

March 28, 1939.

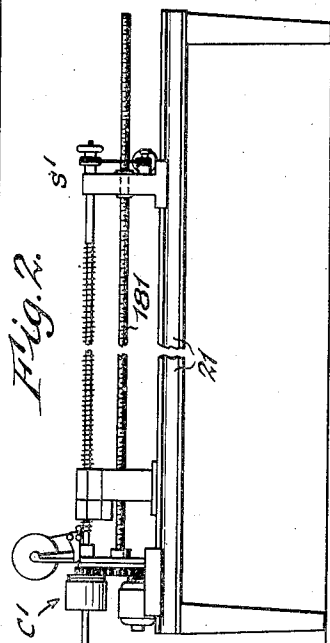
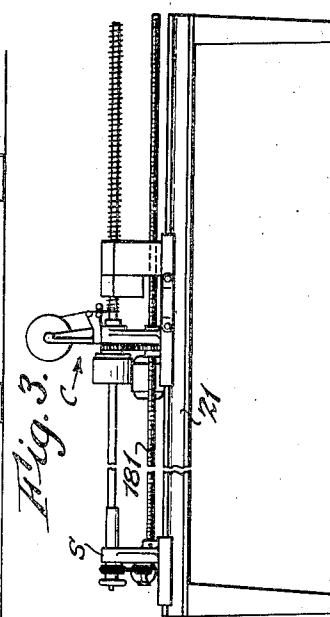
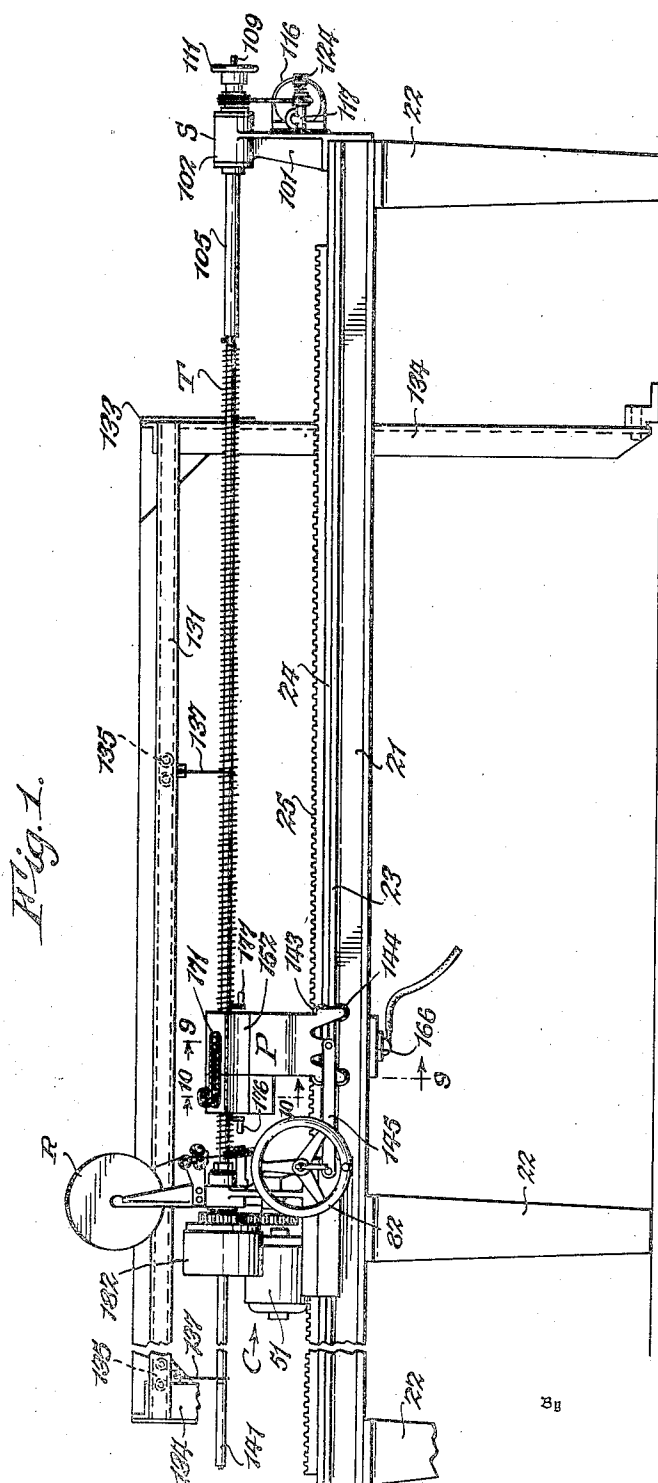
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2,152,437

HELICAL FIN WRAPPING MACHINE

Filed Nov. 6, 1937

5 Sheets-Sheet 1



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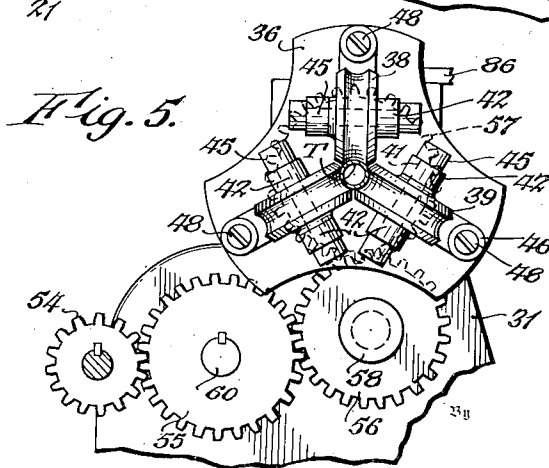
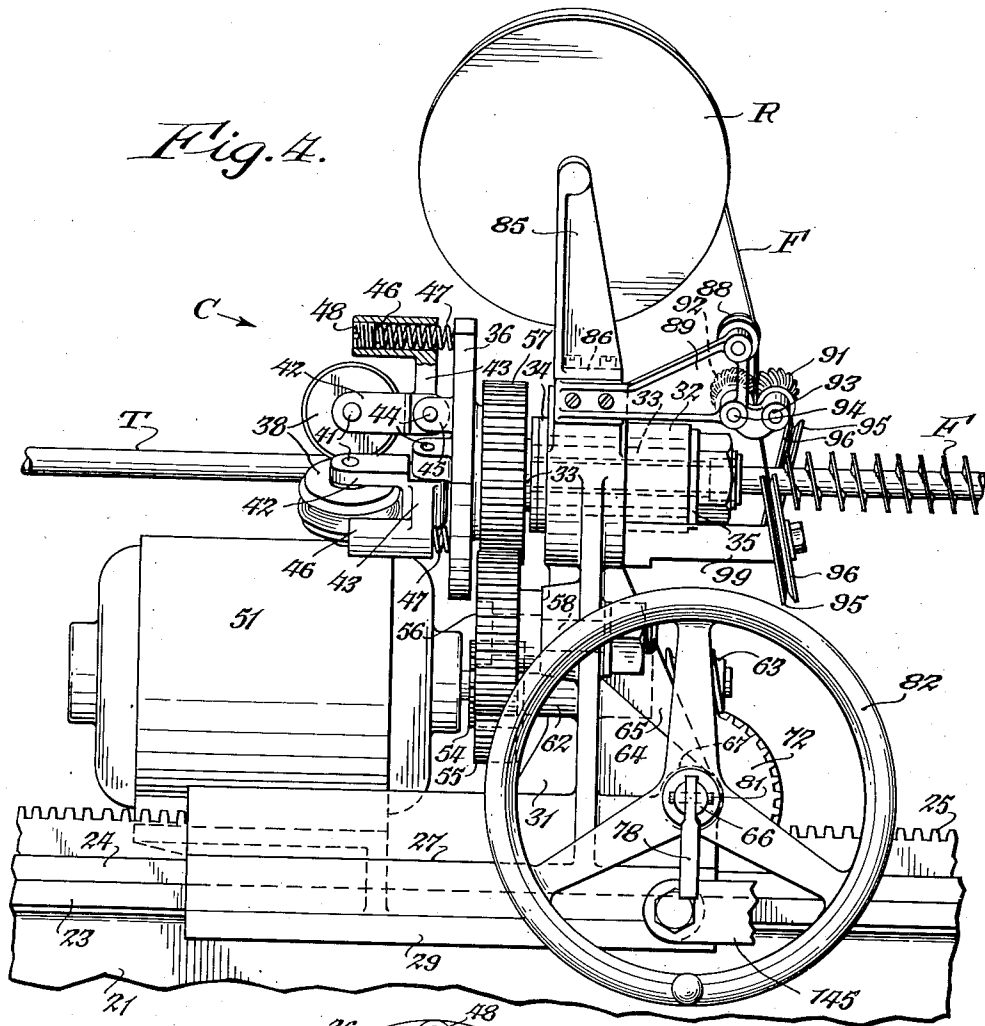
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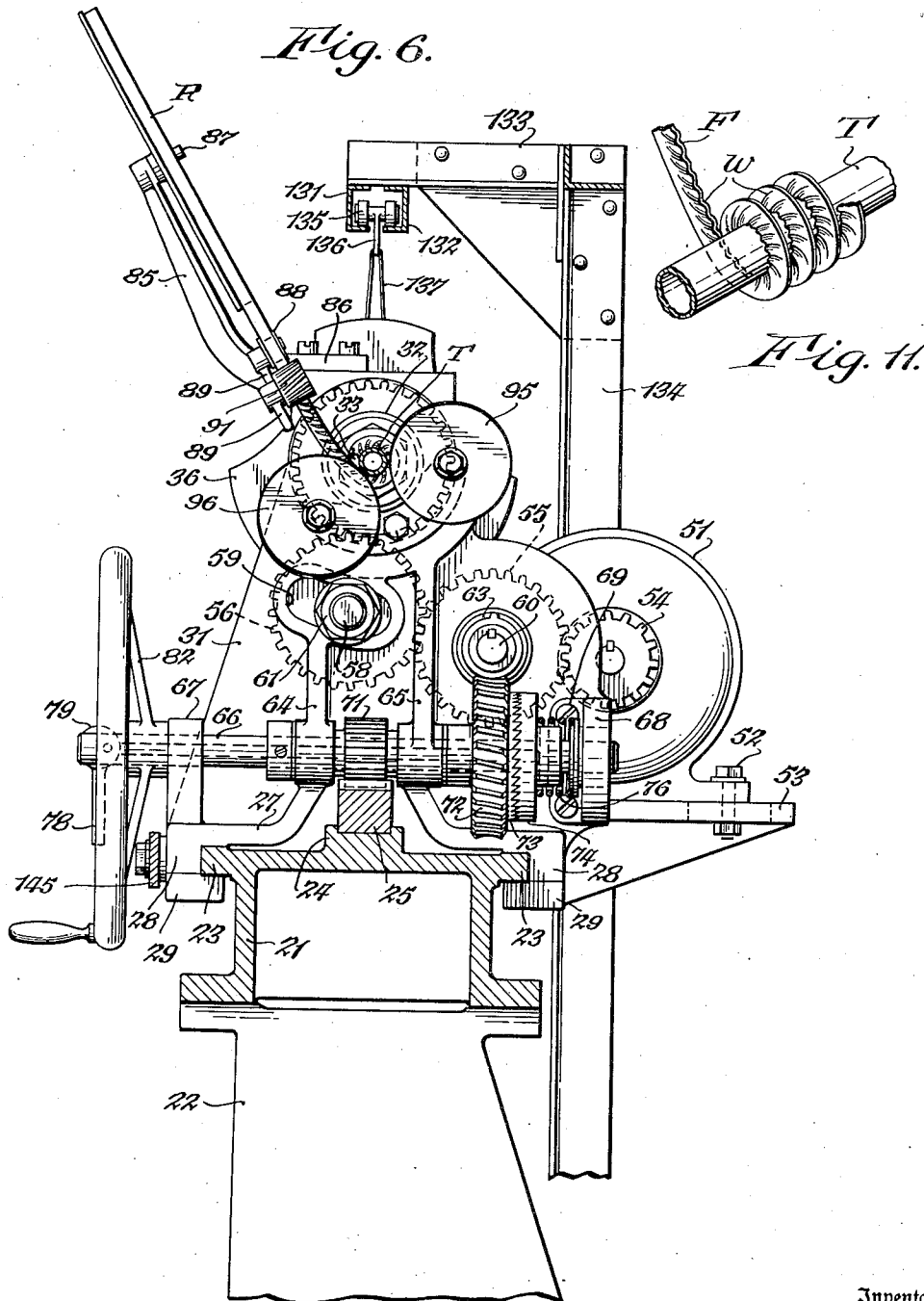
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HELICAL FIN WRAPPING MACHINE

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HELICAL FIN WRAPPING MACHINE

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Fig. 8.

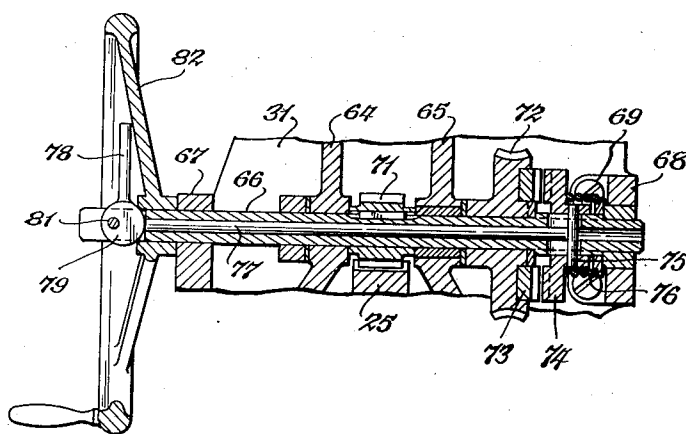
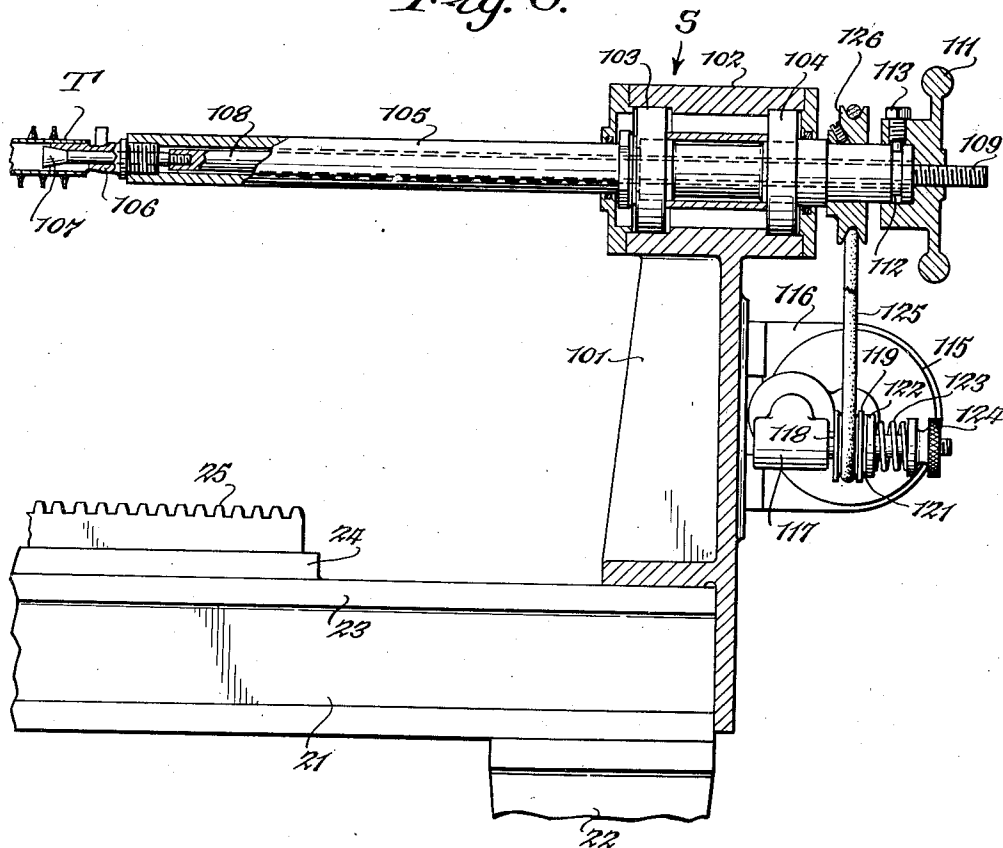


Fig. 7.

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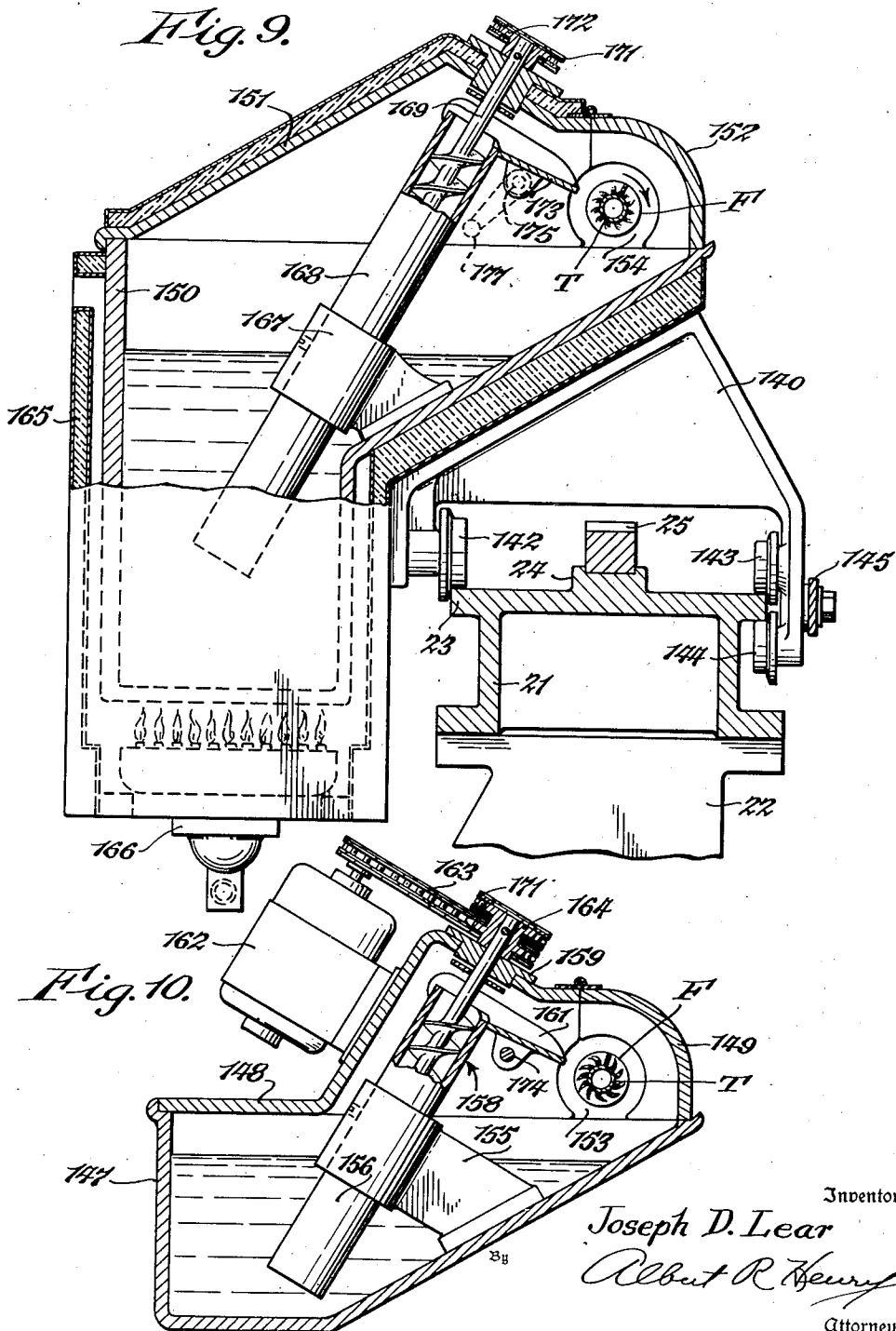
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HELICAL FIN WRAPPING MACHINE

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UNITED STATES PATENT OFFICE

2,152,437

HELICAL FIN WRAPPING MACHINE

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Application November 6, 1937, Serial No. 173,212

15 Claims. (Cl. 29—33)

This invention relates to the manufacture of spiral or helical finned tubing, and it has particular reference to an improved lathe type of machine for applying a winding of fin stock to the tubes.

In the manufacture of spiral fin tubing by winding machines operating on the lathe principle, it has heretofore been proposed to mount a length of tubing for rotation between two spaced bearing members disposed on the machine frame (thus corresponding to the headstock and tailstock) and traverse the tubing, during its rotation, with fin applying instrumentalities placed on a traveling tool holder. It has also been proposed to fix the toolholder with respect to the machine frame and to move a rotatable headchuck, in which one end of the tubing is secured, along the bed, the "tailstock" in this case being a support through which the tubing may move. It has also been customary to apply flux and solder to the assembly, so that, upon removal from the machine, the length of tubing undergoing treatment is substantially completed.

Experience with machines of this nature has shown, however, that they are not entirely satisfactory, particularly when long lengths of tubing or comparatively high speeds are desired. For example, if the span of tubing is only three or four feet, a much higher rotative speed can be tolerated than if the span is twenty feet. In the latter case, speeds in excess of two to three hundred R. P. M. tend to set up so much vibration, or whipping, or torsional stress, that the fin stock either breaks or does not fit uniformly. Shorter tubing lengths, of course, permit of higher rotative speeds, since the displacement of the tubing is proportionately less, but operations at low speed, or on short lengths, in the lathe or intermittent type of machine, both indicate low capacity.

The lathe type of machine has, however, several advantages over other types of spiral winding machines, including facility of operation by comparatively inexperienced or unskilled labor, lower initial cost per machine, and lower service expense and loss during shut-down and repair periods. The present invention proposes to retain these desirable features of the lathe type machine, and to make such improvements in the machine itself as to overcome, to a practical degree, the troubles heretofore experienced.

According to the present invention, the machine consists of a bed having either a relatively fixed or longitudinally movable "tailstock" or support for a rotatably mounted tube of limited

length, and a relatively longitudinally movable or fixed carriage which is so constructed as to correspond at once to both the lathe headstock and toolholder. Thus, if the arrangement is such that the tube is rotated, but is not moved longitudinally with respect to the machine frame, then the toolholder and one of the supports for the tube are moved in unison along the frame, and, of course, in timed relation with respect to the rotary movement, so as to effect the formation of a true helical fin. Or, if the alternative arrangement of lathe operation is employed, then the support for one end of the tube is made to move along the machine bed, while the other support, and the tools for applying the fin to the tube, are relatively stationary.

In either case (generally speaking), the effect obtained is as if the more common type of lathe were set up to operate on a short length of tubing only, and thus higher speeds of operation may be resorted to. Of course, there are still limits upon the length of tubing which can be treated in any given operation,—limits which are imposed by the length of the bed, and by the secondary whipping which tends to develop over long lengths of finned tubing as the movable support and tool holder spread away from each other.

The present invention makes provision to counteract this progressively developed secondary whipping or torsional strain, however, by applying a rotative force to the relatively movable tube support, or "tailstock", and by interposing, as may be required, movable supports at intermediate points along the tube.

Other features for increasing the capacity of a lathe type winding machine, and the means now best known to me for practicing the principles of the invention, will be fully understood from a perusal of the following description of various embodiments, illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevation of one form of the improved machine, showing a movable carriage which includes tube support, fin tools, and solder applicator, with a length of tubing disposed between the carriage and a fixed tailstock;

Fig. 2 is a side elevation of a second embodiment, in which the carriage of Fig. 1 is fixed, and the tailstock is made movable by operation of a feed screw;

Fig. 3 is a side elevation of a third embodiment, in which the carriage of Fig. 1 is made to move towards, rather than away from, the tailstock, thus placing the work under compression instead of tension;

Fig. 4 is an enlarged side elevation of the carriage particularly referred to in connection with the machine of Fig. 1;

Fig. 5 is a fragmentary view from the left of Fig. 4, showing further the construction of the headstock element or tube supporting and rotating means;

Fig. 6 is a more inclusive view from the right of Fig. 4, showing further the fin tool elements and the mode of driving the carriage along the machine frame;

Fig. 7 is a fragmentary section showing in greater detail the connections between the co-operating parts of the carriage and machine frame;

Fig. 8 is a view, partly in side elevation and partly in longitudinal section, of the second tube support or tail stock, showing the means for connecting the tube end thereto and applying driving force;

Fig. 9 is a section, on an enlarged scale, on the line 9-9 of Fig. 1, showing the construction of the solder pot;

Fig. 10 is a section, on an enlarged scale, on the line 10-10 of Fig. 1, showing the construction of the flux pot; and,

Fig. 11 is a perspective illustrating the assembly of the fin on the tube.

The article which is to be made by the machines of the various embodiments is best illustrated in Fig. 11, as comprising a hollow tube T encircled with a helically disposed fin F. Such tubes are useful for heat exchange equipment, wherein the heat transfer through the tube wall is increased by the provision of the outstanding radiating fin. Since the fin is disposed edge-wise, and is made from a strip of flat material, it will be apparent that the winding operation necessarily causes the formation of wrinkles or corrugations transversely of the fin, due to the shortening of the inner edge of the strip. In machines of this type, it is customary to effect some preliminary deformation of the fin stock, just prior to its actual application to the tube, in order to minimize the stresses developed by the winding operation.

In the machine of Fig. 1, the general organization of parts is such that the tube T is rotatably mounted between a tailstock or support S, fixed at one end of the machine, and a movable headstock mounted on a longitudinally movable carriage C, which also may support a reel R of fin ribbon and suitable tools for applying the ribbon to the tube. As the tube revolves, without longitudinal movement, and the carriage travels along the frame, the fin material F is drawn from the reel R and is wound around the tube. Connected to the carriage C may be a solder pot P, so designed as to pour molten solder on the assembled fin and tube as soon as the assembly is effected. As the carriage C reaches the end of its travel, or the left hand end of the machine of Fig. 1, the length of tubing disposed therein is completed, and may then be removed, replaced with a new section, the carriage returned to the right hand end of the machine, and the operations repeated.

With this general explanation of the mode of operation, reference will now be made in greater detail to the construction shown in Fig. 1 and the related views. The machine comprises a horizontal bed 21, mounted on a suitable number of pedestals 22, and formed with spaced side rails 23. A centrally disposed pad 24 formed on the upper portion of the bed receives a rack 25 pro-

viding a driving connection between the bed and the carriage C.

The carriage C, which is best illustrated in Figs. 4, 5, and 6, includes a base portion 27 formed with guides 28 and attached retaining strips 29 which engage the rails 23 of the bed 21. A vertical bracket portion 31 extends upward from the plate 27, and is so formed as to receive and support the various movable elements of the carriage. The upper portion of the bracket 31 is formed with a longitudinally extending bearing 32 which rotatably receives a hollow tube-receiving spindle 33, positioned in the bearing by a thrust washer 34 and a collar 35 engaging the opposite ends of the bearing. The left hand end of the spindle 33 (as viewed in Fig. 4) merges into a rotary collet member 36, so constructed as to engage the tube T to effect the rotation thereof, while permitting relative longitudinal movement.

This mechanism consists of three similar rollers 38 having concave peripheries 39 to fit the tube, which are equally spaced around the collet, as best shown in Fig. 5. Each roller is mounted on a pin 41 disposed between the tines 42 of a forked arm of a bell crank lever 43, which in turn is pivoted, by a pin 44, to a boss 45 formed on the collet face. The opposite arm of each lever 43 is formed with a pocket 46 adapted to receive a spring 47, one end of which bears against the face of the collet 36, and the other end of which bears against an adjustable plug 48 threaded into the outer end of the pocket. The rollers 38 may thus be forced against the tube T to whatever extent is necessary to insure rotation of the tube, but, since rollers are free to revolve on their pins 41, relative longitudinal movement is attainable. In this specification, the term "collet" has been employed to denominate the member which grips the tube to effect the rotary movement thereof, but which also moves lineally of the tube, and the term as used herein will, therefore, be understood with this definition in mind.

The rollers 38 are rotated about the axis of the tube T by gearing motivated by an electric motor 51 which is adjustably secured, by bolts 52, to a table 53 extending from one side of the carriage C. The motor shaft has keyed thereto a pinion 54 meshing with a gear 55 mounted on the vertical bracket 31, which meshes in turn with an idler gear 56 in mesh with a gear 57 keyed to the spindle 33. Operation of the motor 51 therefore causes the rotation of the several gears to revolve the collet 36 and attached rollers 38. The idler gear 56 is mounted on a stud 58 which extends through an arcuate slot 59, formed in the bracket 31, and secured in adjusted position by a nut 61 (see Fig. 6). When it is desired to change the ratio between the speed of rotation of the tube and the lineal speed of the carriage as a whole, the gear 55 is replaced by another gear of appropriate size, the slot 59 permitting the proper meshing of the idler 56 with the gears 55 and 57. It is thus possible to apply windings of various pitches.

The gear 55 is mounted on a stub shaft 60 journaled in a bearing 62 formed on the bracket 31, and projecting through the bracket to receive a worm 63, which serves to transmit motive power from the motor 51 to the carriage C as a whole. Referring particularly to Figs. 6 and 7, it will be observed that the bracket 31 is provided with a pair of aligned bearing bosses 64 and 65, through which extends a transversely disposed hollow 75

shaft 66, receiving further support from end bearings 67 and 68, the latter of which is removably secured to the bracket 31, as indicated by the numeral 69, to facilitate assembly. A pinion 71, keyed to the shaft 66 between the bearings 64 and 65, meshes with the rack 25, and a worm wheel 72 mounted on the shaft 66 between the bearings 65 and 68 engages constantly with the worm 63.

Inasmuch as the carriage C must be able to move either way along the bed 21, and since a permanently fixed connection between the worm wheel 72 and the shaft 66 would prevent such action (due to the irreversibility of standard worm gearing), the worm wheel is releasably engageable with the shaft 66 by means of a clutch connection. To this end, the face of the worm wheel 72 is provided with a clutch disc 73, adapted to cooperate with a movable clutch disc 74, which is splined to the shaft 66, and is constantly urged into engagement with the disc 73 by a spring 76 interposed between the disc 74 and the bearing 68. Disposed within the hollow shaft 66 is a rod 77, one end of which abuts a pin 75 passing through the hub of the disc 74, while the other end protrudes slightly beyond the end of the shaft 66 adjacent the bearing 67.

This end of the shaft is split to receive an operating lever 78, formed with an eccentric boss 79 which receives a pivot pin 81 connecting the lever to the shaft end. When the lever 78 is swung to the position shown in Fig. 7, the cam face of the boss 79 forces the rod inwardly, thereby disengaging the clutch discs 73 and 74. Manual operation of the hand wheel 82, which is secured to the end of the shaft, will then cause the shaft 66 to rotate with the pinion 71 in mesh with the rack 25, to permit reversal of the carriage C, but the worm wheel 72, and hence the collet 36, under such conditions do not revolve. When the lever 78 is thrown to its other position, as shown in Figs. 4 and 6, the spring 76 forces the clutch discs into engagement, and under this condition, power applied through the worm wheel 72, the pinion 71, movement of the carriage C along the bed of the machine frame, and rotation of the collet 36.

As thus far described, it will be understood that, when the clutch is engaged, operation of the motor 51 causes a lineal movement of the carriage C along the bed 21, and therefore along the tube T which is restrained from longitudinal movement by its anchorage in the tailstock S. As the carriage moves along the tube, the collet 36 revolves, and the engagement of the rollers 38 causes the tube T to revolve therewith about its own axis. There are thus established the two concurrent and related motions of translation and rotation which are required to produce helical winding.

As previously noted, there is mounted on the carriage C a reel R containing flat metallic ribbon which is to be worked up into the fin F. This mounting is effected by providing a bracket 85 which is secured to the top of the bracket 31 by a flange 86. The upper end of the bracket 85 receives a trunnion 87 on which the reel R is detachably mounted. It will be observed from Figs. 4 and 6 that the formation of the bracket 85 is such that the reel R is disposed at an angle, to clear other parts of the apparatus during operation. The fin material is guided to the tube by an idler roller 88, mounted on a bracket 89 extending from the vertical bracket 31.

A pair of corrugating rolls, 91 and 92, are mounted on the bracket 89, just below the idler roll 88, on stub shafts 93 and 94. The rolls 91 and 92 are in the general form of partially meshing helical gears, so relieved or tapered that they will form a deeper corrugation at the inner, or tube-contacting portion of the ribbon, than on the outer margin thereof. The helix angle of the teeth of the rolls 91 and 92 is so chosen that the wrinkles or corrugations W also conform in general to the pitch of the helix which is to be formed by the ribbon on the tube, these expediences being resorted to to minimize, as much as possible, the strains which are developed by wrapping the ribbon on edge around the tubing. That is to say, by using a spiral corrugation of varying depth, the ribbon is partially preformed into a curved shape as it approaches the tube T, and thus may be wrapped more readily.

The ribbon F is further guided to the tubing by pairs of angularly disposed rollers 95 and 96, which are rotatably mounted on the ends of brackets 99 secured to the vertical plate 31. As best shown in Fig. 4, the rollers 95 and 96, are slightly spaced to permit the passage of the outer edge of the fin F between the circumferential portions thereof, and are so inclined and located with respect to the tube T, and the pitch of the fin, as to prevent the fin from falling over on its side as it is applied to the tubing.

In the application of the fin ribbon to the tube, the free end of the ribbon is first drawn through the corrugating rollers 91 and 92, and is tacked with solder or otherwise secured to the tubing. Then, as the carriage C is made to move along the tube, and the tube is concurrently rotated, the fin stock is pulled by the rotative force of the tubing from the reel R, and is wrapped therearound in the form of an outstanding helix, whose lead angle is of course determined by the relative speeds of the carriage and the tubing.

It is of course quite apparent that, unless the tube T were held from longitudinal movement, lineal movement of the carriage C would carry the tubing with it. It is therefore necessary to provide the tailstock S, the construction of which is best shown in Fig. 8. A fixed pedestal 101, mounted at the end of the bed 21, is formed at its upper end with a head 102 in which are disposed combined radial and thrust bearings 103 and 104. Rotatably mounted in the bearings is a tube arbor 105, one end of which projects over the end of the rack 25, to receive the end of the tube T, and the other end of which projects beyond the bed 21, to provide for the application of power to the arbor when desired. An internal collet 106 is secured to the tube end of the arbor 105, and is of such size that it may form a plug for the end of the tube T.

This end of the collet 106 is formed with a number of longitudinal slits, so as to be flexible, and it is also formed with a conical bore adapted to receive a conical wedge 107 whose apex is connected to a rod 108 extending through and projecting beyond the arbor 105. This projecting end 109 is threaded for engagement by a hand-wheel 111, mounted on the arbor 105 by means of a groove 112 formed therein and a detent 113. The hand wheel may therefore revolve freely around the arbor, but in so doing, it moves the rod 108 and wedge 107 in one direction or the other, thereby expanding or collapsing the end of the collet 106. When the tube end is fitted over the collapsed collet, operation of the hand wheel causes the wedge to expand the collet with-

in the tube, thereby locking the tube to the arbor, and preventing any movement of the tube along the bed 21 as the carriage C is operated.

With long lengths of tubing, and when the carriage C is remote from the tailstock S, there may be so much torsional strain in the wrapped tube as to interfere with proper operation. Accordingly, means are provided to apply rotative force to the arbor 105 to overcome its inertia. This means comprises a motor 115 mounted on a side bracket 116 secured to the pedestal 101, and connected, through a standard gear reducing mechanism 117, to a drive shaft 118. A pulley 119, formed with a clutch face 121, is rotatably mounted on the shaft 118, but is made to revolve therewith by a clutch plate 122, keyed to the shaft 118, and urged into engagement with the pulley 119 by a spring 123, whose force may be adjusted by the nut 124. Motive power is transmitted from the motor 115 to the arbor 105 by a driving belt 125 encircling the pulley 119 and a pulley 126 secured to the arbor.

Inasmuch as the torsional stress imposed on the arbor is not very great, the motor 115 may be of low power output, and the clutch spring 123 need not be very strong, the purpose of these parts being simply to insure the overcoming of the torsional stress without developing a similar stress by attempting to drive the arbor faster than the tube itself.

Referring now to Fig. 1, it will be apparent that, when the carriage C is close to the tailstock S, as it will be at the beginning of the winding operation, there is a relatively long length of tubing extending along the bed, for which no support has been provided. When the carriage C is greatly spaced from the tailstock, there is an intermediate span of tubing which will also tend to sag. Rotation of such sagging portions tends to develop a whip in the tubing, which interferes with satisfactory operation on relatively long lengths. It will be apparent, of course, that a second tailstock, similar to that just described, can be placed at the extreme left end of the machine, to provide support at the outset of the operation.

However, it is more advantageous to provide traveling supports, or steady rests, which can be spaced along any section of the tube as desired. The present invention proposes the use of overhead rests, which are suspended from channel shaped rails 131 and 132 (see Fig. 6) secured above the machine frame by arms 133 connected to uprights 134. Mounted between the rails 131 and 132 are a number of trolleys 135, consisting of pairs of wheels and downwardly extending tabs 136, from which extend supporting loops of wire 137.

When the tube T is first inserted in the machine, its free end may be supported by as many loops as are necessary, and, as the carriage C moves along the bed 21, these loops are simply removed. As the carriage recedes from the tailstock S, other loops 137 may be engaged around the wrapped tube, the fin of which thereupon acts as a thread to move the trolley along its tracks.

In order to wrap the complete length of tube which is inserted in the machine, a tube having a length less than that of the bed is selected, and a floating mandrel or arbor 141, of the same diameter, is coupled to the free end, by means such as are employed in connection with the arbor 105. This extension member permits the carriage to overrun the end of the tube, so as to

apply the fin wrapping to the entire length thereof. Similarly, the arbor 105 overhangs the rack 25, so that the carriage and tools can move over every portion of the entire tube length.

The fin F may be soldered to the tube T while the work is on the machine, by providing the solder pot P which follows the wrapping. As shown in Figs. 1 and 9, the pot P is secured to a truck 140, on which are mounted rollers 142, 143, and 144, engaging the rails 23. The pot P is not power driven, however, through the rack 25, but may be pushed by hand along after the carriage C, or it may be connected to the carriage by links 145 to be towed thereby like a trailer. In the arrangement shown in Fig. 1, the overhang of the arbor 105 is sufficient to permit the trailer pot P to be moved entirely clear of the rack 25, while the extension mandrel 141 is long enough to permit the solder pot to move over the extreme end of the tube T, with the rollers 38 still engaging the mandrel. If soldering is effected on a separate machine, then of course these parts may be made shorter.

The pot P is actually composed of two pots, one of which, nearer the carriage C, contains flux, while the other contains molten solder to be poured on the tube and fin. The flux pot 147 (Fig. 10) is formed with a cover 148 having a hinged portion 149, and the solder crucible 150 (Fig. 9) is formed with a cover 151 having a hinged portion 152, which is aligned with the hinged portion 149. Both pot and crucible have aligned apertures 153 and 154, respectively, through which the tube T and attached fin F may pass, the cover members preventing splashing of the fluids over the machine or on the workmen.

The flux pot 147, which is simply bolted to the crucible 150, is provided with a clamp 155 within the cavity thereof, which holds a sleeve 156 containing a screw pump 157, the spindle 158 of which extends beyond the cover 148 through a gland 159. Liquid flux forced out of the upper end of the sleeve 156 by rotation of the screw spills into a trough 161, mounted within the pot, for delivery to the tube T, thus wetting the entire tube assembly. The pump 158 is driven by a motor 162, mounted on the casing 148, through a chain 163 extending between the motor shaft and a sprocket 164 secured to the spindle 158.

The solder crucible 150 is shielded by a refractory housing 165, which supports a gas burner 166 serving to keep the solder in a molten condition during the period of operation. The pot 150 is also provided with an internal clamp 167, and a screw pump 168, the spindle 169 of which is driven by a chain 171 extending between the sprocket 164 of the flux pump and a sprocket 172 mounted on the spindle 169. Effluent from the solder pump 168 is delivered to the rotating tube T by a trough 173, to wet the fin and tube and form a bond therebetween. Excess solder, and flux, flow back to the respective baths for recirculation, and the pots may be replenished from time to time as conditions require.

Both troughs 161 and 173 are pivotally mounted on pins 174 and 175 respectively, which project through the pots to receive operating handles 176 and 177. Each trough is also formed, at its inlet end, with a semicircular slot to encircle the upper end of the pump cylinder with which it is associated. When effluent from the pumps is to be kept away from the tube, the handles 176 and 177 are so rotated as to elevate

the discharge ends of the troughs, thus swinging the slotted ends down toward the baths. The pump effluent then simply flows out of the end of the pump casing, and is returned to the bath, and the trough under these conditions forms a shield protecting the tube from liquid.

This feature is particularly useful in the present invention, since the arbor 105 passes through the aligned apertures in the pots when the carriage is at the right hand end of the machine. By rotating the troughs to the shielding, instead of the delivering position, the pumps 156 and 168 may be operated continuously, thus preventing any probability of solder freezing in the pump 168. It will also be observed that the pump glands which fit into the casings 148 and 151 are of greater diameter than the pump screws, and therefore the screws can be withdrawn from the baths during periods of non-use, to prevent corrosion, freezing, or like troubles.

In the form of machine shown in Fig. 2, the carriage C' does not move along the bed 21, but the worm and rack gearing of Fig. 1 is replaced, by standard mechanism, with means for rotating a feed screw 131, one end of which is journaled in the headstock C'. The tailstock S' of Fig. 2 is made movable, by the provision of slides, and is moved lineally by having the screw 181 pass through a nut formed in the body of the tailstock. Thus, in the embodiment of Fig. 2, the tailstock S' moves, pulling the tubing T through the stationary carriage or headstock C'. The fin is wrapped on the tubing in the manner previously described, and therefore further description of structure is deemed unnecessary. This embodiment has the advantage of eliminating flexible conduits which are required with the movable carriage of Fig. 1 to supply electric current to the motors and gas burner.

In both Figs. 1 and 2, as well as Fig. 3, the collet 36 is not shown in detail, but is illustrated as being shielded by a safety housing 182, which reduces the risk of injury to the operator.

Fig. 3 illustrates an arrangement in which the carriage C is again made movable, and the tailstock S is again fixed, but the driving connection is taken through a screw, as in the case of Fig. 2, and the carriage moves toward, instead of away from, the tailstock, as the work progresses. This arrangement has certain advantages when tubes of large diameter are employed. The tubing is placed under compression, instead of tension, as in the case of Fig. 1, and pieces of the finished tubing may be cut off as the wrapping progresses, thus reducing whipping, and permitting higher speeds of rotation during actual operation, with no greater number of shut down periods to insert new lengths of tubing.

From the foregoing description, it is believed that the construction and mode of operation of the machine have been made sufficiently apparent to require no further summation here. It will also be apparent that the present invention, while following the lathe principle of operation heretofore proposed for winding machines of this nature, nevertheless advances practical improvements in such machines, whereby the desired assembly may be effected at higher operating speeds, and therefore lower costs, without resorting to expensive apparatus. The foregoing description of typical embodiments is, of course, intended to be illustrative of, rather than limiting, the principles of the invention, and it is therefore intended to embrace all modifications and variations as may fall within the scope of the following claims.

I claim:

1. A machine for wrapping a helical winding on a tube comprising a machine bed, a pair of supports on said bed for rotatably mounting a tube, means for moving one of said supports longitudinally of the bed with respect to the other of said supports, means for applying power to one of said supports to rotate the tube mounted therein, and means disposed on said power applying support to deliver winding material to the tube.

2. A machine for wrapping a helical winding on a tube comprising a machine bed, a fixed support and a lineally movable support disposed on said bed, means on said supports for rotatably mounting a tube therebetween, means on one of said supports for applying power to the rotatable mounting means thereof to effect the rotation of said tube, means on said last named support for supplying and guiding winding material to said tube, and means operating in timed relation to said tube rotating means to progressively vary the lineal spacing between said supports.

3. A machine for wrapping a helical winding on a tube comprising a machine bed, a tailstock mounted on the bed, said tailstock comprising a rotatable member adapted to engage a tube against relative lineal movement, a headstock mounted on the bed, said headstock comprising rollers adapted to engage the exterior of said tube for relative lineal movement with respect thereto, means for rotating said rollers about the axis of the tube to effect rotation of the tube on its own axis therewith, means on said headstock for guiding wrapping material to the tube, and means operating in timed relation to the rotation of the tailstock, headstock, and tube mounted therebetween to effect a progressive change in the lineal spacing of the headstock and tailstock along the machine bed.

4. A machine for wrapping a helical winding on a tube comprising a machine bed, a headstock and a tailstock mounted on said bed, one of said stocks being relatively fixed and the other of said stocks being relatively movable with respect to each other in a lineal direction along the bed, means on each of said stocks for rotatably mounting a tube for rotation about its own axis, the mounting means of said tailstock securing one end of the tube against relative lineal movement with respect thereto, the mounting means of said headstock being lineally movable with respect to the tube, means for progressively changing the lineal spacing between said headstock and said tailstock, power means acting in timed relation to the change in spacing between the headstock and tailstock for effecting the rotation of the tube supporting means on said headstock, means for supplying wrapping material mounted on the headstock, and guide means to direct such material to the tube.

5. A fin and tube lathe comprising a bed, a tailstock element including a rotatable arbor, means on the arbor for engaging a tube against axial movement with respect thereto, a headstock element including a spindle provided with rotary gripping means for engaging the exterior of the tube, drive means for rotating the spindle and thereby the tube, fin ribbon applying means mounted on the headstock element, one of said elements being relatively fixed and the other of

said elements being relatively movable with respect to the bed, and drive means operating in timed relation to said first named drive means for moving the movable element along the bed.

5 6. A helical winding machine comprising a bed, a pair of tube supporting members on said bed, each of said members being formed with means for rotatably mounting a tube, one of said members being lineally movable with respect to said
10 tube, one of said members being provided with means for applying power to its said rotatable mounting means to effect the rotation of said tube, means on said last named member to apply wrapping material to the tube, and auxiliary
15 power means connected to the other of said rotatable mounting members to prevent the development of torsional strains in the length of tube disposed between said mountings.

7. In combination with a helical winding machine including relatively lineal movable supports for rotatably mounting a length of tubing to be wrapped and means for applying a helical wrapping to the tube, means for supporting portions of the tubing between said supports, said last
20 named means comprising an overhead suspension member, lineally movable means on said suspension member, and loops depending from said lineal movable means adapted to engage the wrapping applied to the tube and to be moved
25 therealong as said tube is rotated by contact with the helix formed by said wrapping.

8. A fin and tube machine comprising a bed, a carriage mounted on said bed for lineal movement with respect thereto, said carriage including an
30 upright bracket member, said bracket being formed with an aperture adapted to permit the movement of a tube therethrough, means disposed on said bracket adapted to engage the exterior of the tube for rotation in unison therewith and
40 for longitudinal movement with respect thereto, gearing on the bracket to effect the rotation of said last named means, and a kinematic connection between said gearing and said bed to move the carriage bodily along the bed in timed relation to the rotation of said tube engaging means.
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9. A fin and tube machine comprising a bed, a carriage mounted on the bed for lineal movement with respect thereto, said carriage comprising a base formed with bed-engaging guides, a vertical
50 bracket on said base, a longitudinally disposed apertured boss formed on said bracket, a hollow spindle rotatably mounted on the boss, an external tube engaging member formed on one end of the spindle, gearing adapted to supply fin stock to the bracket for rotating the spindle, gearing
55 interposed between the bed and the bracket for moving the carriage bodily along the bed, a fin stock reel mounted on the carriage, and fin working tools mounted eccentrically to said spindle at the other end thereof to direct the fin stock to the tube.

10. A fin and tube machine comprising a bed, a carriage movable lineally along the bed, said
60 carriage including a bracket, a bearing boss formed in said bracket, a hollow spindle rotatably mounted on the boss, one end of said spindle terminating in a plate, a plurality of rollers mounted on said plate, said rollers having their axes disposed transversely of the bed, means for urging
70 said rollers toward the axis of the spindle, gearing for rotating said spindle and rollers about the axis of the spindle, gearing for moving the carriage lineally of the bed in timed relation to the speed of rotation of the plate, means for mount-

ing a reel of fin stock, means on the carriage for directing said fin stock from the reel to a tube adapted to be disposed through the hollow spindle, and means fixed to the bed adapted to engage one end of said tube and hold said tube
5 from longitudinal movement.

11. In a fin and tube machine including a bed and a pair of tube supports longitudinally movable with respect to each other along the bed, means on one of said supports for rotatably engaging a tube against lineal movement with respect thereto, and means on the other of said supports for rotatably engaging a tube with longitudinal movement with respect thereto, said last named means comprising a vertical bracket member formed with a longitudinally disposed boss, a hollow spindle journaled in said boss, a rotary plate formed with an aligned aperture at one end of the spindle, a plurality of equally spaced
20 clevises disposed about the face of the plate, bell crank levers pivoted in said clevises, said levers having one arm disposed substantially parallel to the axis of the spindle, tube engaging rollers mounted on said arms, said levers having a second arm disposed substantially parallel to the
25 face of the plate, and springs interposed between the plate and said arms to force said rollers into gripping engagement with a tube disposed through said hollow spindle and the aperture in said plate.

12. A fin and tube machine comprising a bed, a rack secured to the bed, a carriage mounted for lineal movement on the bed above the rack, a vertical bracket on the carriage, a rotary tube gripping member mounted on the bracket, a
35 countershaft mounted on the bracket, gearing extending from the countershaft to said member to effect the rotation thereof, a transverse shaft mounted on the carriage, said transverse shaft carrying a pinion in mesh with said rack, gearing extending from said countershaft to said transverse shaft, whereby rotation of the countershaft causes the lineal movement of the carriage, said last named gearing including a clutch whereby said transverse shaft and pinion may be rotated
45 in a reverse direction without causing the concurrent rotation of the said member.

13. A fin and tube machine comprising a bed, a carriage mounted on said bed for lineal movement with respect thereto, a vertical bracket on the carriage, said bracket being formed with a longitudinal bore receiving a rotatable spindle, a rotary external member secured to the spindle, a countershaft mounted in the bracket, gearing extending between the countershaft and the member, said gearing including an idler gear, said idler being adjustably mounted in a slot formed in said bracket, a transverse shaft mounted on the carriage, a pinion keyed to the transverse shaft, a rack secured to the bed beneath said carriage and in meshing engagement with said pinion, a worm on the countershaft, a worm wheel on the transverse shaft in mesh with the worm, and clutch means on the transverse shaft for engaging and disengaging the driving connection between the
60 worm wheel and said transverse shaft.

14. A fin and tube machine comprising a machine bed, a rack secured to the bed, a carriage mounted on the bed above the rack, a vertical bracket on the carriage, a rotary spindle mounted
70 in said bracket longitudinally of the bed, a plate disposed at one end of the spindle, said plate and spindle being formed with a longitudinal bore to permit the passage of a tube therethrough, tube gripping rollers mounted on said plate for ro-

tation about their own axes, a gear train mounted on the carriage to revolve the spindle and plate, one of said gears being detachable, a second gear train driven by one of said gears in said first
5 named train mounted on said carriage and engaging said rack, said second named gear train including clutch means for interrupting the driving connection between both of said trains, a mounting on said bracket adapted to receive a supply
10 of fin stock, forming rolls mounted on the bracket adapted to crimp the fin stock during passage thereof therethrough, guide rolls mounted on the bracket for directing crimped fin stock to a tube disposed through said spindle, and a rotary arbor
15 secured to said bed and adapted to engage one

end of the tube to restrain said tube from longitudinal movement.

15. In a fin and tube machine wherein a tube wrapped with a helical fin is adapted to be rotated on its own axis during the application of solder
5 to said tube, a pot mounted adjacent said tube, a pump for forcing liquid from said pot, and a trough for directing the liquid from the pump to the tube, said trough being pivotally mounted for
10 rotation into a plane between said pump and tube whereby pump effluent may be diverted from the tube without stopping the pump and said tube may be shielded from said effluent.

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