E. D. C. BAYNE & L. A. SUBERS.

AUTOMATIC MACHINE FOR LAYING ADHERING CORDS OR THREADS UPON A STATIONARY MANDREL TO FORM AN UNWOVEN FABRIC.

APPLICATION FILED FEB. 23, 1909.

987,791.

Patented Mar. 28, 1911.

6 SHEETS—SHEET 1.

Fig. 1

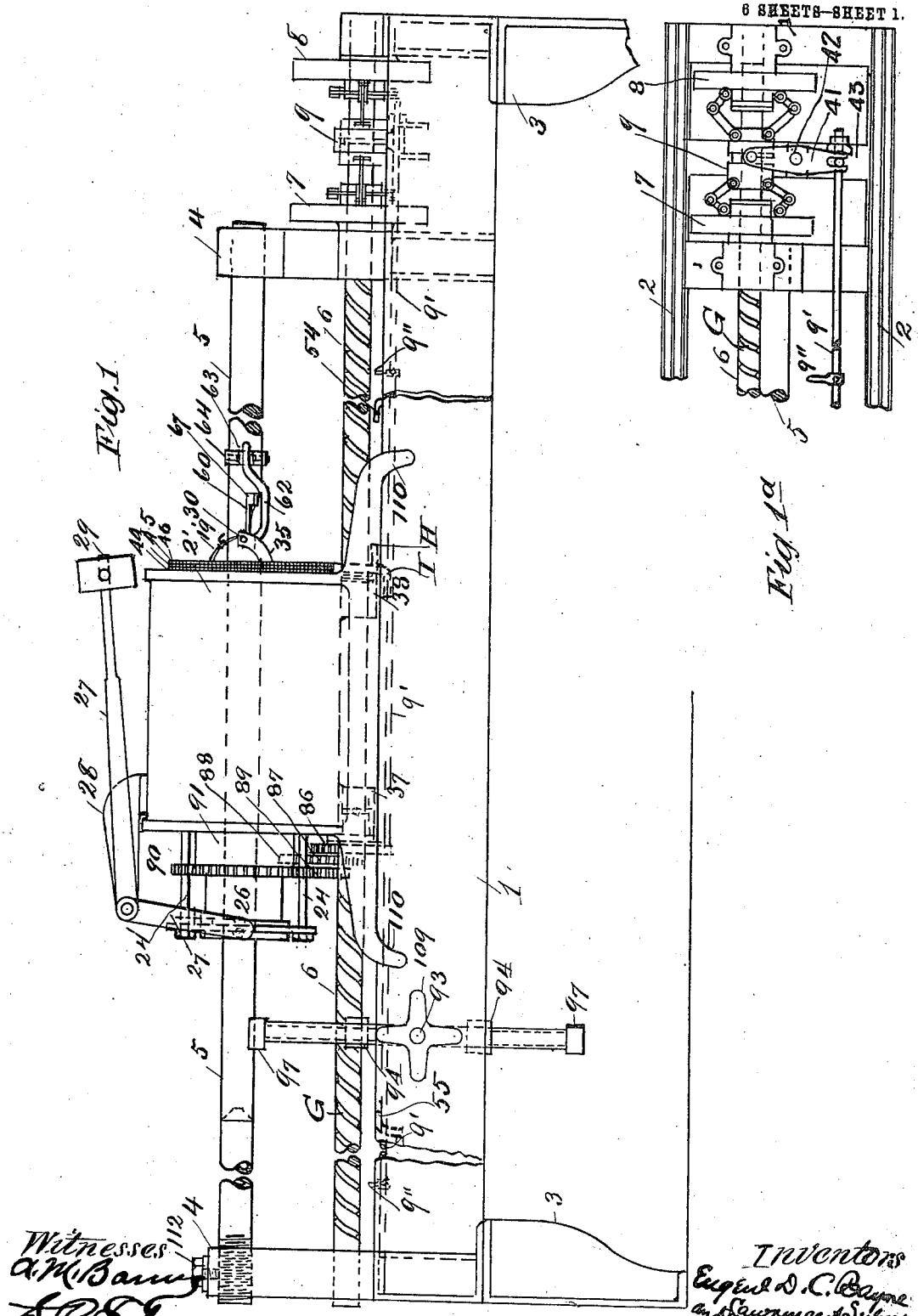

Fig. 1a

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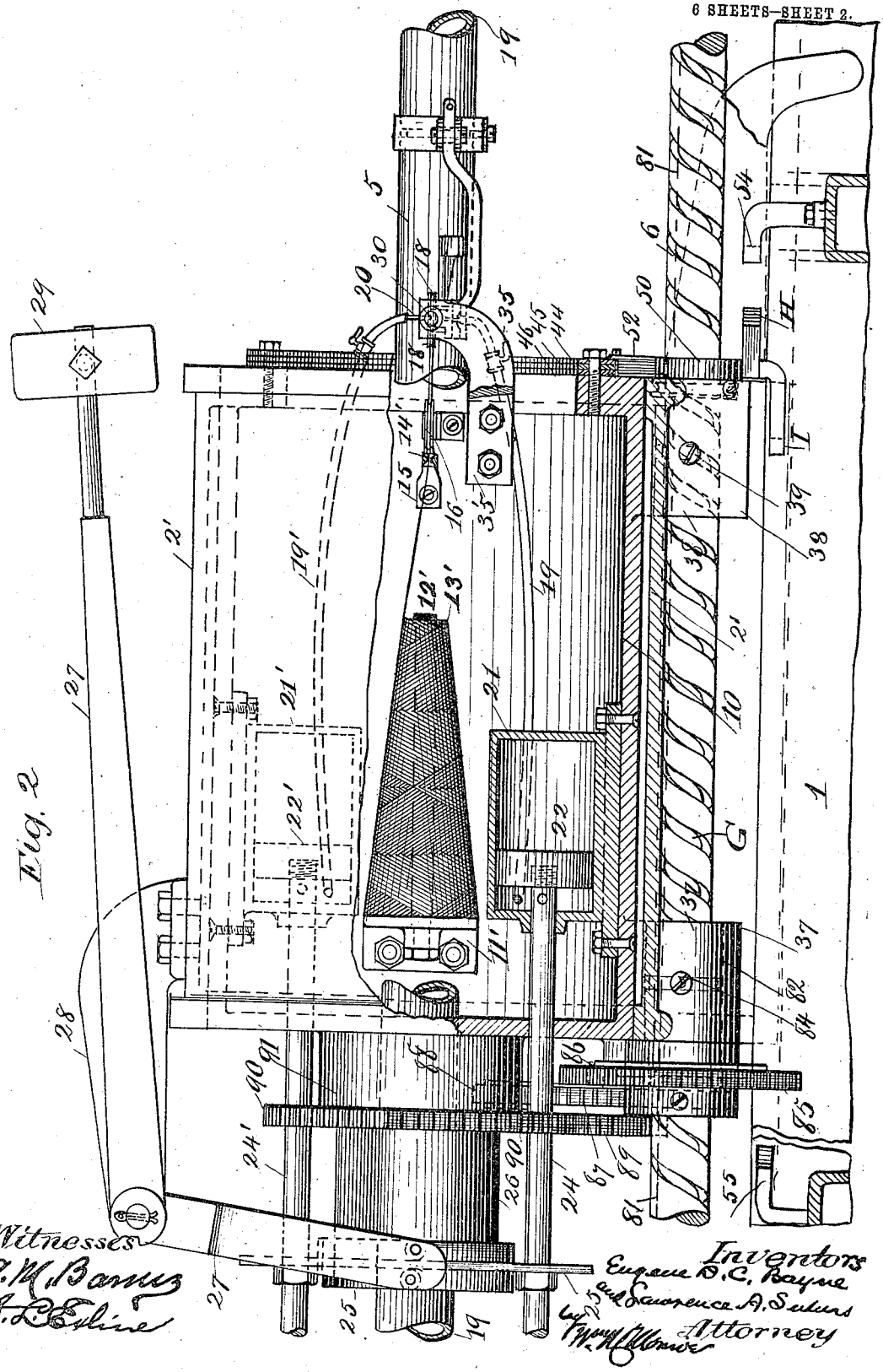

Fig. 2

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Fig. 3

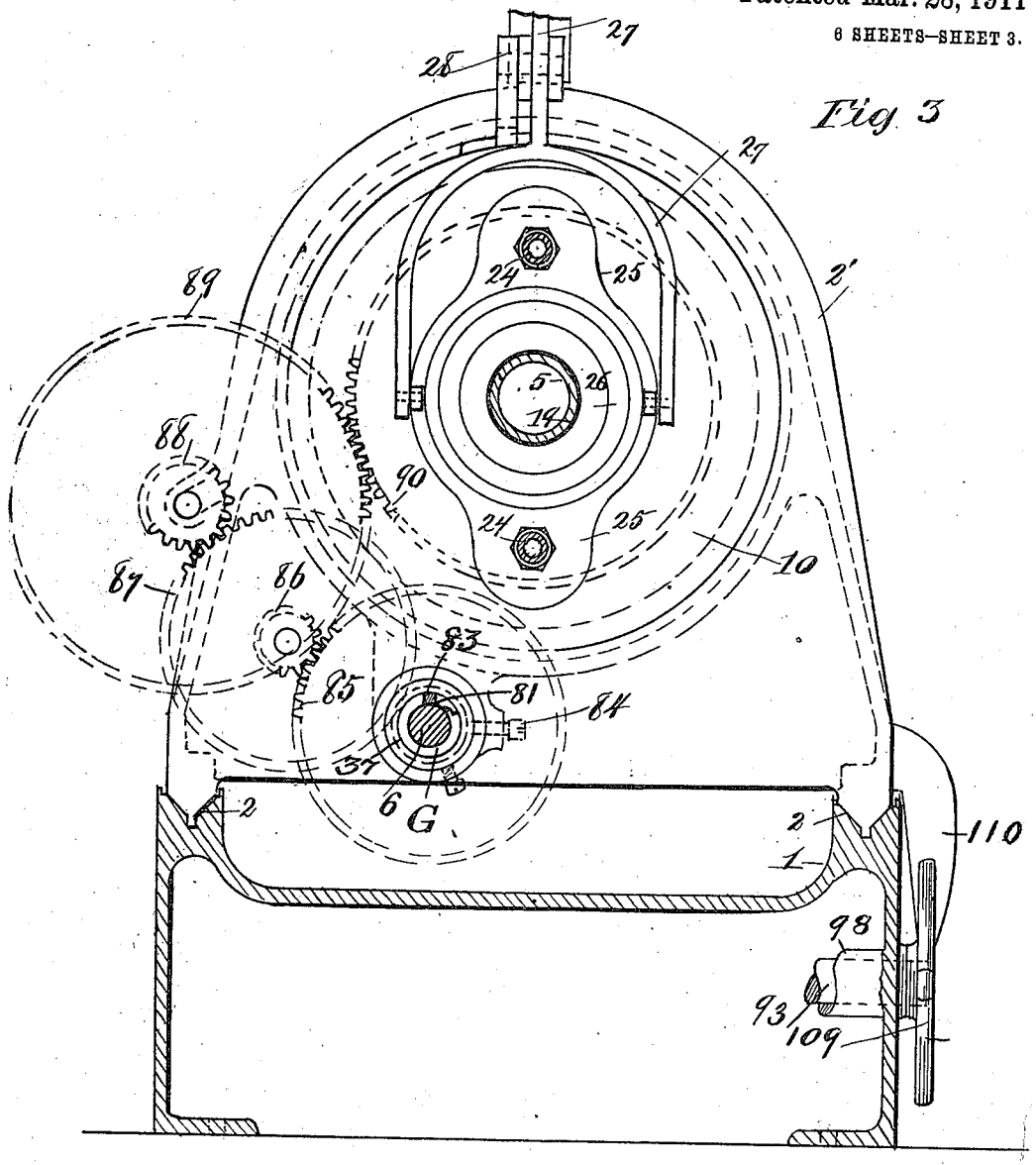

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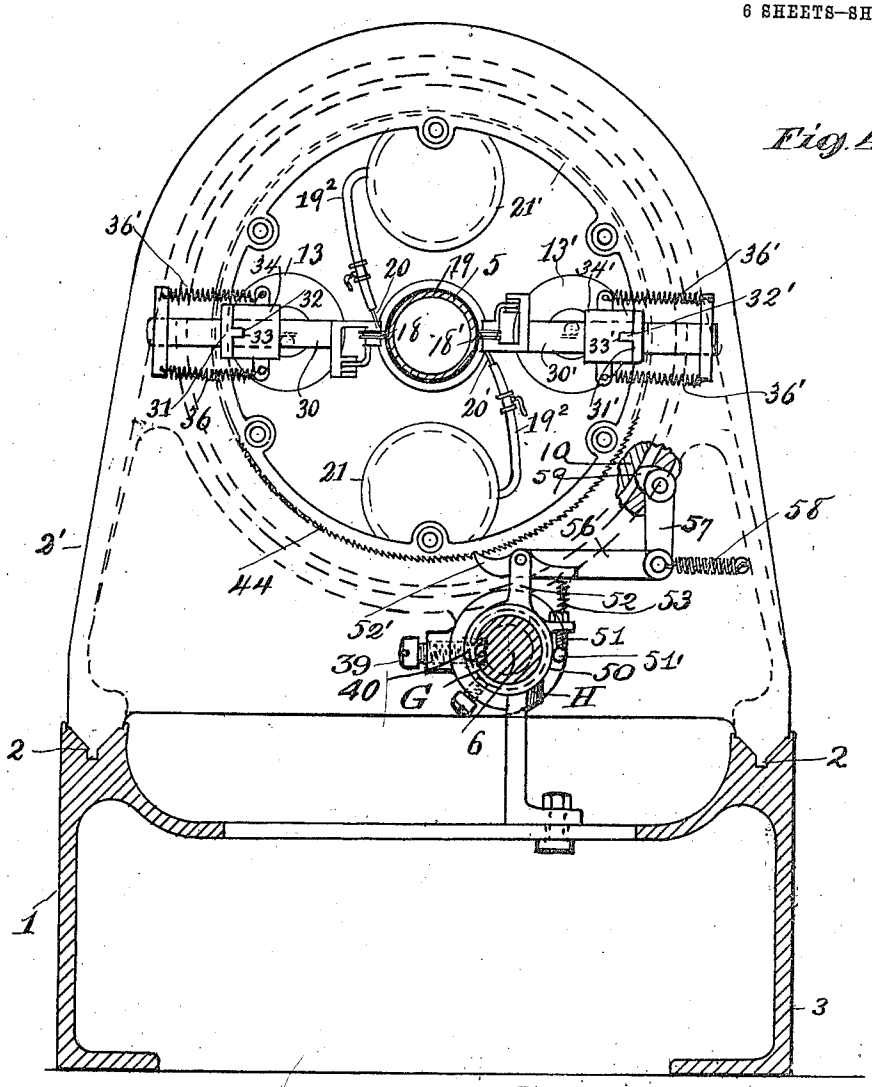
Fig. 4.



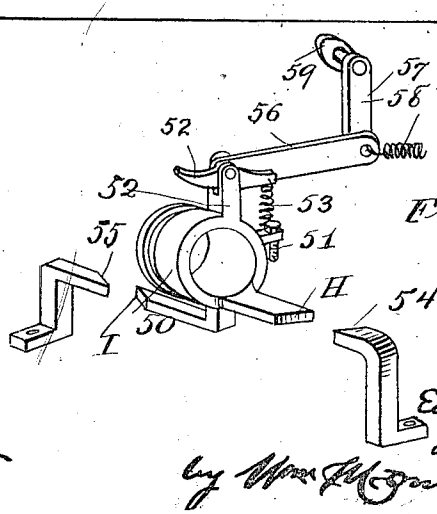


Fig. 4a

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6 SHEETS—SHEET 5.

Fig. 5

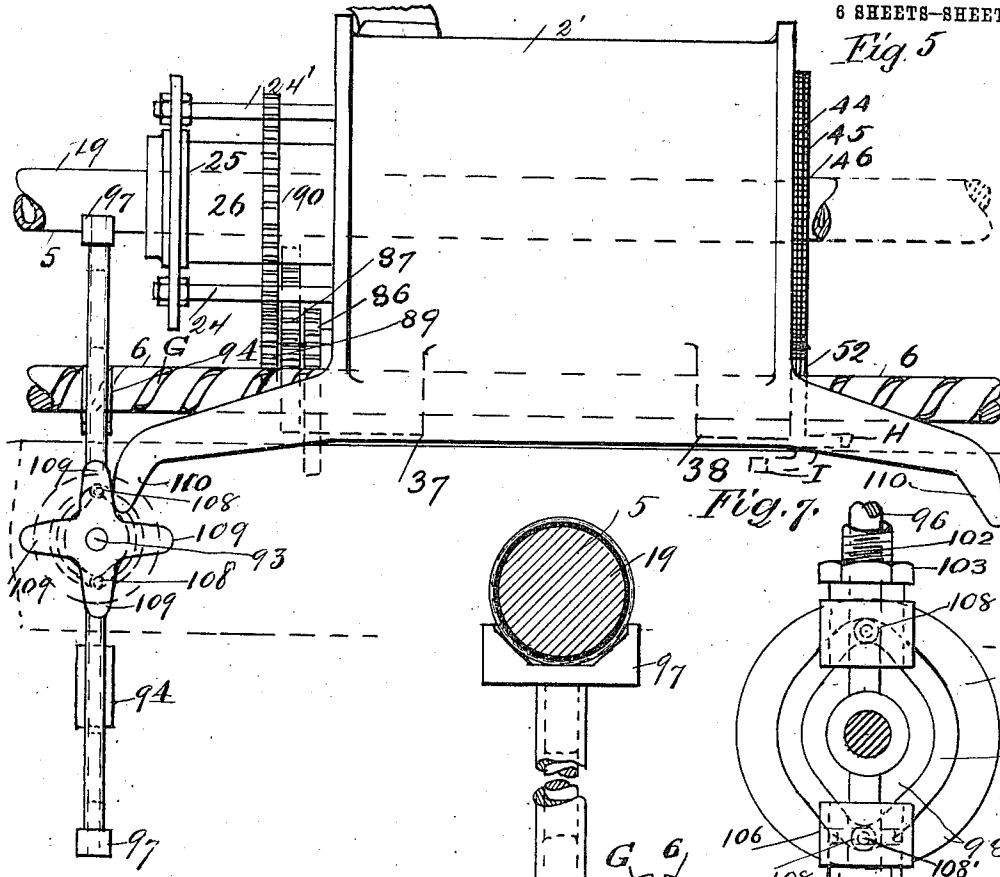
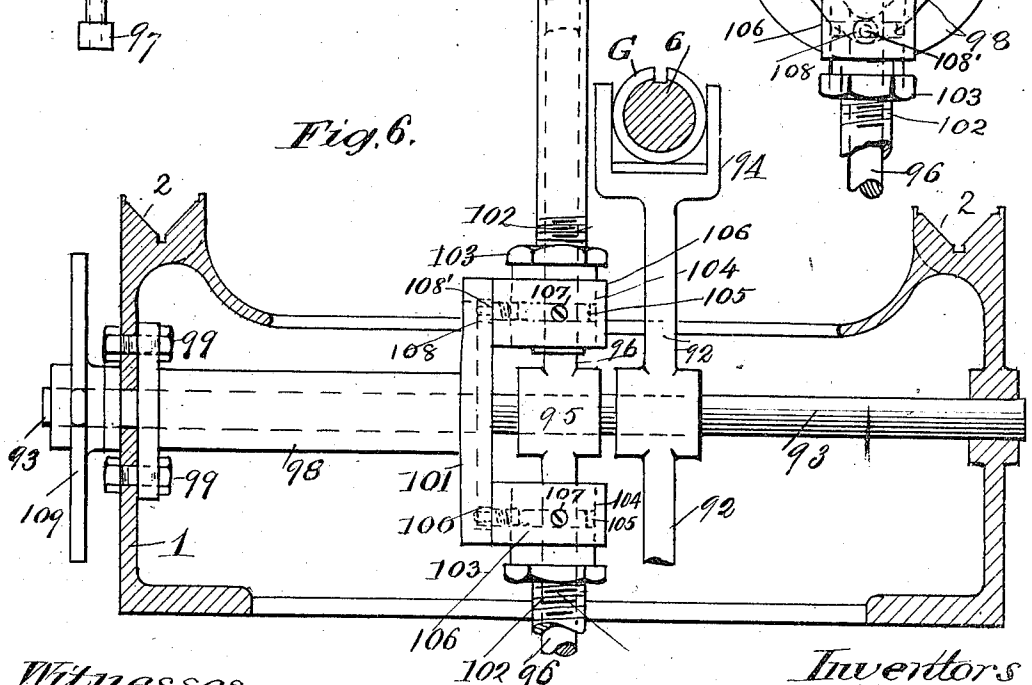


Fig. 7.

Fig. 6.



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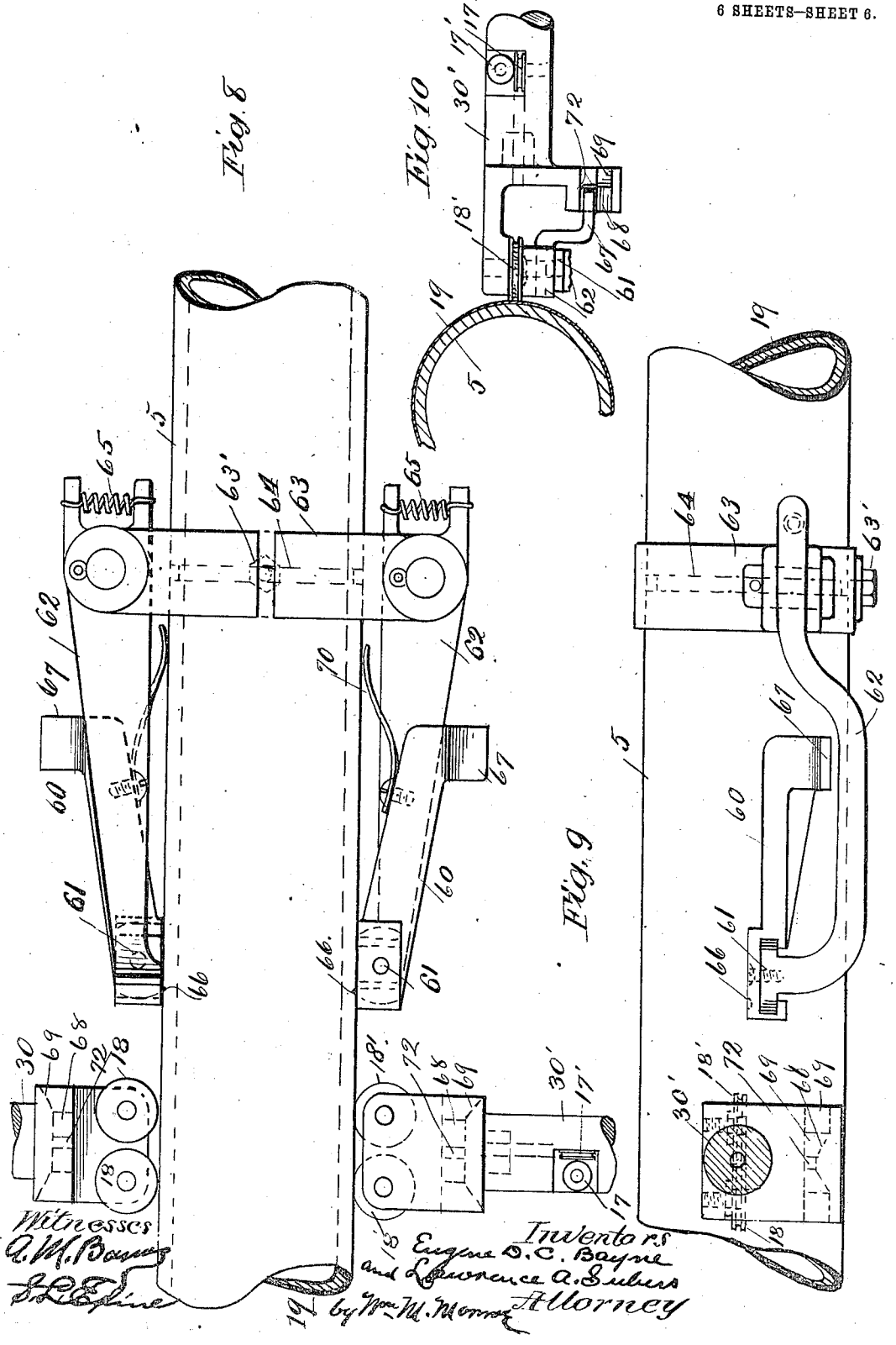
6 SHEETS—SHEET 6.



UNITED STATES PATENT OFFICE.

EUGENE D. C. BAYNE AND LAWRENCE A. SUBERS, OF CLEVELAND, OHIO.

AUTOMATIC MACHINE FOR LAYING ADHERING CORDS OR THREADS UPON A STATIONARY MANDREL TO FORM AN UNWOVEN FABRIC.

987,791. Specification of Letters Patent. Patented Mar. 28, 1911.

Application filed February 23, 1909. Serial No. 479,488.

To all whom it may concern:

Be it known that we, EUGENE D. C. BAYNE and LAWRENCE A. SUBERS, citizens of the United States, and residents of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Automatic Machines for Laying Adhering Cords or Threads Upon a Stationary Mandrel to Form an Unwoven Fabric, of which we 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 acting machine for the construction of a section of hose pipe or analogous tubing of any desired length from one continuous thread or threads. This hose is formed of a fabric composed of layers of unwoven cord or thread, hereinafter mentioned as threads, and these layers are composed of parallel rows of threads adhering together, and adhering to the adjacent layers, each layer of thread crossing the adjacent layers at a definite angle, and preferably alternating in direction, one layer of thread running longitudinally in the hose and the adjoining layers running transversely or spirally around the same, or one layer of longitudinal threads to any desired number of spiral threads.

This machine is designed as an improvement upon our previously invented automatic machinery for the manufacture of unwoven tubular fabric with rubber, in which the fabric was formed upon a rotatable mandrel by means of highly polished director wheels which could be automatically moved to apply the thread either spirally or longitudinally thereon. This former machine had a two-fold use. First, it was provided with automatic mechanism for rotating the mandrel periodically, and for simultaneously providing a rapid longitudinal movement to the director wheel or wheels so that they could apply the longitudinal rows of threads to the forming mandrel. And, second, the mandrel rotates at a constant rate of speed, and the director wheel or wheels were given a slow longitudinal movement so as to enable them to apply the thread in spiral rows upon the mandrel, and means were provided for alternating these movements to provide alternately spirally and longitudinally laid rows of threads thereon. In this former device other important features were the tension and pressure regulating devices, for the thread, and means for laying the threads in rubber. This mechanism has been described in our previous applications for Letters Patent of the United States bearing Serial Numbers 443,372, 467,621, and Letters Patent Nos. 847,041, 885,220, and 897,339.

In the present machine hereinafter described the important features of tension and pressure devices are retained, and also the means for coating the threads with rubber or other tenacious and vulcanizable material, and the polished director and guide wheels. It is better adapted, however, for manufacturing long lengths of hose or tubing.

The important features of novelty and improvement in this machine, therefore, are found in the employment of a stationary mandrel which can therefore be supported at intervals, and in automatically operating mechanism, for revolving the director wheels which apply the thread, and their supports, and thread supplying devices around the mandrel; and in providing a combination and arrangement of the various parts such as will adapt and utilize them for this material change in the general action and mode of operation of the machine.

To permit of manufacturing long lengths of tubing, the thread is laid by means of director wheels mounted in a drum secured within a carriage and which revolve about the stationary mandrel, which is supported upon end supports and removable intermediate supports spaced at intervals thereunder. These intermediate supports are raised and lowered under the control of the said carriage. The drum is given a combined longitudinal and circumferential movement about the mandrel to enable the director wheels to apply the spiral rows of threads thereon, and is given an intermittent longitudinal movement relatively to the mandrel to enable the director wheels to apply the longitudinal rows of threads thereon. Each of these movements can also be reversed at will to change the direction of laying the thread.

The carriage is designed to convey the drum and all the mechanism and appliances required in laying thread upon the mandrel,

including the thread itself, and this mechanism differs only in arrangement of parts and in detail construction from that employed in the former machine hereinbefore mentioned. The carriage is mounted in longitudinal guides upon a suitable bedplate, and the drum is rotatably secured therein.

The appliances within or attached to the drum and rotatable therewith, may be described as, the spools upon which the thread is wound prior to passing over the director wheels, a tension device for each thread and guide wheels therefor; reservoirs stored with liquid rubber and mechanism for exerting a constant predetermined degree of pressure upon their contents, nozzles for applying a stream of liquid rubber in advance of the threads as they are being laid upon the mandrel, spindles upon which director wheels are mounted and springs for exerting a pressure thereon so as to adapt them, for use with varying sizes of mandrels; and brackets secured to the drum in which the spindles are mounted in such a manner that they are adjustable, so as to present the director wheels either longitudinally or transversely of the mandrel, to accommodate the two general directions for laying the threads.

The drum is provided with ratchets which are operated periodically by means of suitable mechanism, a portion of which is secured to the bedplate of the machine and are designed to give a slight intermittent rotary movement to the carriage at one end of its travel when the longitudinal thread is being laid equal to the diameter of the thread. The drum is also provided with gearing arranged to produce a regular rotary movement thereof when the spiral rows of thread are being laid. All the movements of the carrier and drum and all working parts are accomplished by means of a common feed screw or worm shaft passing longitudinally through the machine. Mechanism is also provided for utilizing this feed screw to rotate the drum and to move the carriage and drum longitudinally of the mandrel.

The invention also comprises mechanism for supporting the shaft and feed screw at regular intervals, since these parts can be made very long in this machine and require adjustable mechanism controlled by the movements of the carriage for depressing these supports, to enable the carriage and drum to pass, and for restoring these supports to position as soon as the carrier has passed by them.

It also comprises mechanism for looping the thread and for holding the looped end of the thread during the longitudinal movements of the carriage at the end of its travel, while the next row is being laid; and for revolving the loop-holding devices while the intermittent ratchet movement of the drum is taking place, to properly locate the thread holder for the next laid row of thread.

The invention also has reference to automatically acting reversing mechanism for the worm shaft or feed screw arranged to operate at each end of the tubular fabric, and adjustable so that any predetermined length of fabric can be manufactured on the same mandrel.

The invention further comprises the combination and arrangement of parts, as hereinafter described, shown in the accompanying drawings and specifically pointed out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of the machine; Fig. 1ª is a plan view of the clutch device; Fig. 2 is a longitudinal section of the carriage and drum which convey the thread applying and the coating devices; Fig. 3 is a front elevation of the carriage showing the driving gear therefor; Fig. 4 is a rear elevation thereof, showing the director wheels and their spindles, and the ratchet wheels and pawl for giving an intermittent rotary movement to the drum; Fig. 4ª is a perspective view of the ratchet operating devices; Fig. 5 is a side elevation of the carrier, showing the supports for the mandrel and worm screw, and the extended arms upon the carriage and one of the star operated devices for raising and lowering the said supports; the said arms being adapted to engage with the star in turn as the carrier moves longitudinally of the mandrel; Fig. 6 is a transverse section of the bedplate of the machine showing the star operated mechanism for raising and lowering the supports for the mandrel and worm shaft; Fig. 7 is a face view of the cam which is adapted to raise and lower the support for the mandrel; Fig. 8 is a plan view of a portion of the mandrel, showing the oppositely-placed director wheels and the spindle supports therefor, and the oppositely placed devices for holding the loops at the ends of the longitudinal rows of threads, and the cams upon the spindles which release and rotate the loop-holding devices to correspond with the ratchet movement of the drum; Fig. 9 is a side elevation of the same; Fig. 10 is an edge view of one of the director wheels and its supporting spindle. These views show preferable forms of construction of the automatic mechanism for the purposes described.

In these views 1 represents the machine bed provided with V-shaped guides 2, 2, in which the hood-shaped carrier 2′ is adapted to slide longitudinally thereof. This bed is supported upon legs, 3, 3, of convenient height. At opposite ends of this bedplate are shown bearings 4, 4, for the forming mandrel or hose shaft 5, and similar bearings for the

main actuating feed screw 6, from which the movements of the automatic thread laying mechanism are derived. This feed screw is rotated in opposite directions by means of pulleys 7 and 8 respectively, one being driven by means of a cross belt and the other by means of a straight belt. Either pulley can be thrown into connection with the feed screw 6 by means of any convenient form of clutch such as the friction clutch shown at 9; and a shifting rod 9′ automatically operated by means of fingers 9″, upon the shifting rod 9′ which are adapted to be engaged by the carriage 2′ at each end of its travel.

The carriage 2′ incloses and conveys nearly all of the mechanism required for laying the thread upon the mandrel 5, in alternating longitudinal and spiral rows, to form the tubular fabric. Within the carriage is rotatably mounted the cylindrical drum 10, and to the inner sides of this drum and rotatable therewith are secured brackets 11, 11′, upon which spindles 12, 12′ are secured. Upon these spindles are mounted the spools or cores 13, 13′, which are conically shaped to enable the threads to reel off quickly and without interference. Thence the threads pass through guiding eyes, 14, 14′, so that the threads will feed from the cores equally well in both directions of travel of the carrier. These eyes are formed in brackets 15, 15, secured to the drum 10. These spools of thread and guiding eyes are mounted diametrically opposite each other and revolve concentrically about the mandrel. The threads, after passing through the guiding eyes are fed to tension devices 16, 16, similar to those described in our prior applications and thence pass over guiding wheels 17, 17′ to the spring pressed applicator or director wheels 18, 18′, which press the threads upon the coating 19 upon the mandrel, when the first layer is laid, or upon previous layers of thread thereon. As the thread passes from the director or thread applying wheels to the mandrel, it is laid in a small stream of liquid rubber ejected through a tube or nozzle such as 20, 20′, upon the mandrel, in advance of each director wheel, which thus forms a body or rubber matrix inclosing the threads and when vulcanized causes the several threads and layers to adhere together in a homogeneous mass. The liquid rubber is stored preferably in a separate cylinder 21 and 21′ for each nozzle, and is placed under a constant pressure in each cylinder, so that the liquid will flow with perfect regularity, by means of the piston, 22, and 22′, a piston rod 24, and 24′ which is preferably made tubular, for the introduction of the fluid rubber therethrough, a yoke 25, slidingly movable on the cylindrical projection 26 of the drum, and the bell crank lever 27 pivoted upon the arm 28 upon the carrier 2′, which engages the yoke 25. A weight 29 on the long arm of the lever 27 is adjustable thereon to give the necessary compression to the pistons. A flexible pipe, 19′, 19″, for each nozzle, leads to any desired position for each thread.

The director wheels 18, 18′ are mounted in spindles 30, 30′, rotatable through an arc of 90 degrees each in their bearings, by means of set collars 31, 31′, and projections 32, 32′, which engage the slots 33, 33′ in the bearing 34, 34′. These bearings are mounted upon the brackets 35, 35′, secured to the drum and rotatable therewith. Springs 36, 36′ exert pressure upon the spindles to keep them in engagement with the mandrel and in this manner permit of the use of varying sizes of mandrel. The adjustment of these spindles also permits of their being placed either longitudinally or transversely of the mandrel to lay both longitudinal and spiral layers of the thread.

The worm shaft 6 passes through bosses 37, 38, on the carriage and a screw 39 in one of these bosses enters the groove G in the worm shaft. A roller 40, relieves the friction upon the end of this screw. In this manner the feed screw will operate to move the carriage longitudinally of the bed 1 in each direction according to the direction of rotation of the screw. This change of rotation is accomplished by means of the pulleys 7 and 8 and clutch 9 as previously described. The clutch 9 is operated by means of a lever 41 which is forked at each end, one end grasping the clutch body and the other end operated by the adjustable set collar 42 on the shifter rod 9′. The lever 41 is pivoted at 42 on a bearing 43 secured to the bed, 1. The shifter rod is provided with adjustable finger collars 9″, which engage the carriage 2′ in its travel, and the carriage imparts its motion to the shifter rod which operates the lever 41 and throws the clutch 9, thus releasing the active pulley and throwing the other pulley into action and reversing the direction of rotation of the feed screw and therefore the direction of travel of the carriage 2′. In this manner the carriage travels successively backward and forward, laying the threads longitudinally two at a time, one on each side of the mandrel and diametrically opposite to each other. In the meantime, the drum is intermittently rotated to a distance equaling the thickness of one thread, so that when one-half of a revolution has been made a complete coating has been placed on the mandrel of longitudinally placed threads. This intermittent rotation of the drum is accomplished, as follows:—The cylindrical drum 10 is given an intermittent rotary movement at each end of the travel of the carriage by means of ratchet wheels, 44, 45, and 46, secured to one end thereof and rotating therewith,

A sleeve 50, having a sliding fit on the feed screw is attached to the carriage in such a manner as to permit a revolving motion around the feed screw, which is limited by an adjusting screw 51 on this sleeve, engaging a stop 51′ on the carrier 2′. This sleeve has an arm 52 on its upper side carrying a pawl 52′ held in engagement with the ratchet teeth on one of the ratchet wheels, 44, 45, or 46, by means of a tension spring 53. On the lower end of this sleeve are two cam fingers H and I which at the end of the carrier's travel engage respectively a cam 54 or 55 secured to the bed 1 at each end thereof, and impart a slight rotary movement to the cylindrical drum 10 through the pawl 52′ and engaging ratchet wheel. The upper arm on this sleeve 50 is also attached to a link 56 which is in turn attached to the lower end of a rocking lever 57 pivoted in the carriage whose upper end 59 is pressed against the cylindrical drum in the manner of a brake by means of a tension spring 58. In this manner the drum is locked temporarily after each movement. It is released again by the movement of the sleeve 50 which simultaneously rotates it through the necessary movement.

Any number of ratchet rings can be attached to the drum having different numbers of teeth, and used according to the diameter of the threads and the number of threads to be laid around the mandrel, one ratchet tooth to each thread. These ratchet wheels or rings can be made in halves for convenience in changing.

In order that a continuous thread may be laid longitudinally along the mandrel, first in one direction and then in the other, it is necessary that a loop should be formed at each extreme end of the fabric.

To secure this loop at the right position, a loop holding finger 60 for each thread is pivoted at 61 upon an arm 62 which is pivoted in turn upon a spring collar 63, which slightly grips the mandrel, but can be turned thereon when some pressure is applied thereto. This collar is provided with a set screw 63′ moving in a groove 64 in the mandrel to prevent longitudinal movement thereon. The arm 62 is held pressed against the mandrel by means of a tension spring 65. The loop-holding finger 60 is provided with a looping point 66 in its edge. And the finger at its outer edge is provided with flattened projection 67. The spindle carrying the director wheels is provided with cam faces 68 and 69, and as it approaches the holding finger the director wheels pass over the finger and the cam surface 69 engages the projection 67 on the finger and thus raises the looping point, releasing it from the loop already formed against the pressure of a spring 70. The spindle traveling still farther, the cam surface 68 engages the surface of the said projecting arm 67, and rotates the distance equal to the diameter of one thread. Traveling slightly farther, the flattened arm 67 passes between the jaw 72, 72, of the spindle, and at that instant the drum is rotated by means of the pawl 52 and ratchet wheel thus carrying with it the collar 63 and attached parts, and leaving the projecting point 66 in position to form the loop in the thread on the reverse movement of the carriage. As soon as the spindle returns the point 66 drops against the mandrel and the thread is looped over it. This device for looping the thread is employed at each end of the machine and is duplicated at a point diametrically oppsite on the same collar 63.

The thread is laid spirally upon the mandrel by means of the following automatically acting instrumentalities:—First, the roller 40 is placed in engagement with the slot in the feed screw. This feed screw also has a key slot 81 throughout its length. In a hub 37 on the carriage is a sleeve 82, which is provided with a key 83 adapted to slide in this key way, on the worm shaft. This sleeve rotates constantly with the feed screw. A set screw 84 engages a circumferential groove in the sleeve 82, thus attaching the sleeve to the carriage. This sleeve is provided with a gear 85, on its projecting end attached thereto by means of a set screw, so that the gear can be released therefrom when laying the longitudinal layers. This gear engages the train of gears 86, 87, 88, 89, and 90, the last named gear being secured upon a projecting boss 91 upon the drum, which is thus driven at a high speed. The speeds of the drum and feed screw are so related as to cover the mandrel closely with spiral rows of threads as the carrier traverses the mandrel from one end to the other, and a layer can be laid in either direction by the reversing means for the worm shaft previously described.

The next step is to place the director wheels transversely of the mandrel. The carrier and drums are then in readiness to lay the thread.

The mandrel and feed screw being long, it is necessary to support them at regular intervals, and that these supports should be automatically removed to make a passage for the carriage and immediately restored to position as soon as the carriage has passed. This is an important feature of the invention since the long mandrel and screw would vibrate injuriously to the accurate laying of the fabric if not provided with supports intermediate of their ends. To accomplish this result, diametrically opposite supporting arms 92 are provided for the feed screw and are mounted upon transverse shafts 93 in the bedplate, and arranged at regular intervals, such as every five feet thereon. These supports 92 are provided with forked

heads 94. The removable supports for the mandrel are constructed as follows:—Keyed to each shaft 93 is the adjusting hub 95 which is provided with two diametrically opposite arms 96, and radially movable on these arms are the supporting heads 97 for the mandrel. A sleeve 98 upon each shaft 93 is secured to the bedplate at 99, and is provided at its inner end with a cam groove 100, cut in a flange 101. A portion of each mandrel support is threaded at 102, and a nut 103 placed thereon. This nut is provided with an extension 104, which is grooved at 105, and inserted in a collar, 106. A set screw 107 attaches the extension rotatably in the collar. The face of the collar adjacent to the flange 101 is flattened so as not to rotate on the arm 96 and a roller 108 upon the screw 108′ engages the cam groove 100 in the flange 101. The shafts 93 are rotated by means of the exterior stars 109, 109, and the depending arms 110 upon the carrier, one arm being at each end of the carrier. As soon as one of the arms 110 strikes the star, the shaft rotates through 90 degrees and the supports 94 for the worm shaft are rotated with it to release the feed screw. At the same time the arms 96 are rotated also through 90 degrees, and the rollers 108 moving in the fixed cam groove 100 are drawn inwardly, and thus draw down the supporting heads 97 for the mandrel, with them, thus releasing the mandrel, from contact with the respective head in contact therewith. A different action is required for the mandrel supports, from the feed screw supports since the coated threads on the mandrel cannot be disturbed from their positions by the frictional action of its supports. As soon as the carriage has passed, the arm 110 at the other end of the carriage turns the star 109 through another 90 degrees and brings up the opposite supports in reverse manner underneath the mandrel and feed screw.

Both the mandrel and feed screw can be made in sections attached together in any convenient manner, so as to provide for the manufacture of any desired length of tubing. The mandrel can be withdrawn from the machine by releasing the set screw 112, and by screwing the supporting center out of connection with the mandrel. It is obvious that by suitably adjusting the relative speeds of the gearing on the drum and the feed shaft it would be possible to make the fabric from one continuously and closely laid thread, or from any multiple number of threads and also from a thread or threads of any desired diameter all such modifications being within the spirit of the invention, and relative to the mandrel and the parts of mechanism thereof, as described in these specifications, necessary to construct a tube, the same may be placed in a horizontal or perpendicular position or at any angle necessary or convenient in the operation of the machine and the construction of a tube thereon as herein described without departing from the mode of operation of the invention.

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

1. The combination with a stationary mandrel of a carriage concentric therewith, a pair of director wheels, a support therefor rotatably supported in said carriage, longitudinal guides for said carriage, automatically acting mechanism for moving said carriage longitudinally of said guides, and for reversing the movement thereof, and automatically operating mechanism for rotating said director wheel supports and director wheels around said mandrel.

2. In a machine adapted to apply a longitudinal layer of parallel rows of adhesive threads to a stationary mandrel, alternately with a spiral layer thereof, in combination, the mandrel, a support therefor, longitudinal guides on said support, a carriage encircling the mandrel and longitudinally movable in said guides, a rotatable member in said carriage concentric with said mandrel, a thread support and director wheels therefor, and a thread guide, mounted in said rotatable member, a main feed screw, by means of which said carriage is moved, said screw parallel with said mandrel, reversing means therefor and means for alternately giving an intermittent rotary movement to said rotary member, and means for giving a continuous rotary movement thereto.

3. In a machine for the purpose described, the combination with a bed plate, a stationary mandrel therein, a carriage longitudinally movable in said bedplate through which carriage said mandrel passes, a rotatable member in said carriage, a director wheel in said rotatable member, a thread supplying device in said rotatable member and means for moving said carriage and for rotating said rotatable member about said mandrel.

4. In a machine for laying thread to form a layer composed of parallel rows of threads adapted to adhere together, a stationary mandrel, a member concentric therewith and adapted to rotate about the stationary mandrel, a longitudinally movable support for said rotatable member, a spring pressed director wheel mounted in said rotatable member over which said thread is applied to said mandrel, a feed screw for said longitudinally movable carriage, and gearing adapted to give a quick relative rotary movement to said rotary member, said gearing operatively connected with said screw.

5. In a machine for laying tenacious

thread in parallel rows upon a stationary mandrel, in combination, a mandrel, a carriage longitudinally movable thereof a rotatable member mounted in said carriage and adapted to rotate about said mandrel, a spring pressed director wheel and a thread guide in said rotatable member, a feed screw for said carriage parallel with said mandrel, and automatic means for revolving said rotatable member in said carriage about said mandrel with a rapid continuous movement, and means alternately employed therewith for revolving the same about the mandrel with a short intermittent movement, and means for reversing the movement of the feed screw.

6. In a fabric making machine, the combination with a stationary mandrel, of a director wheel revoluble about said stationary mandrel, means for rotating said director wheel about said mandrel, and means for giving a movement longitudinal of said mandrel to said director wheel.

7. In a fabric making machine, the combination with a stationary mandrel, of a spring pressed director wheel revoluble about said stationary mandrel, supports for said mandrel and director wheel, means for revolving said director wheel and support about the mandrel, means for giving a longitudinal movement parallel to the mandrel to said director wheel and support and means for feeding thread to said director wheel.

8. In a machine for making fabric of the character described, a stationary mandrel, a support therefor, a member rotatable about the mandrel, a support for said rotatable member longitudinally movable of the said mandrel, a spring pressed director wheel, and a thread holding device and a guide therefor, and a tension device, mounted in said rotatable member and movable therewith, and means for reversing the longitudinal movement of said supports and rotatable member.

9. In a machine for making a fabric of the character described, a stationary mandrel and support therefor, a member rotatable about said mandrel, a longitudinally movable support for said rotatable member, a pair of director wheels, mounted in said rotatable support, said director wheels being in line with each other, means for adjusting said wheels to lie longitudinally and transversely of said mandrel, a spring pressed support for said director wheels in said rotatable member, thread holding and guiding and tension devices in said rotatable member, means for giving a reciprocating longitudinal movement to the support for said rotatable member, and means for rotating said rotatable member.

10. In a machine for making a fabric of the character described from a continuous thread, a stationary mandrel, and end supports therefor, intermediate removable supports therefor arranged at intervals thereunder, a bed plate, a carriage, longitudinally movable thereon parallel to said mandrel, a member in said carriage rotatable about said mandrel, a director wheel, and a thread holding and guiding device in said rotatable member, a reversible feed screw passing through said carriage parallel to said mandrel, means for rotating said rotatable member, and means for removing said intermediate supports from said mandrel to permit the passage of said rotatable member and carriage, and means for replacing said intermediate supports after said rotatable members have passed.

11. In a machine for forming tubular fabric from one continuous unwoven thread, a stationary mandrel, supports for the ends of the mandrel, intermediate removable supports for said mandrel, a bed plate, a longitudinally movable carriage thereon, a member mounted in said carriage and rotatable about said mandrel, a thread applying device in said rotatable member, automatically acting mechanism operated by said carriage, for removing said intermediate supports in turn from said mandrel in advance of said carriage, and for placing said supports in engagement with said mandrel as soon as said carriage has passed.

12. In a machine for forming an unwoven tubular fabric from one continuous thread, a stationary mandrel, a bed plate, end supports for said mandrel, on said bed plate, intermediate revoluble supports for said mandrel, spaced thereunder at intervals, longitudinal guides on said bed plate, a carriage movable thereon parallel to the axis of said mandrel, a rotatable member in said carriage, a thread applying device in said rotatable member and rotatable therewith, a feed screw for said carriage, and means for revolving said revoluble supports in turn as said carriage advances, to remove said supports in front of said carriage and to renew said supports in the rear of said carriage, and supporting means for said revoluble supports.

13. In a machine for forming an unwoven tubular fabric from one continuous thread, a stationary forming mandrel, a bed plate, supports on said bed plate for the outer ends of said mandrel, transverse shafts spaced at intervals in said bed plate, radially extending arms on said shaft, radially movable mandrel supports upon said arms, a carriage longitudinally movable upon said bed plate, a thread applying device, and a support therefor in said carriage, said thread applying device and its support being rotatable about said stationary mandrel, and an automatically acting device actuated by said carriage in its passage for rotating said shaft and its arms, and for radially moving

said mandrel supports upon said arms, to disengage said mandrel in advance of said carriage and to engage the said mandrel in the rear of said carriage.

14. In a machine for forming a tubular unwoven fabric from a continuous thread, the combination of a stationary forming mandrel, a bed plate, a carriage longitudinally movable thereon, a thread applying device and support therefor in said carriage adapted to rotate about said mandrel, a feed screw for said carriage, transverse shafts arranged at intervals underneath said mandrel and feed screw, radial arms upon each shaft, separate sets of arms for said mandrel and for said feed screw, rigid supports for said feed screw upon the corresponding sets of arms, radially movable supports for said mandrel upon the corresponding sets of arms, means upon said shafts for engaging said carriage as it passes, to rotate said shafts in turn, both in front and in the rear of said carriage, and a device for radially reciprocating said mandrel supports upon their respective arms, to engage and disengage said mandrel.

15. In combination, a bed plate, a mandrel supported at each end thereon, a carriage movable longitudinally of the mandrel on said bed plate, and thread applying devices in said carriage, transverse shafts in said bed plate, radial arms thereon arranged in sets, one underneath the mandrel and feed screw respectively, fixed supports for the feed screw on the corresponding set of radial arms, radially movable supports for the mandrel on the corresponding sets of arms, a star having a corresponding number of rays to the number of arms in each set, and secured to each shaft, a projection at each end of said carriage adapted to engage said stars in turn, a stationary cam sleeved over each shaft, and a device secured upon each radially movable support adapted to engage and be operated by said cam, and to move said radially movable support.

16. In a machine adapted to automatically form a tubular fabric from a continuous thread upon a mandrel, in combination, a bed plate, a stationary mandrel mounted thereon, a carriage longitudinally movable of said mandrel, a thread applying device within said carriage, adapted to rotate about said mandrel, a feed screw in said bed-plate parallel with said mandrel, and adapted to move said carriage in a longitudinal direction, means for giving a continuous rotary movement to said thread applying devices, means for giving an intermittent rotary movement to said thread applying devices, both said means operatively connected with said feed screw and means for reversing the movements of said feed screw.

17. In combination, a stationary mandrel, a bed plate, therefor, a carriage movable longitudinally of said mandrel, and slidingly movable in said bed plate, a drum rotatably mounted in said carriage, concentric with said mandrel, a thread carrying spool within said drum, a thread guide and a pair of director wheels, and tension device, mounted in said drum, a spring pressed support for said director wheels, a fluid rubber reservoir in said drum, means for applying pressure therein, a nozzle adapted to supply a stream of rubber upon said mandrel in advance of said director wheels, a feed screw adapted to move said carriage and drum longitudinally of said mandrel, speed gearing upon said drum adapted to rotate the same about said mandrel, said speed gearing actuated by said feed screw and detachable therefrom and means for giving an intermittent rotatory movement to said drum, also operatively connected with said feed screw and detachable therefrom, to operate alternately with said speed gearing.

18. In combination, a bed plate, a stationary mandrel therein, a carriage slidingly movable on said bed plate parallel to the axis of said mandrel, a feed screw therefor, a drum in said carriage rotatable about said mandrel, thread applying devices in said drum, fluid rubber applying devices in said drum, means for giving a quick continuous rotary movement to said drum, and alternately therewith to give an intermittent rotary movement to said drum, mechanism for reversing the movements of said feed screw, at each end of the travel of said carriage and mechanism for retaining and looping the thread at the limits of travel of the carriage, said looping and retaining devices being arranged to operate after the intermittent rotary movement has taken place.

19. In combination, a stationary mandrel, a bed plate, upon which the mandrel is supported, a carriage longitudinally movable thereon, a feed screw therefor parallel with said mandrel, a drum in said carriage concentric with said mandrel and rotatable about the same, a pair of director wheels therein, revoluble therewith, means for supplying a thread to said wheels, gearing on said drum operatively connected with said feed screw, and adapted to rotate said drum about said mandrel, instrumentalities within said drum for supplying fluid rubber to said mandrel in advance of said director wheels, and means for reversing the movements of said screw.

20. In combination, a bed plate, a stationary mandrel secured thereto, a feed screw parallel with the said mandrel, a carriage operatively connected with said screw, a rotatable drum therein concentric with said mandrel, a pair of director wheels, a support therefor and a guide wheel therefor, said director wheels and guide wheel revoluble with said drum, a thread guide within said

drum, a ratchet wheel upon said drum, a pawl movable with the carriage and adapted to engage said ratchet wheel, means adapted to operate said pawl, said cams adapted to travel with said carriage, a cam at each end of the travel of said carriage, secured to said bed plate in the path of said pawl operating cams, a retaining device on said carriage adapted to engage and secure said drum from movement and adapted to operate subsequently to the operation of said pawl and ratchet wheel, means for reversing the movement of said feed screw, and automatically operating means for holding and looping the thread at each limit of travel of said carriage, said holding and looping devices being mounted upon said mandrel, one on each side of said carriage, and actuated by contact with said director wheel support.

21. In combination, a bed plate, a stationary mandrel therein and a feed screw, parallel therewith also in said bed plate, a carriage operated by said feed screw, a drum therein concentric with said mandrel, a pair of director wheels therein, adapted to apply thread longitudinally of the mandrel, a ratchet wheel on said drum, a sleeve on said feed screw, said sleeve adapted to travel with said carriage, a pawl pivoted thereon, adapted to engage said ratchet wheel, oppositely pointing cams on said sleeve, and corresponding cams upon said bed plate one at each end of the travel of said carrier, means for adjusting the engaging area of said cam on the sleeve, a link and rock arm and shaft on said carriage operatively connected with said sleeve, a retaining device or brake on said rock arm, a shaft adapted to engage said drum, and a return spring for said rock arm, and for said sleeve and pawl, substantially as described.

22. In a holding and looping device for the end of a row of thread, adapted to be applied to a stationary mandrel, a pair of director wheels and a support therefor, said support intermittently revoluble about said mandrel, an arm pivoted on said support and adapted to press upon the mandrel at its outer end, a sleeve on said arm revoluble thereabout, a loop holding finger pivoted to the outer end of the said arm, and provided with a looping point, a cam upon the director wheel support, adapted to engage said finger to release said point, a cam, on said director wheel support adapted to engage said finger and rotate the said arm and finger, the diameter of one thread, as said director wheels and their support are revolved about said mandrel and a spring adapted to place the finger and point in position to form the loop in the thread on the return movement of the director wheels.

23. In combination, a stationary mandrel, a support rotatable about said mandrel, a director wheel rotatable with said support, a support for the mandrel, and means for revolving said director wheel and its support about said mandrel, and for moving the said director wheel and its support longitudinally of the mandrel.

24. In combination, a stationary mandrel, and support therefor, a director wheel and support therefor, said director wheel and its support revoluble about the said stationary mandrel, and automatically acting mechanism for revolving said director wheel and its support about the mandrel, with a continuous movement, and alternately therewith, with an intermittent movement, and means for giving a longitudinal movement to said director wheel and its support, parallel with the axis of said mandrel.

25. In combination, a stationary mandrel and support therefor, thread laying instrumentalities revoluble about said mandrel, means for giving an intermittent revolving movement to said thread laying instrumentalities, and alternately a continuous revolving movement thereto, and means for reciprocating said thread laying instrumentalities longitudinally of the mandrel.

26. In combination, a stationary mandrel, and a fixed support therefor, thread laying instrumentalities revoluble about said mandrel, means for giving a continuous revolving movement thereto alternating with an intermittent movement, feed mechanism adapted to move said thread laying instrumentalities longitudinally of the mandrel, means for reversing said feed movement, and adjustable means for limiting said movement in each direction.

27. In combination, a bed plate, a stationary mandrel thereon and end supports for the mandrel, intermediate supports therefor detachable therefrom, thread applying instrumentalities revoluble about said mandrel, a support for said thread laying instrumentalities longitudinally movable of said mandrel, a feed device for said last-mentioned support, said support adapted to engage said removable mandrel supports in turn, and to alternately remove and replace them to permit of the passage of said thread laying instrumentalities.

28. The combination with a stationary mandrel, and bed plate, of duplicate sets of thread laying instrumentalities spaced apart and revoluble about said mandrel, a support therefor, means for giving an intermittent rotary movement to said duplicate sets of thread laying instrumentalities, and means for giving a reciprocating movement thereto, longitudinally of the mandrel.

29. The combination with a stationary mandrel and support of duplicate thread laying devices, spaced about said mandrel, said devices adapted to lay the thread upon the mandrel both spirally and longitudinally, a common support for the said dupli-

cate thread laying devices, means for giving an intermittent revolving movement to said thread laying devices, about said mandrel, means for alternately therewith giving a continuous revolving movement thereto and mechanism for giving a longitudinal movement to said thread laying devices and their support relatively to said mandrel.

30. The combination, with a stationary mandrel, and support therefor, of duplicate thread laying devices spaced about said mandrel, a common support for said duplicate devices, means for revolving said duplicate devices continuously about said mandrel and means for moving said common support therefor longitudinally of the said mandrel.

In testimony whereof, we have hereunto set our hands this 20th day of February 1909.

EUGENE D. C. BAYNE.
LAWRENCE A. SUBERS.

In presence of—
ED. O. PEEDS,
A. T. OSBORN.