April 10, 1945. W. F. ASTLEY 2,373,091

APPARATUS FOR WEAVING INSULATING MATERIALS

Filed Feb. 10, 1940 7 Sheets-Sheet 1

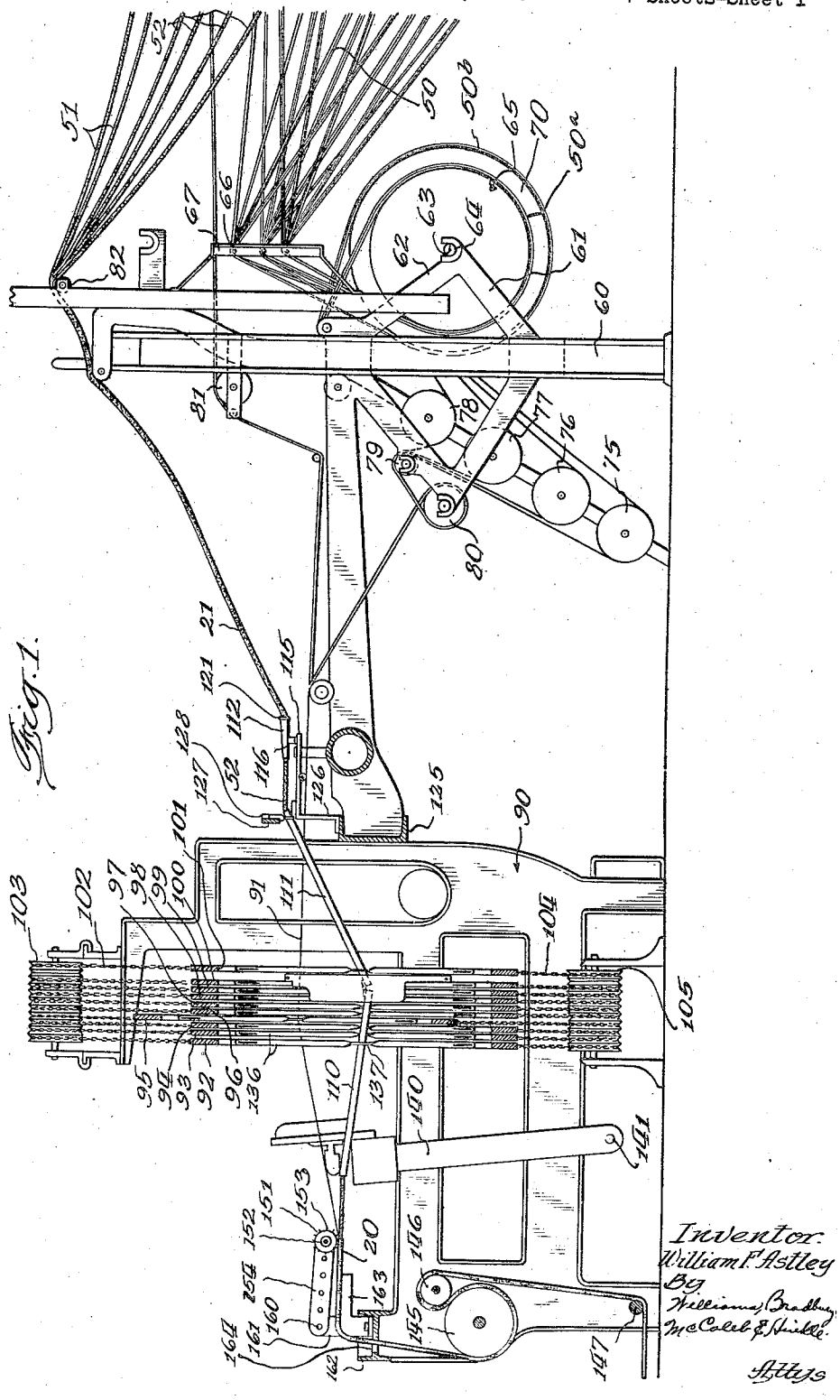


Fig. 1.

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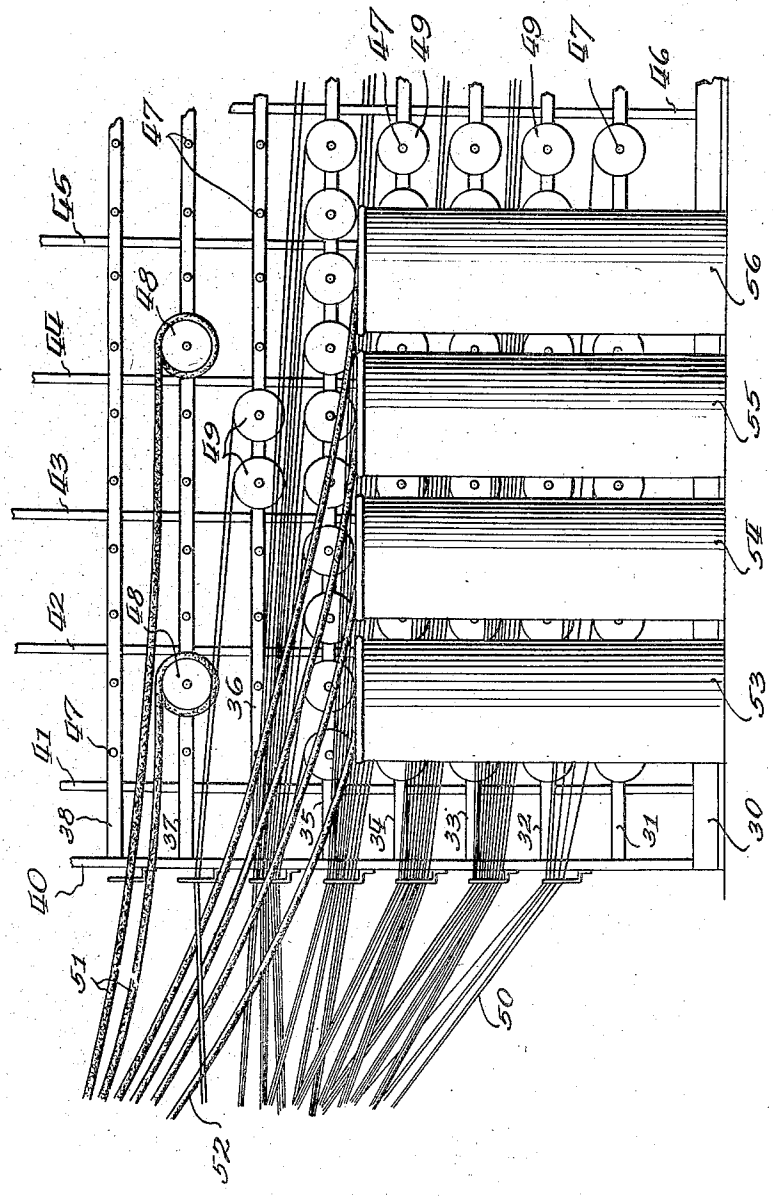
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APPARATUS FOR WEAVING INSULATING MATERIALS

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Fig. 1a.



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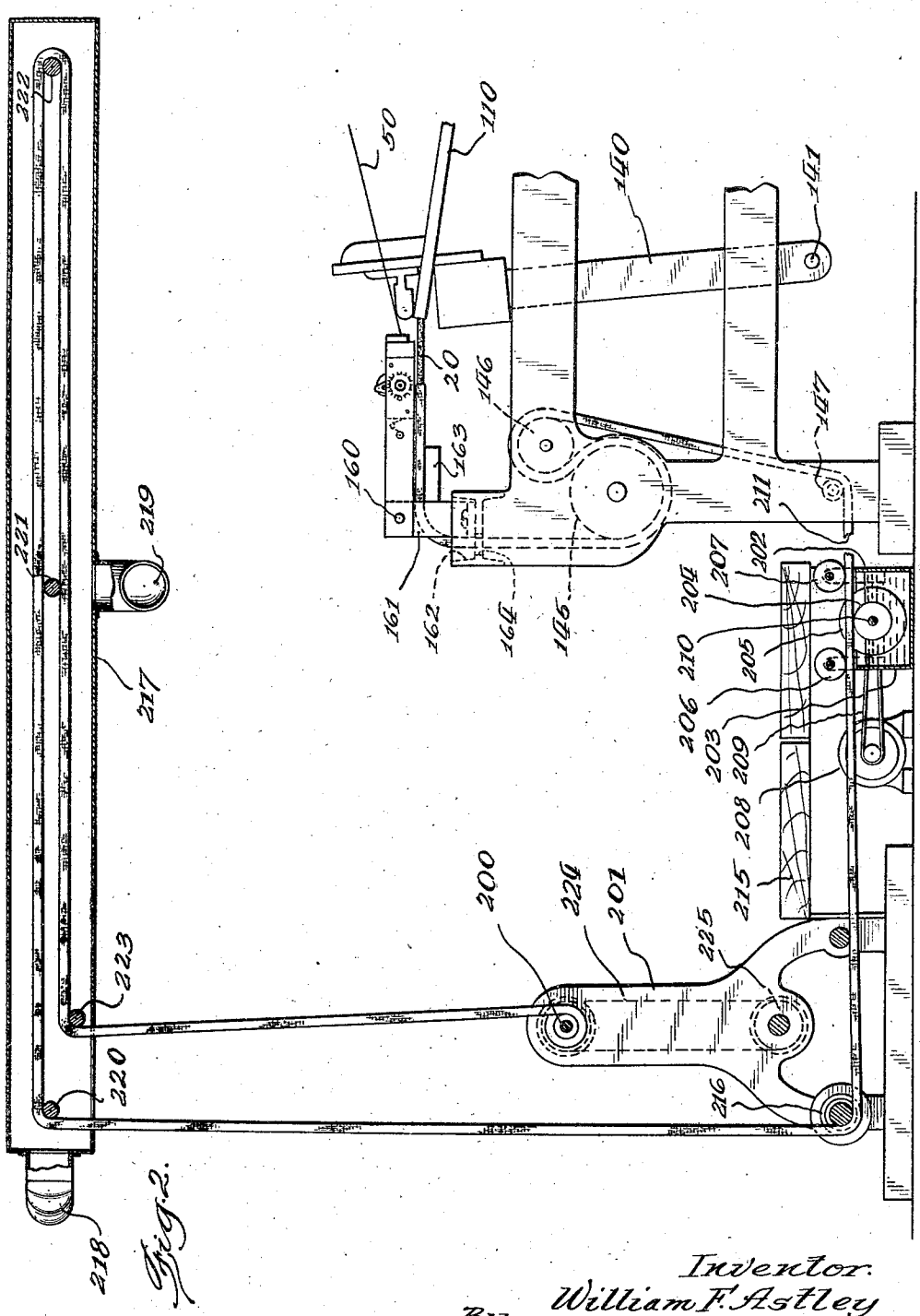


Fig. 2.

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Fig. 3.

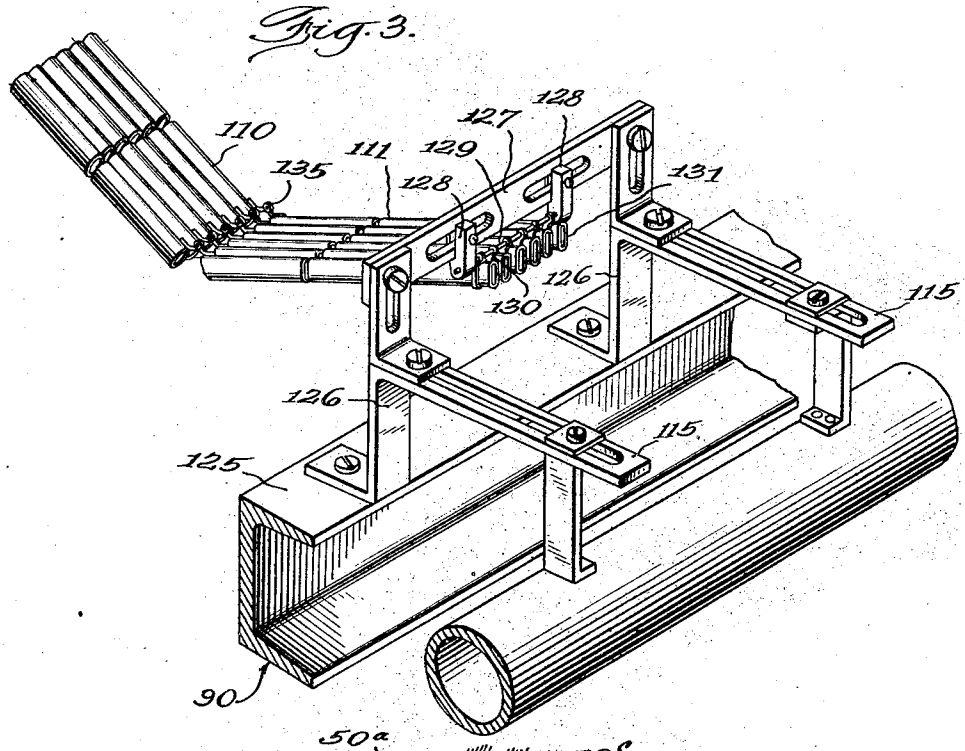
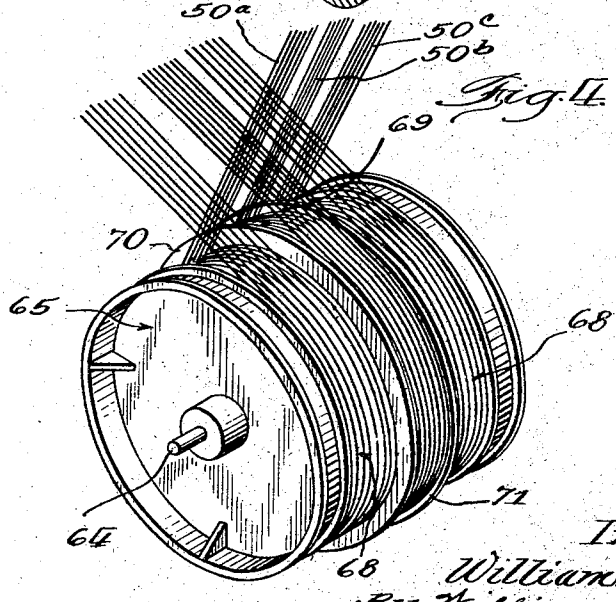


Fig. 4.



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Fig. 5.

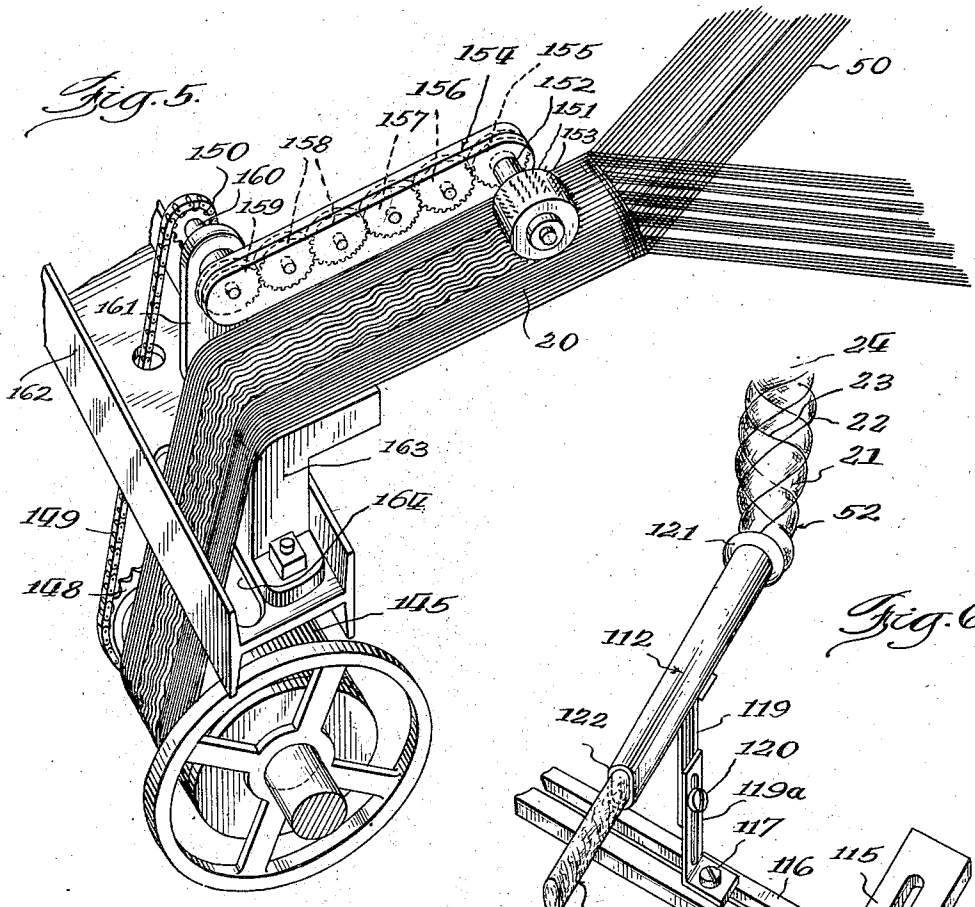
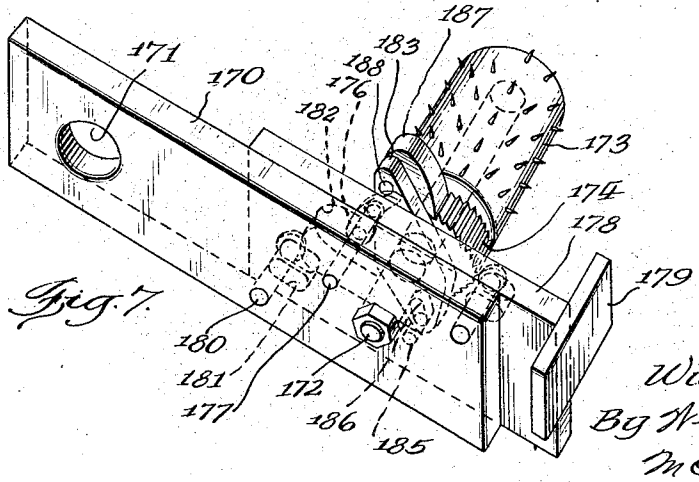


Fig. 6.

Fig. 7.



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Fig. 8.

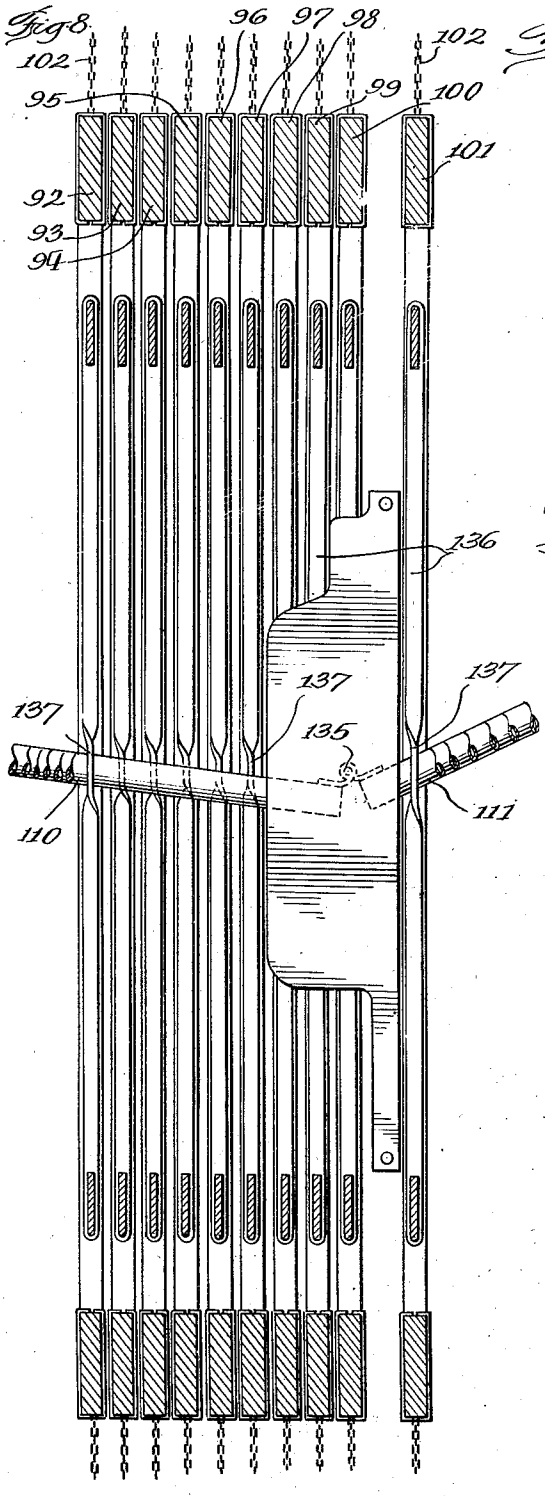
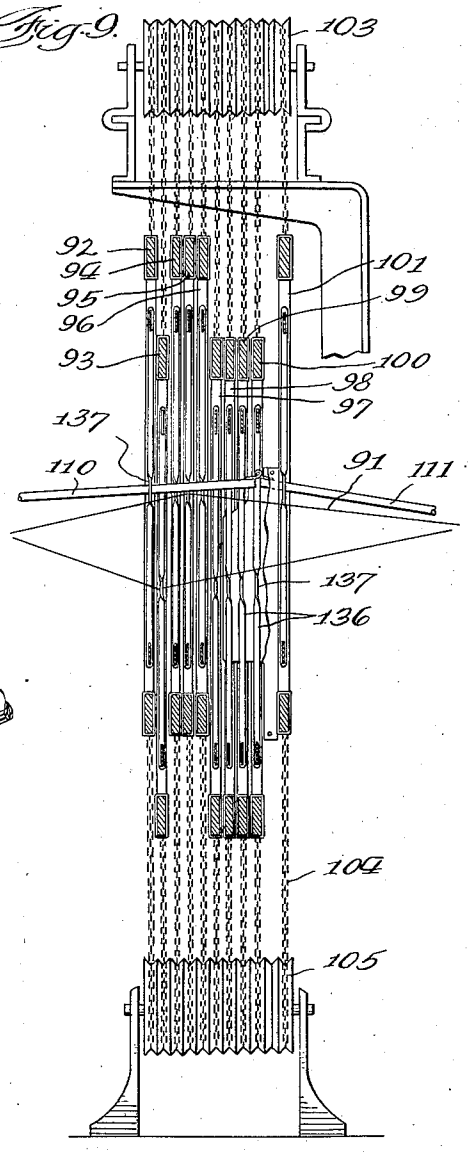


Fig. 9.



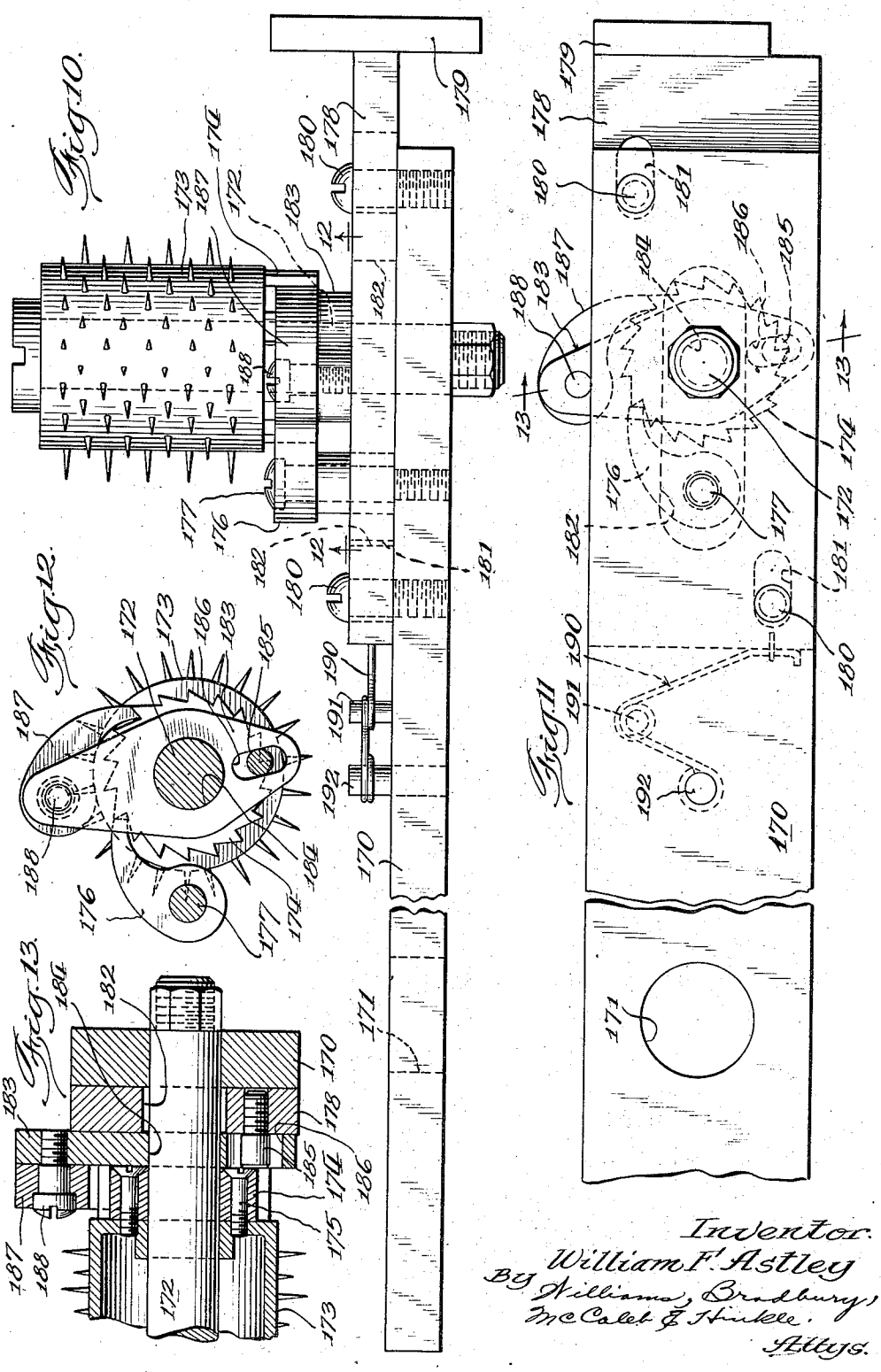
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Patented Apr. 10, 1945

2,373,091

UNITED STATES PATENT OFFICE

2,373,091

APPARATUS FOR WEAVING INSULATING MATERIALS

William F. Astley, Cicero, Ill., assignor to Union Asbestos & Rubber Company, Chicago, Ill., a corporation of Illinois

Application February 10, 1940, Serial No. 318,228

12 Claims. (Cl. 139—11)

The present invention relates to methods and apparatus for weaving insulating materials, and is particularly concerned with methods and apparatus adapted to weave insulating tape of the type comprising a filler having a plurality of large loose soft rovings of asbestos or other insulating material and a woven asbestos sheath.

The present application is related to prior Patent No. 2,302,093, which is a division of this application.

One of the objects of the invention is the provision of an improved method and weaving machine adapted to be used for making insulating tape of the general type covered by my prior application, Serial No. 300,104, filed October 19, 1939, for improvements in Heat insulating tape and methods of manufacture now Patent No. 2,239,281. It is to be understood that the number of hard and soft fillers in these tapes may be varied.

Another object of the invention is the provision of an improved method by means of which such filled insulating tapes may be woven and filled with rovings, all in one operation, so that it is no longer necessary to manufacture the filler and to weave the sheath separately and fill the sheath after it has been woven.

Another object of the invention is the provision of an improved method and weaving machine which is adapted to make an insulating tape, the sheath of which is made longer on one side, so that the outer wall of the sheath, when it is applied to a pipe, is not subjected to such tension as is present in the insulating tapes of the prior art; and the flattening effect on the filler, which is present in the devices of the prior art, is eliminated.

Another object of the invention is the provision of an improved method of handling the rovings which are used for fillers of insulating tape, by means of which the filler may be inserted in the sheath of the insulating tape at the time the sheath is woven.

Another object of the invention is the provision of an improved weaving machine, which is adapted to weave a tubular sheath about one or more filler members, the filler members being introduced in the spaces between the elements of a relatively coarse reed.

It should be understood that the present machine is not limited to the manufacture of asbestos blankets or to the use of asbestos material. It may be used for making various kinds of fabrics, rugs, and blankets of any kind of fiber which may be spun into threads, or which may be used as fillers, respectively and such fabrics, rugs, or blankets may be made with or without a sheath.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the seven sheets of drawings accompanying this specification,

Fig. 1 is a side elevational view of the main part of a weaving machine embodying the invention;

Fig. 1A is a similar view of the right hand portion of the machine, which may be combined with Fig. 1 to show the complete structure of this end of the machine, and this figure relates particularly to containers for supporting the filler, and a rack for supporting the reels for the threads used in the weaving of the sheath;

Fig. 2 is a diagrammatic elevational view of the left end of the machine of Fig. 1, showing the apparatus for applying a waterproof coating to the sheath of the insulating tape and for curing the coating and reeling the tape in suitable coils;

Fig. 3 is a view in perspective of that portion of the machine which is adapted to handle the filler rovings by means of a plurality of protective tubes through which the rovings slide;

Fig. 4 is a view in perspective of a feed roll for the warp threads of the sheath by means of which warp threads of greater length are fed to that portion of the fabric of the sheath which forms the outer wall of the sheath so that this wall of the sheath may be longer, since it will be on the outside of the assembly when the tape is wrapped about a pipe;

Fig. 5 is a view in perspective of a part of the left end of the machine, showing one form of the feeding mechanism by means of which the outer wall of the woven sheath is drawn from the weaving machine at a faster rate than the rest of the insulating tape being made by the machine;

Fig. 6 is a view in perspective of a part of the machine embodying one of the tubes adapted to protect and shape the filler rovings that are disposed within the sheath of the insulating tape;

Fig. 7 is a view in perspective of another alternative form of step-by-step mechanism for engaging the outer wall of the insulating tape and withdrawing it from the machine at a faster

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rate than the rate at which the rest of the insulating tape emerges from the machine;

Fig. 8 is a vertical sectional view taken through the heddles of the weaving machine, showing the arrangement by means of which the tubes, which carry the filler rovings, are moved up and down within the shed in the operation of the weaving machine;

Fig. 9 is a side elevational view, with a diagrammatic illustration of the shed, and showing the heddle frames in cross section;

Fig. 10 is a full sized top plan view of the step-by-step mechanism shown in perspective in Fig. 7;

Fig. 11 is a side elevational view of the step-by-step mechanism of Fig. 7;

Fig. 12 is a sectional view of this mechanism, taken on the plane of the line 12—12 of Fig. 10, looking in the direction of the arrows;

Fig. 13 is another sectional view taken on the plane of the line 13—13 of Fig. 11, looking in the direction of the arrows.

The insulating tape made according to the present methods and apparatus is illustrated in Fig. 5, and is further covered by my prior application, Serial No. 300,104, mentioned above.

It comprises a woven sheath 20 of the type shown in Fig. 5, in part of the machine, and a plurality of large loose soft rovings 21 of asbestos fibers, which may be in the form of ordinary slivers, the loose fibers being preferably embraced by one or more spirally extending threads 22 extending about the fibers in the right hand direction, one or more spirally extending threads 23 in the left hand direction, and one or more of the additional threads of asbestos may be included as a core for the insulating fibers of the filler members 21 and for the purpose of entraining the loose fibers with them as the fibers emerge from a machine of the type shown in my prior application, Ser. No. 195,117, filed March 10, 1938, on Machines for making insulation now Patent No. 2,191,875.

The spirally extending threads 22, 23 and the warp and weft threads of the woven sheath 20 are also preferably made of asbestos, and a certain percentage of cotton may be included with the fiber of which the threads are made, for the purpose of increasing the tensile strength and workability of the stock from which the thread is made. The asbestos fibers used may be of Canadian Chrysotile.

I desire it to be understood that the present methods and machines are not limited to the weaving of small or narrow sheathed insulating materials, but may be used for making insulating materials of any width or thickness desired. For example, blankets of the dimensions of ¼ inch thick and 19½ inches wide have been made, as well as sheathed insulating tapes $1\frac{9}{16} \times \frac{3}{16}$, $2 \times \frac{4}{16}$, and $2\frac{3}{8} \times \frac{3}{8}$ inches in size.

It should also be understood that the machine and method are not limited to the making of insulating tape of the precise structure shown in the present drawings, but the elements of the machine may be adjusted and manipulated in a manner known to those skilled in the art of making many different types and structures of insulating tape. One example of this is the insulating tape shown in my prior application, Serial No. 300,104, in which the edge of the sheath is provided with a plurality of ropes, and in which certain parts of the sheath are tied together by warp threads extending between certain rovings from the top to the bottom of the sheath to hold the parts of the filler in definite predetermined position.

One of the distinguishing characteristics of the insulating tape made by the present machine, when it is equipped with the feed mechanism shown in Figs. 5, 7, and 10 to 13, is that the outer wall of the sheath is longer, as evidenced by a puckered condition, as illustrated in my prior application on the tape, Serial No. 300,104.

This puckered condition actually represents a greater length in the woven fabric at the outer wall of the sheath, and is included for the reason that the outer wall of the sheath is disposed at a greater radius from the center of a pipe than the inner wall when the tape is wrapped on the pipe. This being the condition, the outer wall will not be under such great tension in the tape made by the present machine as it will be in the devices of the prior art, where both walls, inner and outer, of the sheath are of the same length.

The tape made by this machine will, therefore, tend to maintain its filler in a loose, fluffy condition, instead of tending to compress the filler when the tape is wrapped about a pipe.

It should also be understood that the sheath may be made according to the present methods and machine with a plain weave, a diagonal twill weave, a herringbone twill weave, or a granite weave. The particular type of weave depends upon the adjustment and manipulation of the heddles and other elements of the machine.

Referring to Figs. 1 and 1A, these views may be combined to show the structure of the right hand of the machine. Fig. 1A shows a spool rack comprising a plurality of horizontally extending frame members 30 to 38, fixedly secured to a plurality of vertically extending frame members 40 to 46 for the purpose of providing a vertical rack adapted to support a multiplicity of spools.

The horizontal frame members 30 to 38 are provided with a plurality of regularly spaced pintles 47 adapted to carry a multiplicity of spools 48, 49, which are rotatably supported, and provided with a thread or cord for the weaving of the fabric.

The spools 48, for example, may support rolls of cord, such as that used for filler at the edges of the tape, to make the edges of the tape non-compressible. All of the other spools 49 are adapted to support threads used as the warp threads 50 of the sheath, and the multiplicity of fine strands extending toward the left of Fig. 1A represent the threads being fed to the loom.

The members 51 are the hard cords used at the edge of the tape. The members 52 at the left of Fig. 1A are the large, loose, soft insulating filler units, the coils of which are supported in the substantially cylindrical metal members 53 to 56, after the manner shown in Fig. 2 of my prior application, Serial No. 195,117 on Machines for making insulation.

These insulating filler units are adapted to be withdrawn from the drums 53 to 56 and fed to the machine in order that the insulating sheath of the tape may be filled as its weaving progresses.

Referring to Fig. 1, the weaving machine preferably comprises a frame-work which may consist of a pair of similar vertically extending metal frame members 60 joined together by suitable horizontally extending frames, and each provided with the rearwardly extending diagonal frame members 61 and 62, having an open bearing 63 for supporting the trunnion 64 of a feed drum 65.

The feed drum 65 extends across the back of the machine, and is adapted to be rotated at a suitable speed for feeding the warp strands to

the machine in proper relative length. For example, the warp strands 50 coming from the spools 49 may extend over suitable supporting dowels 66 carried by frame members 67, and may extend thence down about the drum 65.

Referring to Fig. 4, the drum 65 is here shown in perspective, and it has two cylindrical portions 68 of the same diameter, and the central cylindrical portion 69 of a larger diameter.

These cylindrical portions are preferably separated by intervening radial flanges 70 and 71, and the warp strands wound about these portions respectively may be identified as 50*a*, 50*b*, and 50*c*.

The warp strands 50*b* wound about the central larger cylindrical drum portion 69 are those warp strands which are to be used for the upper and outside portions of the sheath of the tape. The warp strands 50*a* and 50*c* are those wound about the drum portions 68 of reduced diameter, and are for weaving the rest of the sheath, comprising the edges, and inside wall of the sheath when it is wrapped on the pipe.

All of the drum portions 68 and 69 are fixedly secured together and rotate together, and therefore the warp strands 50*b* for the outer wall of the tape sheath are fed at a great rate and are necessarily longer than the rest of the warp strands in the sheath. The purpose of this is to increase the length of the sheath at its outer diameter when it is applied to the pipe so that the outer wall of the sheath, when it is applied to the pipe will not be so tightly tensioned as it otherwise would be, and it will not tend to compress the large, loose soft members which are used as a filler.

The insulating value of the assembly is enhanced by maintaining the filler in its most loose and soft condition, due to the insulating value of the air in the interstices between the fibers. It is this extra length of the outer wall of the sheath which results in what may be called a crimped or puckered appearance in the outer wall of the sheath. The amount of crimp depends somewhat upon the thickness of the filler, as the crimp is intended to supply the extra peripheral length for the outer wall of the sheath, which is rendered necessary by the location of this wall at a greater radius from the center of the pipe.

Insulating tapes have been constructed with from twenty-two percent to twenty-four percent of crimp, and other thinner tapes with approximately sixteen percent of crimp. The amount of crimp can readily be calculated by calculating the theoretical circumference of the insulated pipe assembly at the outer wall of the sheath and at the inner wall, as will be evident to one skilled in the art.

In addition to the supports mentioned for the warp strands, the frame members 60 may also support an additional number of suitable idler rolls 75—82, and the warp strands may be carried over a suitable number of rods or dowels to place the desired tension on these warp members. The friction caused by the threads passing about the idler rolls or passing about rods or dowels places the desired tension on the warp members as they are drawn over the rolls, rods, or dowels.

From the feeding devices at the right of the machine, the warp threads pass to the main part of the loom, the frame of which is indicated by the numeral 90. This loom is in many respects similar in construction to ordinary weaving looms in that it is provided with suitable heddles for controlling the warp strands and forming the shed 91, through which the shuttle moves in the weaving of the tubular sheath.

The heddles, some of which are indicated by the numerals 92 to 101, may be supported from the top by means of suitable metal chains 102, passing over pulleys 103; and similarly, at the bottom, by the chains 104, passing over the pulleys 105.

Like the other looms of the prior art, the heddles are actuated by means of a suitable cam or cams (not shown) for the purpose of moving the warp strands back and forth between the movements of the shuttle which passes through the shed 91.

As this part of the loom is like the devices of the prior art in respect to the warp threads, and as the shuttle structure is likewise similar to the devices of the prior art, they will not be described in detail.

Certain of the heddles, however, such as, for example, Nos. 92 and 101 (Fig. 1) are adapted to control the movements of a plurality of tubular metal members 110, 111, which are adapted to support, move, and protect the insulating filler members 51, 52 as they progress past the heddles, and are placed in predetermined position within the sheath as it is woven. The hard cord insulating members 51 might be handled without the use of the protecting tubes, but the present machine is adapted to make insulating tapes which have the large, loose, soft, insulating fillers throughout.

In the embodiment illustrated there are six separate filler members employed, which have been identified on the spool racks as Nos. 51 and 52. Therefore, there are six sets of the tubular members 110, 111 and six of the guiding and shaping members 112 (Fig. 1), which are also of tubular shape. All of the elements of an assembly for handling one filler member are similar to the elements of another assembly, and therefore only one may be described in detail.

Referring to Fig. 6, the frame of the machine supports suitable rearwardly extending frame members 115, which carry the transversely extending frame members 116, both of which are provided with slots so that the screw bolts 117 and 118 may be adjusted to the desired positions.

The transverse frame member 116 is adapted to support a plurality of the shaping members 112, each of which is fixedly supported by a pair of upwardly extended slotted frame members 119, 119*a* adjustably secured together by screw bolt 120. Each of the shaping members 112 comprises a tubular member, the leading end of which is belled out or made slightly funnel-shaped at 121, in order to facilitate the entry of the insulating filler unit 21.

The leading end 121 is also substantially cylindrical, but the discharging end 122 of the shaping members 112 is oval in shape. In order to give the filler members 52 the cross sectional shape of an elongated oval, the largest dimension is in a vertical direction. This is for the purpose of facilitating the passage of the filler members 52 through the supporting tubes 110, 111, which are also of oval shape, and for the purpose of reducing the width of these filler members and their tubes 110, 111, since these tubes pass through the reed of the loom.

The oval shape of the filler members also facilitates the placing of a thicker filler in the

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sheath, and effects an increase in the insulating value of the finished tape.

From the shaping members 112, the filler strands 51 and 52 extend into the tubular members 111.

Referring to Fig. 3, in this figure the frame 90 of the machine includes the horizontally extending frame member 125, having a plurality of upwardly extending brackets 126 for carrying the transverse frame member 127. Transverse frame member 127 has slots for adjustably supporting the pintle brackets 128, between which there is supported an elongated pintle 129 for pivotally supporting one end of a plurality of the tubes 111.

Each of the tubes has an upwardly extending pintle flange 130, which may be in the form of a band of metal, having its ends apertured to receive the pintle 129. The ends 131 of the tubular members 111 may be slightly belled outward to facilitate the entry of the insulating filler units 51 and 52 as they come from the shaper members 112.

The opposite end of each of the tubular members 111 is pivotally secured by means of a hinge 135 at the upper side of each tubular member to the tubular members 110, so that the tubular members 110, 111 are pivotally secured together at the middle, and they are adapted to be moved upward and downward by the heddles, of which Nos. 92 and 101 are exemplary, to keep the filler members in such position that they do not interfere with the operation of the loom.

One position of the tubular members 110, 111 is shown in Fig. 1. A second position of these members is shown in Fig. 9. For example, in Fig. 1 the filler is held below the shed, and in Fig. 9 the fillers are held above the shed.

The heddles which actuate the tubular members 110, 111 comprise suitable rectangular frames, having vertically extending metallic strips or heddle bars 136, disposed with their plane surfaces parallel to the direction in which the warp threads extend. At the tubular members 110, 111, however, these bars 136 have portions 137 twisted into a plane at right angles to the portion 136, and apertured to receive the tubular members 110, 111 with sufficient clearance to permit a limited pivotal movement between the heddles and the tubular members.

The other heddle bars also have twisted portions 137 which are provided with eyes for receiving warp threads, as shown with regard to heddle 93 (Fig. 9).

The heddles which actuate these tubular members 110, 111 are likewise controlled by chains or other flexible members extending over pulleys, as previously described, and actuated by a suitable cam or cams in a manner similar to the weaving machines of the prior art.

Two of the ten heddles illustrated in Fig. 1 are utilized in controlling the movements of the tubes 110, 111. The other eight heddles are used for controlling the movements of the warp threads which form the sheath of the tape.

It is to be understood that the time and range of movement of any of the heddles of a loom may be suitably adjusted to accomplish these results.

The left end of each tubular member 110 extends through the reed. For this purpose a relatively coarse reed is provided. A relatively deep reed is also employed so as to permit sufficient range of movement of the tubes so as to clear the shuttle. If it were not for the guiding and protecting tubes 110, 111, the filler would, of course, be torn to pieces by the heddles and reed.

The reed is illustrated as a movably mounted member 140 of the conventional type, which is pivotally mounted at 141, and which is adapted to compact the weft thread, which is led in the shed by the shuttle. The reed is actuated in this loom in the same manner as in the devices of the prior art, by means of suitable cams. It will be seen in Fig. 1 that the tubular members 110 extend through the reed so that the filler is fed into the sheath as it is woven.

As the right end of each tube 111 is pivotally secured to a fixed support, and there are two heddles, one of which, 101, for example, engages the tube 111, and another 92, for example, engages the tube 110. It will be seen that these heddles are adapted to control the position of the tubes 110, 111 to move them periodically between the positions shown in Figs. 1 and 9.

The left end of each tube 110 may then be free of any other support. The movement of the heddles is such that the left or discharge end of each tube 110 is maintained at the center of the sheath. Thus the sheath is adapted to be woven and filled with the insulating filler members simultaneously, and the fillers can be placed exactly where it is desired to have them. There is no possibility of the fillers getting out of place or being wrongly placed, as may be the case where they are drawn into the sheath after the sheath has been woven.

Furthermore, much labor is eliminated in the making of the insulating tape by means of the present machine, and the tape may be manufactured at a lower cost; between one-third and one-half of the cost of manufacture may be saved by the manufacture of insulating tape according to the present method with the present machine.

Referring to Figs. 1 and 5, the woven and filled sheath 20 may be seen as it emerges from the loom at the left of Fig. 1. The loom is preferably provided with suitable devices for withdrawing the tape at a predetermined rate, in the form of suitable driving rolls 145, with idler rolls 146 and 147 for guiding the tape as it emerges from the machine.

In addition to this, the driving roll 145 (Fig. 5) preferably has a sprocket 148 driving a chain 149, which drives a smaller sprocket 150, carried by an auxiliary crimping device, shown in Fig. 5.

This crimping device is for the purpose of handling the additional length of warp threads, and resulting additional length of fabric in the outer wall of the sheath of the tape 20. It comprises a cylindrical roll 151 mounted upon a shaft 152 and provided with a multiplicity of radially projecting wire teeth 153. The wire teeth 153 engage in the fabric of the sheath of the tape 20, and particularly in that portion of the fabric which has the longer warp threads.

The roller 151 is driven at a greater peripheral speed than the speed at which the woven tape 20 emerges from the machine, and thus the fabric of the sheath at the outer wall is withdrawn at a faster rate, corresponding to the additional length of warp threads provided by the enlarged drum portion 69 (Fig. 4).

This gives the outer surface of the sheath a puckered appearance when the sheath extends in a straight line; but when the sheath is filled and wound on a pipe, its outer wall has that additional length which it should have by reason of the fact that the outer wall is disposed at a greater radius from the center of the pipe.

In Fig. 5 the shaft 152 is rotatably mounted on a metal plate 154. It is driven by a series

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of inter-engaging gears 155 to 159, each of which is mounted on a stub shaft carried by the plate 154. The last gear 159 of this series is fixedly secured to the shaft 160, which also carries the sprocket 150. The shaft 160 is rotatably mounted in a frame member 161 carried by the frame of the machine, and mounted on the I beam 162.

The metal gear support plate 154 is rotatably mounted on the shaft 160 so that the toothed roller 151 rests upon the tape 20 by virtue of its weight, which causes the teeth 153 to penetrate into the interstices between the fibers or threads.

The frame member 162 may also support an angular guide sheath 163, over which the insulating tape passes as it is directed through the aperture 164 in the I beam 162, to pass about the feed roll 145.

In the embodiment of Fig. 5, this withdrawing mechanism operates at a regular rate of speed continuously; but in a further modification, disclosed in Figs. 7, and 10 to 13, the tape has its outer wall puckered or withdrawn at a greater rate of speed by a step-by-step mechanism. The mechanism of Fig. 7 may be substituted for that of Fig. 5, the supporting plate 170 being pivotally mounted on the shaft 160 by means of the aperture 171.

In this embodiment the supporting plate 170 is provided with a shaft 172 fixedly secured thereto and rotatably supporting a toothed metal drum 173.

The toothed metal drum has secured thereto a ratchet wheel 174 by means of the screw bolts 175, and the ratchet wheel is adapted to actuate the drum. The plate 170 carries a retaining pawl 176, which is rotatably mounted on a screw bolt 177 that is threaded into the plate 170.

The pawl 176 is urged into engagement with the ratchet by reason of its weight, the pawl being disposed in the position of Fig. 11, where its free end tends to pivot downward into engagement with the ratchet at all times.

In order to actuate the ratchet wheel 174, the plate 170 slidably supports a second or sliding plate 178, having a transversely extending plate 179 secured thereto to be used as a shoulder that is engaged by a part of the reed 140.

The plate 178 is slidably mounted by means of a pair of screw bolts 180, which pass through the slots 181, and are threaded into the plate 170. The plate 178 has an elongated and enlarged slot 182 surrounding the shaft 172 and the stud bolt 177 carried by the plate 170.

An actuating lever 183 is mounted between its ends on the shaft 172, by means of an aperture 184. At its lower end it is pivotally mounted on a pin or screw bolt 185, which is carried by the plate 170, and the bolt 185 is located in a slot 186 in the lever plate 183. At its upper end the plate 183 carries a driving pawl 187 by means of a screw bolt 188 fixedly secured to the plate and pivotally supporting the pawl 187.

It will be observed that the pawl 187 is also urged into engagement with the ratchet by gravity.

The operation of this type of puckering mechanism for the sheath is as follows: Each time that the lay or reed 140 moves toward the left in Fig. 1, it engages the member 179 and causes the plate 178 to slide toward the left in Fig. 10 and Fig. 11. This causes the pawl 187 to take a new bite on the teeth of the ratchet wheel 174, which is held against counterclockwise rotation by the pawl 176.

When the reed or lay 140 moves toward the right in Fig. 1, there is a spring 190, carried by pins 191, 192 on the plate 170 that engages the end of the sliding plate 178, and again moves it toward the right, to the position of Figs. 10 and 11. This causes the driving pawl 187 to move toward the right to the position of Fig. 11, again rotating the ratchet 174 one step, and also rotating the toothed drum 173 one step.

The toothed drum in this case serves the same purpose as in Fig. 5, that is, it withdraws from the loom the outer wall of the sheath at a greater speed than the rest of the tape, and causes a puckering of the outer wall which is actually a greater length of fabric in that wall.

Thus, the insulating tape may be made according to the present method and by the present machine is adapted to have its outer wall proportioned in length to the increased periphery which is necessary to such a wall when the tape is wound about a pipe.

In some embodiments of the invention the insulating tape as it emerges from the loom may be immediately coiled upon a mandrel 200 carried by frame 201.

In the preferred embodiment of the invention, however, the tape as it comes from the roller 147 may pass into a waterproofing device 202. The waterproofing device 202 comprises a suitable container 203 for a waterproofing compound, such as pitch or rubber latex, or other initially plastic materials diluted with suitable solvent.

The container 203 may be provided with a roller 204 rotatably mounted in the waterproofing compound, and the roller 204 is provided with side flanges 205 at each end of the roller. The length of the roller 204, that is, the width between the side flanges 205, is such that the side flanges 205 touch the edge of the tape. Idler rollers 206, 207 at each end of the container 203 at the top hold the tape down into engagement with the roller 204, and the roller 204 may be driven by means of an electric motor 208 having a drive pulley and a belt 209 driving a pulley on the shaft 210.

As the tape comes from the machine in Fig. 2, its outer side is uppermost; that is, the side which will be outermost on the pipe will be uppermost, for the reason that the puckering mechanism is above the insulating tape, its toothed feed rollers engaging the tape by gravity.

The waterproofing mechanism, however, requires that the tape be inverted, having the side to be waterproofed turned downward for engagement with the roller 204 and flanges 205. Therefore, the break indicated at 211 (Fig. 2) indicates a twist of 180 degrees in the tape, which may be brought about with or without suitable guide rollers; or, if it is not desirable to twist the tape, it may be brought under another roller and reversed in direction, with the waterproofing mechanism extending in the opposite direction from that of Fig. 2, behind the weaving machine.

The waterproofing machine has its roller 204 driven by the motor 208, which causes the roller and its flanges 205 to dip into the waterproofing compound in the container 203. This compound may consist of an initially plastic or substantially liquid rubber latex composition with sufficient solvent, such as ammonia, so that the roller 204 and flanges 205 are covered with the compound by immersion. Contact between the roller, its flanges, and the tape applies the waterproofing compound to the outside of the tape and both edges thereof, but leaves the inner side free from waterproofing compound for application to the

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pipe. As the tape emerges from the waterproofing machine, which is enclosed in a housing 215, it may pass over suitable rollers 216 into a baking oven 217, which is provided with a heated atmosphere entering at the pipe 218, and exhausted at the pipe 219. The heated air is preferably suitably dried or has the solvent removed therefrom by condensation. The air may be heated by means of electric heating elements or gas heat.

The length of the oven 217 is such that by the time the tape has passed over the rollers 220 to 223 in the oven, it has traversed the oven twice, and the waterproofing compound has been completely dried. The tape may then be rolled upon the mandrel 200, which is suitably driven by means of a belt 224 from motor 225, and when a suitable length has accumulated upon the mandrel 200, the tape is removed and tied in the form of a roll or coil.

Thus the present machine is adapted to eliminate many of the manual operations necessitated by the methods of the prior art, and insulating tape is woven, filled, waterproofed, dried, and rolled without the necessity for further attention than the maintenance of the supplies of raw materials, which are necessary to the manufacture of the tape.

The present tape is adapted to have its filler maintained in the best insulating condition, that is, large, loose, and soft, even after it has been wrapped on the pipe, because the external wall of the sheath as it is applied to the pipe is of greater length than the inner wall, thereby eliminating the tendencies of the devices of the prior art to compress the filler as it is applied to the pipe.

The flattening of the filler, which was necessary in drawing a filler into a completely woven tape, is avoided by the methods of the invention, and the tendency of the fillers to get out of place is also eliminated. Approximately one-third of the cost may now be saved by means of the present method and machines, and the improved structure of the tape also tends to eliminate any tendency toward flattening.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. A weaving machine comprising a supporting frame, a loom having a reed with a lay adapted to pass a plurality of insulating filler units, a plurality of heddles movably mounted on said frame said loom having its shed controlled by said heddles, and a plurality of jointed tubular members movably mounted on said frame and passing through said comb for protecting and passing said insulating filler units through said comb and heddles, said jointed tubular members having one end pivotally mounted on said frame for receiving the filler units at substantially the same position, and having two jointed sections pivotally secured together and controlled by heddles.

2. A weaving machine comprising a supporting frame, a loom having a reed with a lay adapted to pass a plurality of insulating filler units, a plurality of heddles movably mounted on said frame said loom having its shed controlled by heddles, and a plurality of jointed tubular members movably mounted on said frame and passing through said comb for protecting and passing said insulating filler units through said comb and heddles, said jointed tubular members having one end pivotally mounted on said frame for receiving the filler units at substantially the same position, and having two jointed sections pivotally secured together and controlled by heddles, said jointed sections being moved by said heddles alternately up and down while maintaining the discharge end of said sections at substantially the same level to discharge the filler into a woven sheath and to keep the filler and tubular members outside the shed during the weaving of the sheath.

3. A weaving machine comprising a supporting frame having a lay provided with a reed movably mounted on said frame and adapted to pass a plurality of large, loose, soft filler units, a plurality of heddles movably mounted on said frame for controlling the warp threads of both sides of a tubular sheath to form a shed for the weaving of said sheath, a plurality of tubular members for working and guiding said filler units, said tubular members each comprising a pair of sections pivotally secured together at their inner ends and each pair of sections having one end of one section pivotally secured to said frame, a plurality of additional heddles movably mounted on said frame for controlling said tubular members, said tubular members being pivotally connected to said heddles whereby the tubular members and filler units which they contain may be moved out of the shed of warp threads of said sheath and the sheath may be woven simultaneously as the tubular members are fed into the tubular sheath.

4. A weaving machine comprising a supporting frame having a lay provided with a reed movably mounted on said frame and adapted to pass a plurality of large, loose, soft filler units, a plurality of heddles movably mounted on said frame for controlling the warp threads of both sides of a tubular sheath to form a shed for the weaving of said sheath, a plurality of tubular members for working and guiding said filler units, said tubular members each comprising a pair of sections pivotally secured together at their inner ends and each pair of sections having one end of one section pivotally secured to said frame, a plurality of additional heddles movably mounted on said frame for controlling said tubular members, said tubular members being pivotally connected to said heddles whereby the tubular members and filler units which they contain may be moved out of the shed of warp threads of said sheath and the sheath may be woven simultaneously as the tubular members are fed into the tubular sheath, means on said frame for supporting supplies of warp threads for said sheath, and feed means comprising a feed drum having portions of different diameter for feeding said warp threads, the warp threads for the outer surface of said sheath passing about the portions of larger diameter, whereby the outer wall of the sheath is of greater length to adapt the product for wrapping upon a pipe or the like.

5. A weaving machine comprising a supporting frame having a lay provided with a reed movably mounted on said frame and adapted to pass a plurality of large, loose, soft filler units, a plurality of heddles movably mounted on said frame for controlling the warp threads of both sides of a tubular sheath to form a shed for the weaving of said sheath, a plurality of tu-

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bular members for working and guiding said filler units, said tubular members each comprising a pair of sections pivotally secured together at their inner ends and each pair of sections having one end of one section pivotally secured to said frame, a plurality of additional heddles movably mounted on said frame for controlling said tubular members, said tubular members being pivotally connected to said heddles whereby the tubular members and filler units which they contain may be moved out of the shed of warp threads of said sheath and the sheath may be woven simultaneously as the tubular members are fed into the tubular sheath, means on said frame for supporting supplies of warp threads for said sheath, and feed means comprising a feed drum having portions of different diameter for feeding said warp threads, the warp threads for the outer surface of said sheath passing about the portions of larger diameter, whereby the outer wall of the sheath is of greater length to adapt the product for wrapping upon a pipe or the like, said machine having a take-up roll for withdrawing the finished product from the machine and having an additional take-up mechanism engaging the outer wall of said sheath to withdraw it at a faster rate than the rest of the woven product.

6. In a weaving machine for the sheath of an insulating tape, the combination of a supporting frame with a take-up mechanism for the woven product, said take-up mechanism comprising a cylindrical roll upon which the woven product is wrapped, a plurality of heddles movably mounted on said frame for controlling the warp threads of a shed forming said product, a plurality of reels for supporting supplies of the warp threads forming said shed, and means for controlling the feed of said warp threads to said shed, comprising a feed drum having feed portions of different diameter, the warp threads for one of the sides of said sheath passing around a feed portion of larger diameter, and the other warp threads passing around a feed portion of smaller diameter, and an auxiliary take-up mechanism comprising means for engaging that wall of the sheath which receives the warp threads that pass about said feed portion of larger diameter whereby the latter wall is withdrawn from the shed at a faster rate to produce a greater length in said latter wall.

7. In a weaving machine for the sheath of an insulating tape, the combination of a supporting frame with a take-up mechanism for the woven product, said take-up mechanism comprising a cylindrical roll upon which the woven product is wrapped, a plurality of heddles movably mounted on said frame for controlling the warp threads of a shed forming said product, a plurality of reels for supporting supplies of the warp threads forming said shed, and means for controlling the feed of said warp threads to said shed, comprising a feed drum having feed portions of different diameter, the warp threads for one of the sides of said sheath passing around a feed portion of larger diameter, and the other warp threads passing around a feed portion of smaller diameter, and an auxiliary take-up mechanism comprising means for engaging that wall of the sheath which receives the warp threads that pass about said feed portion of larger diameter whereby the latter wall is withdrawn from the shed at a faster rate to produce a greater length in said latter wall, said latter take-up mechanism comprising a toothed roll and a step-by-step driving mechanism, and said machine having a lay movably mounted thereon, said lay also actuating said step-by-step mechanism.

8. In a weaving machine, a mechanism for controlling a plurality of filler units to be fed into a tubular tape woven by said machine, comprising a frame for said machine, a plurality of heddle units movably mounted on said frame, a plurality of tubular members for receiving said filler units, each of said tubular members comprising two sections having their inner ends pivotally secured together, and each of said tubular members having its receiving end pivotally mounted on said frame, predetermined of said heddles each having an aperture for slidably and pivotally receiving one section of each tubular member which is remote from the pivotal mounting on said frame, whereby the heddles may move the tubular members out of the shed of the loom and the discharge ends of said tubular members may be maintained in position to feed the filler units contained thereby at approximately the same point.

9. In a weaving machine, a mechanism for controlling a plurality of filler units to be fed into a tubular tape woven by said machine, comprising a frame for said machine, a plurality of heddle units movably mounted on said frame, a plurality of tubular members for receiving said filler units, each of said tubular members comprising two sections having their inner ends pivotally secured together, and each of said tubular members having its receiving end pivotally mounted on said frame, predetermined of said heddles each having an aperture for slidably and pivotally receiving one section of each tubular member which is remote from the pivotal mounting on said frame, whereby the heddles may move the tubular members out of the shed of the loom and the discharge ends of said tubular members may be maintained in position to feed the filler units contained thereby at approximately the same point, said tubular members being of vertically oval cross section, and each tubular member having at its receiving end a tapered forming member fixedly mounted on said frame and adapted to contract the filler member into suitable size and shape to enter the tubular members.

10. A weaving machine comprising a supporting frame, means carried by said frame for supporting a supply of warp threads, a plurality of heddles carried by said frame and adapted to control said warp threads to weave a fabric of predetermined construction, a support for a supply of separate filler units of insulating fibers, a separate pair of tubes pivotally secured together, through which each of said separate filler units passes, a plurality of additional tube-controlling heddles, each of said latter heddles controlling the movement of a pair of said tubes, and each of said latter heddles having a heddle bar pivotally connected to one of the tubes of each pair, one end of the tube of each pair being disposed to feed the filler into position adjacent the fabric, and the other end of the other tube of each pair being pivotally mounted on said frame to receive the filler, whereby the tubes may be moved by said latter heddles into a position outside the shed of the loom so as to dispose the filler in a position to prevent interference between the filler and the shed during the weaving of said fabric.

11. A weaving machine comprising a supporting frame, means carried by said frame for supporting a supply of warp threads, a plurality of

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heddles carried by said frame and adapted to control said warp threads to weave a fabric of predetermined construction, a support for a supply of separate filler units of insulating fibers, a separate pair of tubes pivotally secured together, through which each of said separate filler units passes, a plurality of additional tube-controlling heddles, each of said latter heddles controlling the movement of a pair of said tubes, and each of said latter heddles having a heddle bar pivotally connected to one of the tubes of each pair, one end of the tube of each pair being disposed to feed the filler into position adjacent the fabric, and the other end of the other tube of each pair being pivotally mounted on said frame to receive the filler, whereby the tubes may be moved by said latter heddles into a position outside the shed of the loom so as to dispose the filler in a position to prevent interference between the filler and the shed during the weaving of said fabric, said tubes being of oval shape, with the widest dimension disposed in the direction of movement of the heddles.

12. A weaving machine comprising a supporting frame, means carried by said frame for supporting a supply of warp threads, a plurality of heddles carried by said frame and adapted to control said warp threads to weave a fabric of predetermined construction, a support for a supply of separate filler units of insulating fibers, a separate pair of tubes pivotally secured together, through which each of said separate filler units passes, a plurality of additional tube-controlling heddles, each of said latter heddles controlling the movement of a pair of said tubes, and each of said latter heddles having a heddle bar pivotally connected to one of the tubes of each pair, one end of the tube of each pair being disposed to feed the filler into position adjacent the fabric, and the other end of the other tube of each pair being pivotally mounted on said frame to receive the filler, whereby the tubes may be moved by said latter heddles into a position outside the shed of the loom so as to dispose the filler in a position to prevent interference between the filler and the shed during the weaving of said fabric, said tubes being of oval shape, with the widest dimension disposed in the direction of movement of the heddles, and a tapered tubular forming member having a large opening and a discharge end of flattened shape for engaging and shaping the filler before it enters said tubes.

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