

June 15, 1954

J. L. GOLDSMITH
FIN FORMING MACHINE

2,680,975

Filed Feb. 24, 1953

2 Sheets-Sheet 1

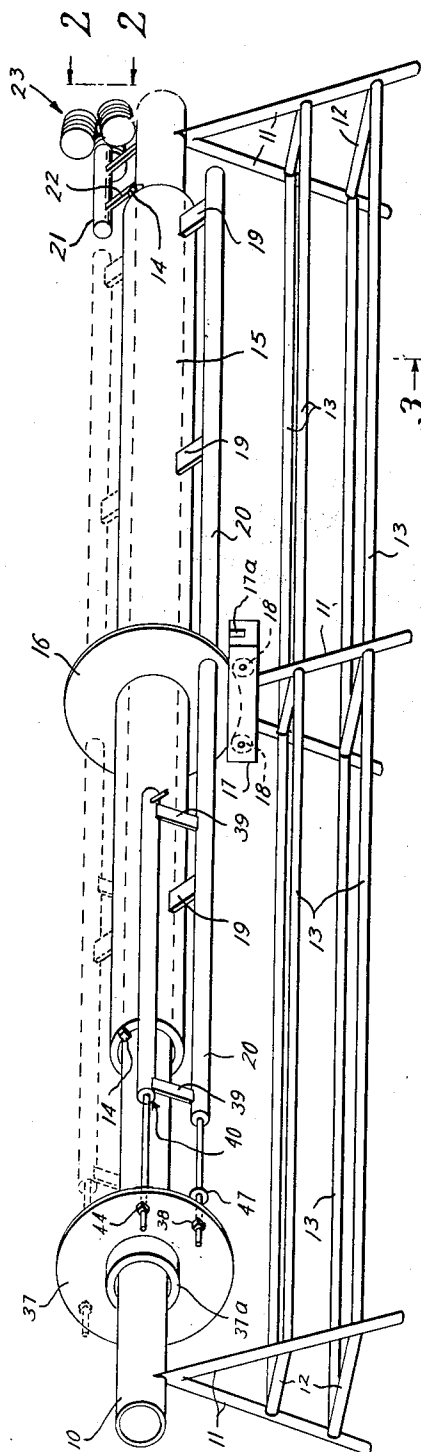


Fig. 1

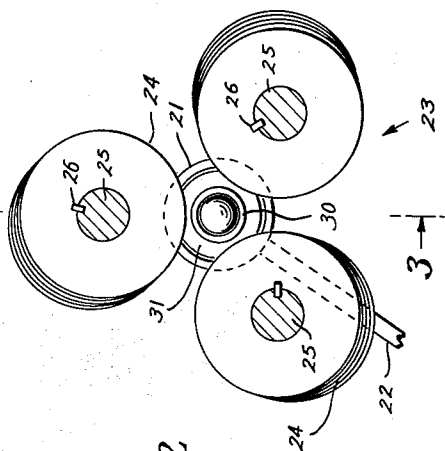


Fig. 2

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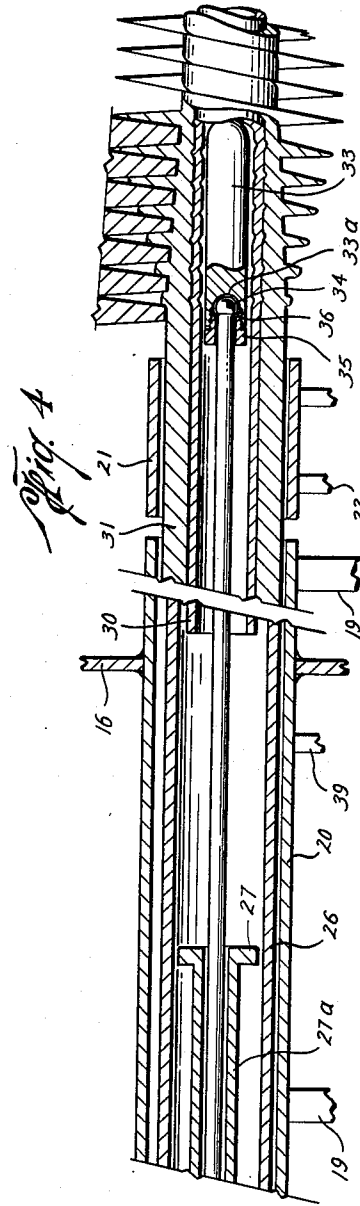
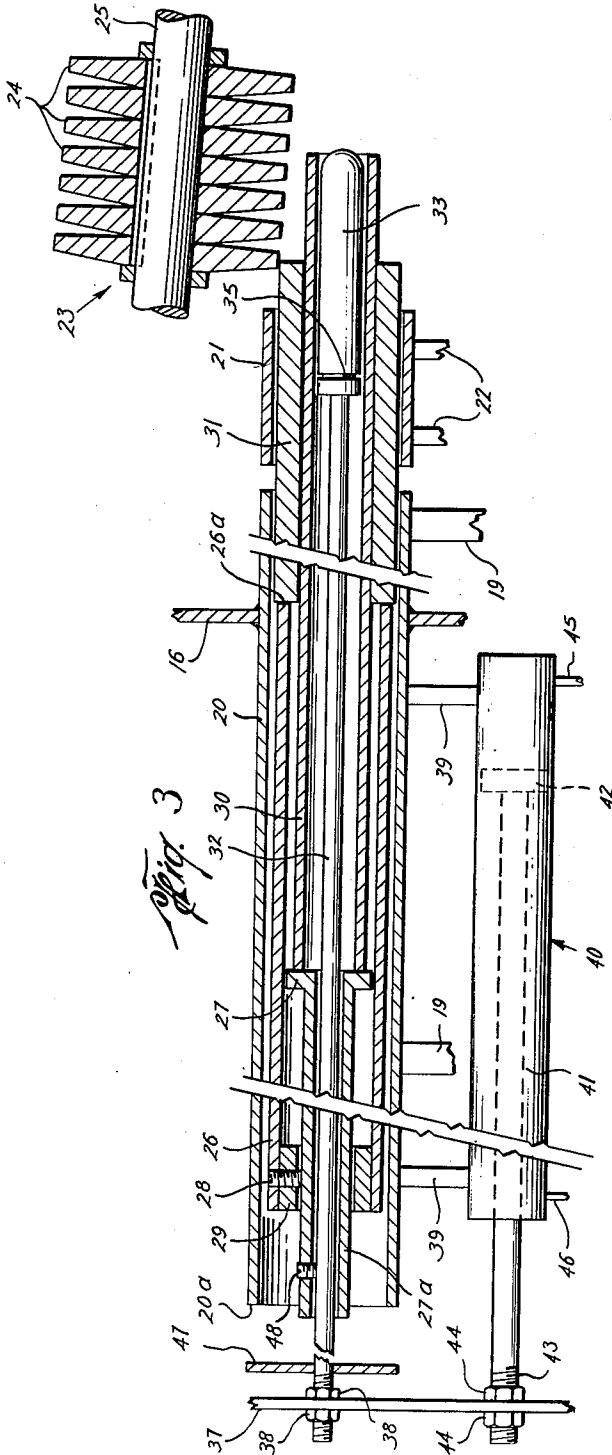
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UNITED STATES PATENT OFFICE

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FIN FORMING MACHINE

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11 Claims. (Cl. 80—13)

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This invention relates to a machine for finning tubes and relates more particularly to a machine for forming a cooling fin on the outer of telescoped tubes.

In the selection of tubes to be used in conducting one fluid in indirect heat exchange relation with another it is often desirable that the tubes be of a corrosion resistant metal to prolong their useful life. It is also desirable that the exterior of the tubes be provided with one or more cooling fins which increase their exposed area and thereby their ability to transfer heat.

Since corrosion resisting tubes are often fabricated of a metal which is not sufficiently ductile to permit a high thin cooling fin to be raised therefrom, it is common practice to telescope a tube of highly ductile material over the corrosion resisting tube and then work the outer tube with a gang of fin forming rolls to raise the desired cooling fin.

During this fin forming operation the outer tube is tightly squeezed about the inner tube and a mechanical bond is formed between the two tubes. This mechanical bond prevents excessive loss of efficiency in transmitting heat between the two tubes. Before this bond is effected the tubes are free to slide along each other and considerable difficulty has been experienced in maintaining the tubes in the desired telescopic relation until a mechanical bond has been effected along a short length of the tubes by the action of the fin forming rolls.

One method of holding the telescoped tubes against sliding along each other until a mechanical bond is formed along a short length of the tubes is to crimp the forward end of the outer tube over the forward end of the inner tube. The telescoped tubes are then introduced between the gang of rolls by applying a force to the rear end of the inner tube.

The relative length of the telescoped tubes is desirably such that the inner tube projects beyond the outer tube at both ends to facilitate installation of the finned tubing in spaced apart tube sheets. When the crimping method is used this projection can be provided at the rear end of the tubes by cutting tubes to a predetermined relative length before finning, but the crimped end of the outer tube must be stripped from the forward end of the finished product to give the desired projection at both ends.

It is an object of this invention to eliminate the necessity for crimping the outer tube over the inner tube and stripping the crimped end of the outer tube from the finned tubing with its resultant waste of time, labor and material.

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Another object of this invention is to provide a machine for forming a cooling fin on the outer of telescoped tubes wherein the tubes are positioned and fed into the fin forming mechanism in a predetermined relative position without crimping the tubes together.

Another object of this invention is to provide a machine for relatively positioning and finning telescoped tubes in which the tubes may be selectively positioned in a plurality of relative longitudinal positions.

Another object of this invention is to provide a machine for relatively positioning and finning telescoped tubes which is capable of producing finished products of various lengths.

Other and further objects will appear from the following description, in which is set forth by way of example one illustrative embodiment of the invention.

In the accompanying drawings wherein like reference numerals indicate like parts:

Fig. 1 is a pictorial view of a machine illustrating one embodiment of this invention;

Fig. 2 is a fragmentary end view on an enlarged scale taken along the line 2—2 of Fig. 1;

Fig. 3 is a view partly in elevation and partly in vertical cross-section with the receiving and aligning means illustrated in alignment with the central axis of the fin forming rolls, only one of which is illustrated, and with the feeder and telescoped tubes shown in the position they occupy on initial engagement of the tubes by the fin forming rolls; and

Fig. 4 is a view similar to Fig. 3 illustrating the position of the parts at a more advanced stage of the fin forming operation.

Referring to the drawings, an elongate cylindrical base member 10 is supported by a frame comprising legs 11 reinforced by cross members 12 and 13.

Rotatably received about the base member 10 and rotatably positioned thereon by guide lugs 14 secured to the member 10 is an elongate cylindrical carrier 15. The inner diameter of carrier 15 and the outer diameter of member 10 are such that carrier 15 fits closely about base member 10 but is free to rotate without binding.

Positioned approximately midway the length of base member 10 is an anti-sag means in the form of a block 17 carried by the frame and a disc 16 concentrically disposed about carrier 15. Block 17 has a groove 17a formed in its upper face adapted to receive disc 16 and cooperate with guide lugs 14 to prevent lengthwise movement of carrier 15. Rollers 18 (shown in dotted lines) are journaled in block 17 so as to be engaged by

disc 16 and provide a rotatable support for carrier 15. This type of support is preferred as it does not interfere with the rotation of carrier 15 about member 10.

A fin forming mechanism for raising a cooling fin on the exterior of the outer telescoped tube is provided by a gang of fin forming rolls 23, each having a plurality of discs 24 keyed to axle 25 by keys 26. The rolls are circumferentially arranged about a common central axis with axles 25 slightly crossed with respect to the central axis so that the discs of the several rolls will track each other in a helical path. The axes of the rolls are also inclined toward the central axis so that the discs take progressively deeper bites in the tube and form a helical fin on the tube as it passes through the fin forming mechanism. It will be understood that the rolls may be arranged so as to form one or more helical fins. The rolls are supported in suitable support structure and rotated by a power means, both of which are omitted from the drawings for the sake of clarity.

A receiving and aligning means for receiving the telescoped tubes and holding them in alignment with the fin forming mechanism is provided by attaching tube receiver 20 to carrier 15 by straps 19. Receiver 20 is arranged parallel to the carrier and the longitudinal axis of the receiver and the central axis of the fin forming mechanism are disposed equidistant from the carrier so that the receiver 20 may be rotated with carrier 15 and brought into register with the central axis of the fin forming mechanism. The rotative positions of receiver 20 are illustrated in Fig. 1. In the solid line position the receiver is out of register with the fin forming mechanism and unfinned telescoped tubes may be inserted in its open end. Receiver 20 can then be rotated to its dotted line position and the tubes moved into the gang of fin forming rolls.

A guide in the form of tubular member 21, secured to base member 10 by straps 22, is positioned between the receiving means and the fin forming mechanism with its axis extending coaxially with the central axis of the fin forming mechanism to insure the alignment of the tubes to be finned with the fin forming mechanism before the finning operation is begun.

Associated with receiver 20 is a feeder for feeding the telescoped tubes from the receiver into the fin forming mechanism. The feeder comprises an engaging means having parts for engaging and pushing each of the telescoped tubes simultaneously and means for moving the engaging means toward the fin forming mechanism.

The engaging means comprises a sleeve 26 having an abutment 26a adapted to engage the outer of the telescoped tubes and a plate 27 slidably received in the sleeve and adapted to abut the inner tube 30. The telescoped tubes are engaged and moved toward the fin forming rolls by sleeve 26 and plate 27 which are spaced along the central axis of the fin forming mechanism at different distances therefrom when the receiver is in register with the central axis of the fin forming mechanism. The relative longitudinal position of abutment 26a and plate 27 will determine the relative position of the ends of the tubes and the tubes will be moved into the fin forming mechanism in this relationship.

The inner of the telescoped tubes desirably projects beyond the outer tube at each end to provide a free section of unfinned tubing to facilitate fastening the tube in a tube sheet or the like. In order that the amount of this projection might

be varied plate 27 is provided with an extension 27a and sleeve 26 is adjustably anchored along this extension by set screw 28 which is threadedly received in sleeve 26 and spacer 29. It will be understood that this adjustment determines the relative position of the forward ends of the telescoped tubes and that the relative position of the rear ends of the tubes will be dependent upon the lengths in which the tubing is cut.

During the fin forming operation the outer tube will elongate slightly and this elongation should be taken into account when cutting the lengths of outer tubing so that both ends of the inner tube will project beyond the ends of the outer tube by whatever distance desired.

In some instances the telescoped tubes are not strong enough to withstand the forces exerted by the fin forming mechanism. To prevent collapse of the tubing by the fin forming mechanism there can be provided, when necessary, a mandrel 33 of slightly smaller diameter than the bore of the inner telescoped tube which is adapted to lie between the finning rolls during the fin forming operation. A mandrel support rod can pass through extension 27a and have formed on one end a ball 34 adapted to fit in socket 33a in mandrel 33, and be secured therein by a nut 35. Nut 35 has a seat surface 36 which complements socket 33a and allows relative rotation between the mandrel support rod 32 and mandrel 33.

It will be appreciated that in a machine such as illustrated in the drawings, it is necessary for the mandrel to be retracted from between the fin forming rolls before the tube receiver can be rotated to an out of the way position for loading. As the engaging means is also retracted in much the same manner the two elements may be advantageously reciprocated together by fastening the engaging means to mandrel support rod 32 and reciprocating the rod.

During the fin forming operation the inner tubing is tightly squeezed about mandrel 33 and some means must be provided to limit the travel of mandrel 33 so that it will remain between the fin forming rolls during the finning cycle. Such a means can be provided by securing a stop 47 to mandrel support rod 32 in a position to engage the end 20a of receiver 20 and prevent further travel of mandrel 33. It will be understood that where the inner tube is strong enough to withstand the action of the finning mechanism without collapsing the mandrel may be omitted.

The engaging means is adjustably anchored along mandrel support rod 32 by set screw 48 to accommodate tubes of different lengths. This adjustment coupled with the adjustment of the relative longitudinal position of sleeve 26 and plate 27 provided by set screw 28 makes possible the production of finned tubing of various lengths with any desired relative longitudinal positioning of the telescoped tubes.

Rod 32 is threaded at its end remote from the finning apparatus and passes through an aperture in collar 37. Nuts 38, one on each side of collar 37, secure the rod 32 to the collar and provide for limited adjustments in the length of rod 32. Collar 37 is provided with a sleeve 37a which slidably embraces base support 10. This tubular extension prevents cocking of collar 37 without interfering with its rotative or sliding movement along base support 10. If desired, a heavy grease may be applied to base support 10 to facilitate sliding of collar 37 therealong.

Suspended from receiver 20 by straps 39 is a pneumatic actuator tube 40. This pneumatic

tube comprises a closed cylindrical tube 41 having a piston 42 slidably received therein. Connecting rod 43, which passes through one end of tube 41, is connected at one end to piston 42 and has a threaded portion at its other end which passes through an aperture in collar 37. Nuts 44 secure the connecting rod 43 to collar 37 and provide for limited adjustment in the effective length of the connecting rod.

Pneumatic tube 40 is provided with conduits 45 and 46 at its respective ends through which a pressure fluid may be supplied from a suitable source, not shown, to actuate piston 42.

During the fin forming operation outer tube 31 is tightly squeezed about inner tube 30 by disc 24 and this mechanical bond between the telescoped tubing is usually sufficient to maintain the relative longitudinal position of the telescoped tubes after they have passed through approximately one-third of the fin forming discs 24. Thus, it is only necessary that sleeve 26 and plate 27 maintain the relative position of the telescoped tubing during the initial stages of the fin forming operation and once the mechanical bond is complete, the movement of the engaging means may be arrested by stop 47 with the engaging means and mandrel in the position shown in Fig. 4.

In operation a pressure fluid is introduced through conduit 45 moving piston 42 and collar 37 to the left as viewed in Fig. 1, carrying sleeve 23 and plate 27 to their fully retracted position. The receiver 20 is then loaded with the unfinned telescoped tubes and rotated into register with guide 21. The pressure is removed from conduit 45 and a pressure fluid applied to conduit 46 to move the piston and collar to the right, and bring the sleeve 26 and plate 27 into engagement with the telescoped tubes and move them into an initial relative position. On continued movement of the piston the telescoped tubes are passed through guide 21 and introduced between the tube finning rolls 23. The pressure against piston 42 is maintained until a mechanical bond between the telescoped tubes has been induced by action of the finning rolls 23. At this point stop 47 will engage receiver 20 to arrest travel of mandrel 33 and the engaging means as illustrated in Fig. 4. After the initial bond between the tubes has been completed and stop 47 engaged by receiver 20, the pressure may be removed from conduit 46 as the engaging means has no further function in the finning cycle.

When the finned tube has been completely ejected from between the rolls 23, pressure may be reapplied through conduit 45 to withdraw the mandrel 33 until it is entirely contained within receiver 20 so that in rotation of the receiver the mandrel will not strike guide 21. Carrier 15 may then be rotated to move receiver 20 into an out of the way position for reloading.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying

drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A machine for raising a fin on the outer of telescoped tubes comprising, a fin forming mechanism, a tube receiver for receiving and aligning with the fin forming mechanism telescoped tubes the outer of which is to be finned, means simultaneously engageable with each of the telescoped tubes to position the ends of the tubes in predetermined initial relation to each other and movable to urge the tubes toward the fin forming mechanism, and means for moving said means toward the fin forming mechanism.

2. A machine for raising a fin on the outer of telescoped tubes comprising, a gang of fin forming rolls circumferentially arranged about a central axis, a tube receiver mounted to align telescoped tubes to be finned with said central axis, engaging means for moving telescoped tubes in said tube receiver longitudinally of said axis toward the rolls and having abutments spaced apart along said axis and at different distances therefrom for respectively engaging the inner and outer telescoped tubes to position the ends of the tubes in predetermined initial relation to each other and means for moving said engaging means toward said rolls.

3. A machine for raising a helical fin on the outer of telescoped tubes, comprising, a gang of fin forming rolls circumferentially arranged about a common central axis, a tube receiver for aligning telescoped tubes therein with said common central axis, engaging means comprising a sleeve and a plate in the sleeve, said sleeve and plate being slidable with respect to the tube receiver, and adapted to respectively engage the outer and inner tubes to axially space their ends apart, and means for moving said engaging means toward the rolls.

4. A machine for raising a helical fin on the outer of telescoped tubes comprising; a fin forming mechanism; receiving means for receiving telescoped tubes and positioning them in alignment with the fin forming mechanism; engaging means comprising a sleeve slidable in the receiving means and a plate in the sleeve, said sleeve and plate providing abutment surfaces adapted to engage the outer and inner tubes respectively to position the ends of the tubes in predetermined relation to each other; a mandrel carried by the engaging means adapted to receive the tubes thereabout; means selectively urging said engaging means and mandrel toward said rolls to introduce said tubes and mandrel therebetween; and stop means preventing travel of said engaging means and mandrel beyond a predetermined position.

5. The machine of claim 4 wherein releasable anchoring means are provided for selectively varying the relative positions of the sleeve, plate, and mandrel along the axis of the sleeve.

6. A machine for finning the outer of telescoped tubes comprising, a fin forming mechanism, a receiving and aligning means for receiving telescoped tubes and holding them in alignment with the fin forming mechanism, and a feeder for feeding the telescoped tubes from the receiving means into said fin forming mechanism, said feeder including parts for engaging and pushing each of the tubes simultaneously toward the finning mechanism, said parts being spaced from each other by an amount such as will position the ends of said tubes in predetermined re-

lation to each other and urge them toward mechanism in such relation.

7. A machine for finning the outer of telescoped tubes comprising, a fin forming mechanism, a receiving and aligning means for receiving telescoped tubes and holding them in alignment with the fin forming mechanism, a feeder for feeding the telescoped tubes from the receiving means into said fin forming mechanism, said feeder comprising an abutment plate and a sleeve slidably surrounding the plate, and releasable means for anchoring the sleeve to the plate whereby the plate may be selectively positioned along the axis of the sleeve to position the tubes in predetermined longitudinal relationship while urging them toward the finning mechanism.

8. A machine for raising a fin on the outer of telescoped tubes comprising, in combination, a gang of fin forming rolls circumferentially disposed about a central axis, a tube receiver, said tube receiver and gang of rolls being movable with respect to each other so that said central axis can be brought into and out of operative alignment with the longitudinal axis of tubes disposed in said tube receiver, engaging means having spaced apart abutments engageable respectively with the inner and outer tubes to position the ends of the tubes in predetermined initial relation to each other and movable to urge the thus engaged tubes toward said gang of rolls, and means for moving said engaging means toward said gang of rolls.

9. A machine for raising a helical fin on the outer of telescoped tubes comprising in combination, a base, a gang of fin forming rolls circumferentially disposed about a central axis, a carrier rotatably mounted on the base, a tube receiver attached to the carrier and adapted to be selectively rotated to align tubes therein with said central axis, engaging means slidable with

respect to the receiver and engageable with each of the tubes to position their ends in predetermined initial relation to each other and movable to urge the tubes thus engaged toward the gang of rolls, and means for moving said engaging means toward said rolls.

10. A machine for raising a helical fin on the outer of telescoped tubes comprising, an elongate base, a gang of fin forming rolls circumferentially disposed about a common central axis, a carrier rotatably mounted on said base, a tube receiver attached to the carrier and rotatable with the carrier to operatively align tubes in said tube receiver with said central axis, engaging means comprising a sleeve and a plate in the sleeve adapted to engage the outer and inner telescoped tubes respectively to position the ends of the tubes in predetermined initial relation to each other, and means urging the engaging means toward the rolls to introduce the workpieces therebetween.

11. A machine for raising a helical fin on the outer of telescoped tubes comprising; an elongate base, a gang of fin forming rolls circumferentially disposed about a common central axis; a carrier rotatably mounted on said base; a tube receiver attached to the carrier and rotatable therewith to operatively align telescoped tubes in said receiver with said central axis; engaging means for tubes in said receiver comprising a sleeve and a plate in the sleeve, the sleeve and plate being engageable with the ends of outer and inner tubes respectively; a mandrel carried by the engaging means adapted to receive the tubes thereabout; means selectively urging said engaging means and mandrel toward said rolls to introduce said tubes and mandrel therebetween; and stop means preventing travel of said engaging means and mandrel beyond a predetermined position.

No references cited.