandrel varies with the speed of revolution of the reels and the speed of advancement of the mandrel, the guide rollers B^9, B^9 (see Figs. 11, 12, 15 and 16), are mounted upon separate supports B^{10}, B^{10}, which are pivoted at B^{11}, B^{11} for angular adjustment relative to the axis of the mandrel upon radially movable supports B^{18}, B^{18}. The supports B^{10}, B^{10} are fixed in the angular position desired by tightening the screws B^{12}, B^{12}.

Radial slots B^{13}, B^{13} in the supports B^{18}, B^{18}, and screws B^{14}, B^{14}, permit of adapting the guide rollers to varying sizes of mandrel. These supports B^{18}, B^{18} are secured upon the rings B^{15}, B^{15} which are made rotatably adjustable upon the reel, by means of the slots B^{16}, B^{16}, and screws B^{17}, B^{17} so as to adjust the relative positions of the bands upon each reel to those upon other reels, so that the edges of parallel bands will not overlap when wound upon the mandrel but will fit closely together.

As many reels are employed as may be required to produce a fabric of one or more layers and the rates of speed and revolution of the sets of reels employed in forming the different layers can also be different if desired.

A compression lever D (see Figs. 9 and 11), having a handle D′ and a roller D^2 rotatably mounted in the forked extremity D^3, is secured to the shaft D^4 mounted on the reel. The roller D^2 is pressed upon the band stored on the spool B^3 by means of the coiled spring D^5 adjustably secured to the reel by the threaded rod D^6, nut D^7 and to the lever D^8 upon the shaft D^4. The tension upon the spring D^5, and the pressure of the roller D^2, is greatest when the diameter of the coil of bands on the spool is greatest. But in this case the pull on the band necessary to rotate the spool B^3 has the greatest leverage, and as the diameter of the coil of bands upon the spool decreases, both the pressure of the roller D^2 and the leverage of the band decreases thereby, forming a practically constant tension or pull on the band.

The tension on the band from the pressure roller D^2 serves to prevent the band from getting off the guiding rolls B^8 and B^9.

The means for rotating the reels on each frame in opposite directions to interlay the bands as described in the above mentioned Letters Patent are shown in Figs. 1, 5, 11 and 12, and comprise change speed gears arranged in trains, one train on each side of the frame.

In these figures E is the main shaft from which all the movements of the mandrel and reels are obtained. F, F′, F^2, F^3, F^4, F^5, F^6 and F^7 are a train of spur gears which provide for the movements of one reel B and G. G′, G^2, G^3, G^4, G^5, and G^6 are a train of gears which provide for the movement of the reel B′ in the reverse direction.

In Fig. 11 the gear F^3 is so mounted upon the pin G^8 on the movable arm G^9 as to permit of being easily removed and another gear substituted when a change of speed is desired.

In the same manner (see Fig. 14) the gear G^2 is mounted upon a pin G^7 in a movable arm G^{10} which permits of the substitution of other gears for increasing or diminishing the speed of the reel B′. The remaining gears are duplicates of the gears which operate the reel B.

In Fig. 13 the manner of securing the gears F and G upon the main shaft is shown and in Fig. 16^a the manner of detachably securing the spools B^4, B^4 upon the hubs of pulleys B^7, B^7 is shown.

Here a spring pressed bar B^{20} provides the friction which enables the pulley to drive the spool but will slip when the tension produced becomes too great, and thus prevent disarranging the band. A depressible spring hook B^{21} provides a detachable means for securing the spool upon the hub of the pulley.

In Fig. 10 the manner of detachably securing the spools B^3 to the reels is shown. Here B^2 is the axial shaft, P is a spring pressed pin slidingly movable in an opening P^2 in the shaft. P^3 is a holding dog or latch pivoted in the slotted projecting end of the shaft at P^4 and P^5 is a flattened head upon the pin P which engages and holds the latch firmly in place to retain the spool B^3, which can be readily released by swinging the pin P into a position axial with the shaft.

The means for propelling the longitudinally movable mandrel are shown in Figs. 1, 5, 17, and 18, and comprise the bevel gear M′ upon the main shaft E the bevel gears M^2 and M^3 upon the short shaft M^4, bevel gears M^5, and M^6 upon the shaft M^7, the vertical shafts or shafts M^8, M^8, having mounted thereon the bevel gears M^9, M^9 and spur gears M^{10}, M^{10}, arms M^{12}, M^{13}, pivoted on shaft M^8 and pin M^{14} respectively, spur gear M^{15} on shaft M^{16} driving roller M^{17} mounted thereon, also gear M^{18} pivoted on pin M^{14} engaging gear M^{19} on shaft M^{20} mounted on arm M^{13} and driving roller M^{21}. The oppositely placed rollers M^{17}, and M^{21}, grip the mandrel A^3 by means of the tension rod M^{22} which is secured to arm M^{12} and engaged by arm M^{13}, exerting pressure thereon by spring M^{23} and nut M^{24}. The speed of rotation of these gripping rollers

M^{17} and M^{21}, driven by the train of gears, as described, determines the speed of propulsion of the mandrels. The arm M^{12} is adjustable for different sizes of mandrels and is locked in place by the screw M^{25} in the slot M^{26}.

The main shaft E as described furnishes the source of power for driving the mandrel and the reels, and in addition to the adjustments for the control of the speed of the reels the speed of propulsion of the shaft can be controlled by the substitution of other gears for the bevel gears M^1 and M^2, or the gears M^5 and M^6 can be changed to gears of larger or smaller diameter if desired.

In this manner a complete control of the relative rates of speed of the mandrel and reels and of the relative rates of speed of the several sets of reels can be obtained, that is the reels employed in winding the separate layers.

Before winding the fabric bands upon the mandrel it is preferably coated with powdered soapstone or other non-adhesive material to prevent the tube of adhesive material from sticking thereto, and is supplied by means of a receptacle H through which the mandrel passes.

At suitable intervals frames I, I, are provided, upon which guiding and supporting rollers I', I', I', are mounted equally spaced about the mandrel. A tube of adhesive material is next formed upon the mandrel making the lining for the fabric tubing and is applied by passing the mandrel through the annular receptacle J which contains the tubing material in a fluid or plastic condition under pressure.

The tubing material flows under applied pressure through an annular opening formed between an annular lip J' of the receptacle and a screw threaded annular closure J^2 which can be advanced or withdrawn to reduce or enlarge the opening.

The lip J' is of conical form and the closure corresponds in shape so that an adjustment of the size of the opening can be obtained.

A lock nut J^3 is employed to secure the closure in place.

The mandrel A^3 is formed in detachable sections S as shown in Figs. 1, 2, 3, 4, 5, 17, and 18, which are attached in a progressive or continuous manner, one at a time as the mandrel is propelled through the machine.

The mandrel sections S are united together temporarily by means of double ended plugs S' prevented from turning by means of keys S^2 adapted to fit in diametrically opposite keyways S^3 in each end of the sections which are bored out to receive the plugs and are cylindrical and accurately fitted.

Each plug is provided with an enlarged central cylindrical portion S^4 which is of the same diameter as the mandrel and separates the two sections when they are attached together, and its ends form shoulders S^5 against which the mandrel sections closely abut.

After the fabric tube is completed on the mandrels it is cut transversely at one of the shoulders S^5 and the mandrel sections are then separated. The length of hose formed upon each section is then approximately the length required for that hose.

In Fig. 4 one mandrel section is shown after it has been detached from the accompanying mandrel section and the ends closed so that the fabric can be vulcanized. In this figure S^6, S^6 are closures for the inner opening spaced from each end and provided with screw threaded openings S^7, S^7. One end of each mandrel section is closed before vulcanizing by means of a screw threaded rod S^8 screwed into one of the closures S^6 and passing through a flanged plug S^9, the flange S^{10} of which covers that end of the mandrel and supports a washer S^{11} of rubber. A flanged ring S^{12} is next employed to extend over the end of the fabric, and the unvulcanized rubber washer or cap S^{11} is compressed thereby upon the end of the hose S^{13}.

The parts are finally clamped together by means of the washer S^{14} and nut S^{15} screwed upon the outer end of the rod S^8.

In the other end of the mandrel section the plug which joins the mandrel sections together is retained and a rod S^{16} longer than the rod S^8 is employed to secure the parts together and passes through a central opening S^{17} in the plug.

A ring S^{19} is sleeved over the outer end of the plug S' attached thereto by a set screw S^{20}, and serves as a seat for and to compress a rubber washer S^{18} upon the end of the hose so that the ends of the hose are sealed at this end with rubber. The similar ring S^{12} at the other end has the same function. A nut S^{21} on the rod S^{16} and washer S^{22} finally secure the parts together for vulcanization.

To permit the stripping of the hose from the mandrel by means of air or fluid under pressure applied between the hose and mandrel each plug is externally grooved at S^{24} for the passage of compressed air, an annular external groove S^{25} at the side of the shoulder S^5 permits the air to circulate around the plug and it passes around the end of the mandrel where the clamping ring S^{26} prevents it from escaping at that point. The air is introduced through the central opening S^{17} after the rod S^{16} is removed, and screw threads S^{26} permit the attachment of an air pump nozzle thereto. The clamp S^{28} prevents the plug S' from being driven out.

The devices employed for slitting and flattening the tubular fabric formed upon the machine are shown in Figs. 1, 5, 6, 7, 8, 22, 23, and 24, where K represents a circular

knife mounted upon a journal bearing K′ which is vertically adjustable upon a frame K^2. The knife K is adjusted to bear upon and cut through the fabric upon the center line, as the mandrel progresses, and is rotated by means of a band wheel K^3 upon the shaft K^4. Since the fabric tubing when cut open loses its frictional contact with the mandrel a separate means is provided for propelling the same and this is shown to be a pair of endless propelling chains L, L, one on each side of the mandrel. The links of these chains are provided with serrations L′, L′, which engage with the fabric.

The chains are kept in contact with the fabric by means of the guide bars L^2, L^2, which are mounted in the adjustable brackets L^3, L^3, and are pressed by springs L^4, L^4, as shown in Figs. 7 and 8, the amount of pressure being regulated by means of the screws L^5, L^5. The brackets L^3, L^3 are adjusted by slots L^6, L^6 and screws L^7, L^7.

The chains are propelled by means of the sprocket wheels N, N, and a train of bevel and spur gears N′, N^2, N^3, N^4, N^5, N^6 and spiral gears N^7 and N^8 operated by the main shaft E. The sprocket wheels N^9 are idlers.

The tubular fabric after being slit is flattened by passing it between the pressure rollers O, O, operated by the gears O′, O^2, O^3, O^4, O^5, and spiral wheels O^6 and O^7 driven by the main shaft E.

The amount of pressure can be controlled by means of the spring pressed bearing O^8 and adjusting screw O^9, O^{10} is an idler over which the flattened fabric can be passed to any suitable storing mechanism.

At R is shown a second receptacle for applying an exterior coating to the fabric through a central opening R′ in which the mandrel passes. R^2 is the wall of this opening showing a conical lip R^3 at the inner end. A conical closure R^4 is screw threaded into the inner wall of the receptacle permitting of fine adjustment of the closure to control the thickness of the coating. A lock nut R^5 secures this in place when properly adjusted.

Previously to passing through this receptacle the fabric is compressed by means of pressure rollers T, T, T, shown in Figs. 21, 22 and 23, which are pressed against its surface by means of the springs T′, T′, T′, and glands T^5, T^5, T^5.

These rollers are mounted in bearings T^2, T^2, upon a separate standard T^4 and serve also to support and guide the mandrel. This standard also supports the receptacle R.

The rollers T, T, are so arranged as to compress the entire circumference of the fabric.

It is obvious that means may be provided for automatically feeding the mandrels to the machine as required, without departing from the spirit of the invention or scope of the claims.

It is obvious that the width of the fabric bands used may be larger or smaller and that the number of spools, containing fabric bands on the reels, may be increased or diminished according to the diameter of the mandrels used and the angles at which it is desired to interwind the fabric bands thereon, without departing from the spirit of the invention or scope of the claims.

It is also obvious that the rubber or other adhesive material may be forced through the annular opening, formed by the conical lip J′ and closure J^2 by any desired means, such as a rotating screw W encircling the mandrel fitting in an annular chamber and having a changing lead, (see Fig. 17^a) without departing from the spirit of the invention or 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 constructing a tubular fabric upon a longitudinally moving mandrel, the combination with the mandrel of a chamber containing non-adhesive material through which said mandrel passes to coat the same, and an annular chamber containing an adhesive material through which said mandrel passes, thereby receiving first a coating of said non-adhesive material and subsequently receiving a tube of adhesive material, and means for controlling the thickness of the tube of adhesive material, supplied by said second named chamber.

2. In a machine for constructing a tubular fabric upon a moving mandrel, the combination with the mandrel, of a series of radially adjustable supporting rollers therefor, a series of pressure rollers, engaging the mandrel upon opposite sides, means for rotating said rollers at a common rate of speed to propel the mandrel, a series of standards in the line of the mandrel, a tube secured in each standard through which said mandrel passes, a reel rotatably mounted upon each end of each tube, means for rotating the reels on each tube in opposite directions around said mandrel, a series of spools for fabric bands on each reel, pressure devices for equalizing the tension upon the fabric bands on each spool, and guiding rollers over which the fabric bands pass from the spools to the mandrel.

3. In a machine for constructing a tubular fabric upon a moving mandrel, the combination with the mandrel, of means for alining and supporting the mandrel, propelling means for the mandrel, a series of standards spaced in line with the mandrel, a tubular bearing member secured to each standard, and through which said mandrel passes, a reel rotatably mounted upon each end of said tubular bearing member, means for rotating the reels on each tubular bear-

ing member in opposite directions, guiding rolls and adjustable supports therefor on said reels, means for operating the propelling means for the mandrel, and means for rotating the said reels and a common operating means therefor, said mandrel propelling and reel rotating means permitting adjustment of the speed of the mandrel relative to that of the reels, and of the reels on the several bearing members relatively to each other.

4. In a machine for constructing a tubular fabric upon a moving mandrel from fabric bands coated with adhesive material, the combination with the mandrel, means for propelling the same, a series of standards spaced apart in the line of the mandrel, tubular bearing members secured to said standards and projecting upon each side thereof, a reel detachably secured upon each projecting end of each tubular bearing member, upon which said adhesive bands alternating with the bands of non-adhesive material are wound, a series of spools rotatably mounted upon each reel, adjoining spools upon which the bands of non-adhesive material are wound from the first mentioned spools, means for driving the second mentioned spools from the first mentioned spools, rollers for guiding the fabric bands to the mandrel, radially and circumferentially adjustable supports for said guide rollers, and rotatable means for adjusting the angular position of the inmost guide rollers relative to the axis of the mandrel.

5. In a machine for constructing a tubular fabric upon a moving mandrel, the combination with the mandrel, of means for propelling the same at a predetermined rate of speed, means for applying a tube of adhesive material to the mandrel as it progresses through the machine, and devices rotating alternately in opposite directions for winding spaced spiral rows of fabric bands progressively upon the tube on said mandrel, the first band being laid in spaced spirals, the next laid at the reverse angle thereon, and the following bands being so laid as to coincide with and overlap the spaces between the previously laid rows, and means for operating said rotating devices at a predetermined rate of speed relative to the speed of propulsion of the mandrel.

6. In a machine for constructing a tubular fabric upon a longitudinally moving mandrel, the combination with the mandrel, of reels rotatable about the mandrel, a series of spools upon each reel for storing flexible bands, a circularly movable main support upon each reel, a series of radially adjustable supports thereon, a guide roller for one of the flexible bands on each radially adjustable support, a second guide roller closely adjacent to said mandrel, and an adjustable support for said second guide roller, whereby the said roller is set to the inclination of said flexible band as it is applied to said mandrel.

7. In a machine for constructing a tubular fabric upon a longitudinally moving mandrel, the combination with the mandrel, of reels rotatable about said mandrel, a series of spools adapted to store fabric bands upon each reel, outer and inner guide rollers adapted to receive the bands from said spools and direct them to the moving mandrel, a main support for said guide rollers upon each reel, and adjustable circumferentially of said mandrel to adjust the positions of the bands thereon relatively to the positions of bands laid by other reels, radially adjustable supports for said guide rollers upon each main support, and angularly adjustable supports for the inner guide rollers upon said radially adjustable supports.

8. In a machine for constructing a tubular fabric formed of adhesive bands, upon a longitudinally moving mandrel, the combination with the mandrel, of means for applying a tube of adhesive material to the mandrel, reels rotatable about the mandrel in opposite directions, a series of spools upon each reel adapted to store adhesive bands, said adhesive bands being wound upon said mandrel alternately with bands of non-adhesive material, a second series of spools on each reel upon which the bands of non-adhesive material are wound from the first mentioned spools, means for operatively connecting said first and second series of spools, means for controlling the tension upon the first named series of spools, and means permitting the slipping of the second named series of spools to regulate the speed of rotation of the spools for non-adhesive material to the speed or unwinding of the adhesive bands.

9. In a machine for constructing a tubular fabric upon a longitudinally moving mandrel, in combination, a mandrel composed of duplicate sections and connecting devices permitting the formation of the mandrel in a progressive manner by the constant attachment of sections thereto as it is propelled through the machine, means for propelling the mandrel, reels alternately rotatable around the mandrel in opposite directions, means for rotating the reels spools upon said reels upon which fabric bands are stored, guide rollers for said fabric bands and means for adjusting said guide rollers to apply spaced bands to said mandrel at predetermined positions relatively thereto.

10. In a machine for constructing a tubular fabric upon a longitudinally movable mandrel from fabric bands coated with adhesive material, in combination, a mandrel

composed of sections, means for progressively attaching additional sections to the end of the mandrel as it is propelled through the machine, means for applying a tube of adhesive material to the mandrel as it enters the machine, series of oppositely rotatable reels encircling the mandrel, and supports therefor, a series of spools on said reels on which said fabric bands are wound alternately with bands of non-adhesive material, means for removing the bands of non-adhesive material from the spools as the fabric bands are unwound therefrom, and adjustable guiding means for said fabric bands.

11. In a machine for constructing a tubular fabric from fabric bands upon a longitudinally moving mandrel, the combination with the mandrel, of means for applying a tube of adhesive and vulcanizable material thereto, a series of reels revoluble about said mandrel alternately in opposite directions, spools on said reels for storing said fabric bands, guide rollers for said bands, adjustably mounted upon said reels, a device for applying a tubular coating of adhesive material upon the fabric formed upon the mandrel, means for propelling the mandrel, means for operating the reels, rigid roller supports for the mandrel, and yielding roller supports for the mandrel and fabric formed thereon.

12. In a machine for constructing a tubular fabric upon a longitudinally movable mandrel composed of sections attachable thereto one at a time as the mandrel progresses through the machine, a device for applying a non-adhesive substance to the mandrel, a device for supporting and guiding the mandrel, a device for applying a tube of adhesive material to the mandrel, rotatable reels and guiding devices thereon for applying fabric bands to the mandrel, supporting means for the mandrel and fabric, a device for applying an exterior coating of adhesive material to the exterior of the tubular fabric.

13. In a machine for constructing a fabric upon a longitudinally moving mandrel from fabric bands, a series of reels, rotatable about the mandrel, and arranged to apply said bands thereon, as said mandrel progresses, a rotatable knife blade arranged in engagement with said fabric, and adapted to slit said fabric longitudinally as said mandrel progresses, propelling means adapted to move the slitted fabric in unison with the movements of said mandrel, pressure rollers adapted to flatten said fabric as it is drawn off from said mandrel and means for operating said mandrel, reels, and propelling means and pressure rollers.

14. In a machine for constructing a tubular fabric upon a moving mandrel, the combination with the mandrel, of a series of radially adjustable supporting rollers therefor, a series of pressure rollers, engaging the mandrel upon opposite sides, means for rotating said rollers at a common rate of speed to propel the mandrel, a series of standards in the line of the mandrel, tubes secured in each standard through which said mandrel passes, a reel rotatively mounted upon each end of each tube, means for rotating the reels on each tube in opposite directions around said mandrel, and a series of spools for fabric bands on each reel.

15. In a machine for constructing a tubular fabric upon a moving mandrel, the combination with the mandrel, of means for moving said mandrel in the direction of its length, a series of standards in the line of the mandrel having apertures therein through which the mandrel passes, two reels rotatively mounted upon each of said standards, means for rotating the reels on each standard in opposite directions around said mandrel, and a series of spools for fibrous elements on each reel.

In testimony whereof, I hereunto set my hand this 20th day of February, 1914.

LAWRENCE A. SUBERS.

In presence of—
WM. J. KLOTZBACH,
WM. M. MONROE.