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Cauffiel

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[54] **TAPERED POLE CONSTRUCTION AND MANUFACTURE OF SAME**

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[52] **U.S. Cl.** **29/477.3,** 29/477.7, 29/481, 52/720, 138/156

[51] **Int. Cl.** **B23k 31/06**

[58] **Field of Search** 52/736, 734, 720, 52/108; 138/154, 144, 150, 129; 72/135, 49; 29/477.3

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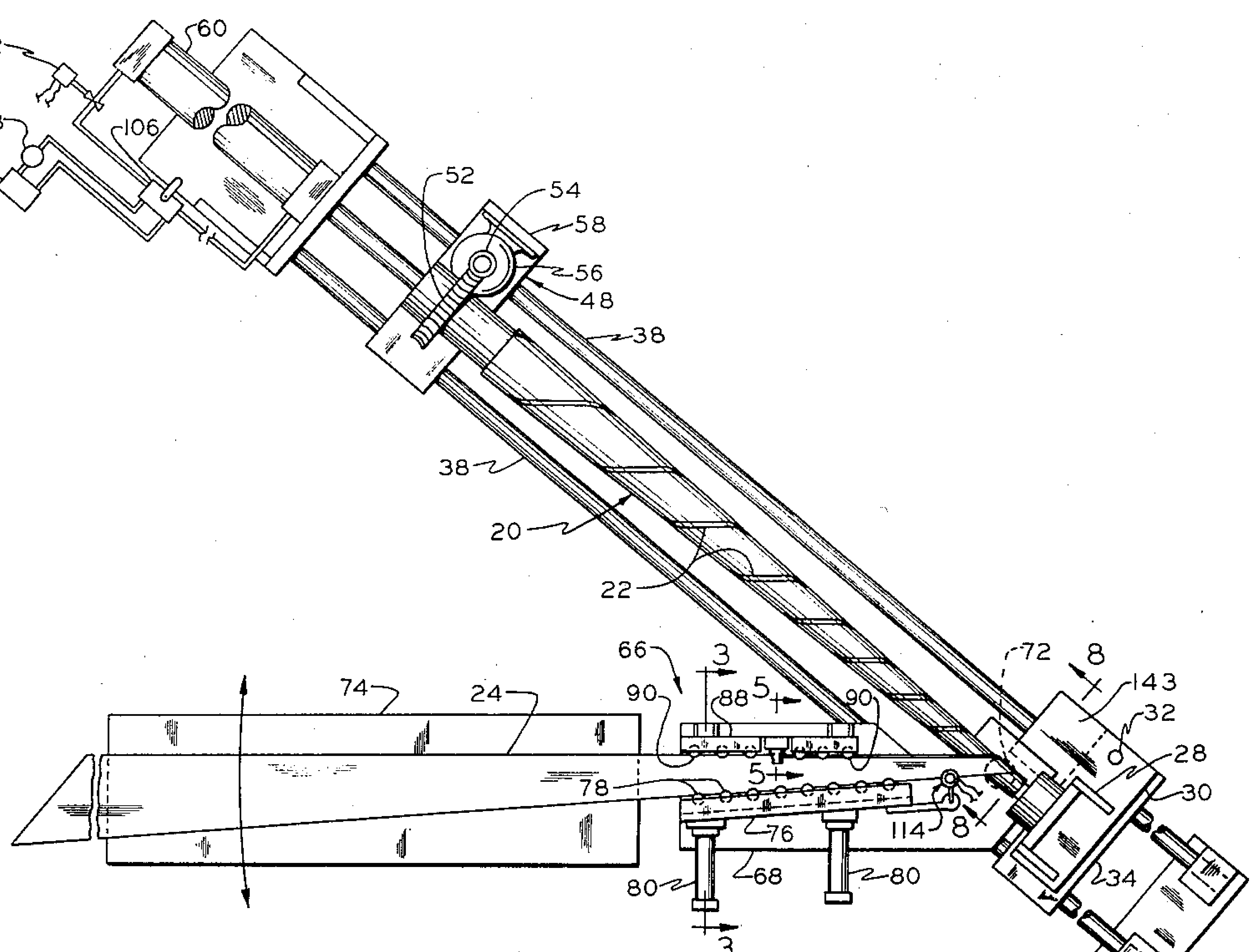
[57] **ABSTRACT**

A tapered pole construction and apparatus for making same are provided. The tapered pole is made from a spirally wound strip of tapered configuration and, in a preferred form, the strip has an offset, welded lap seam. The pole also can be made of tapered metal strips, joined end-to-end, of different gauges so that lighter gauge strips are used toward the top of the pole and heavier gauge toward the bottom. The apparatus for making the tapered poles includes a tapered mandrel having a spiral groove therein which receives the flat overlapped, offset welded joint. The mandrel is rotated in one direction as the strip is wound thereon and, when the pole is completed, the mandrel can be rotated in the opposite direction with the pole held stationary so that the pole can be unscrewed from the mandrel for easy removal. The apparatus includes sensing means for sensing one edge of the strip being wound onto the mandrel with the sensing means operating drive means for the mandrel to advance it at a desired rate.

2 Claims, 14 Drawing Figures



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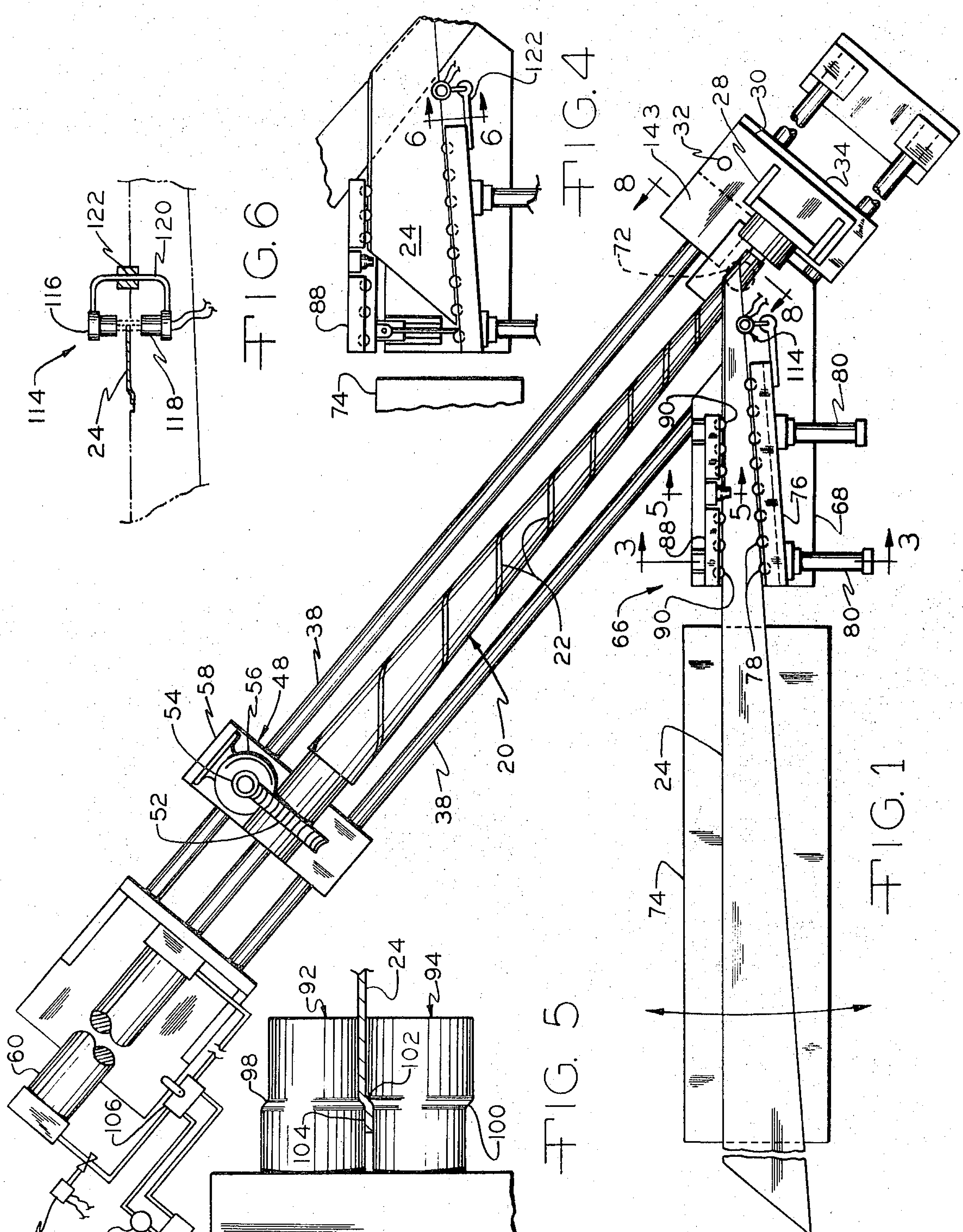

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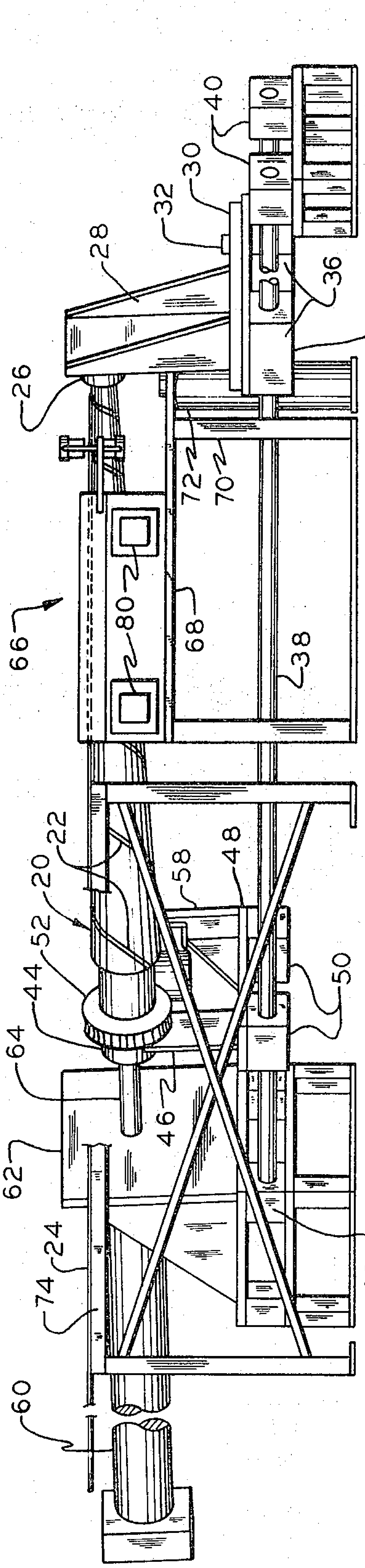

FIG. 2

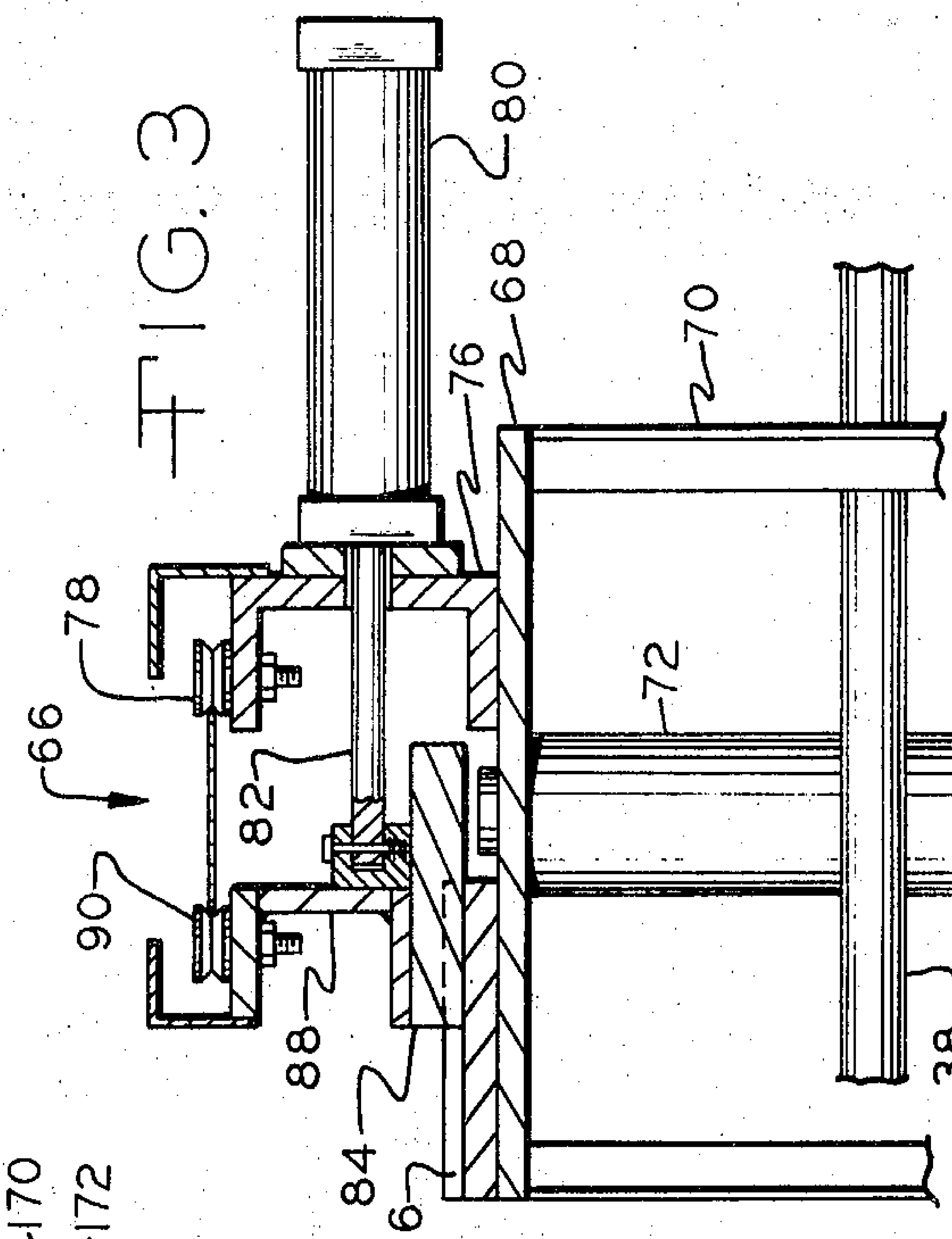

FIG. 3

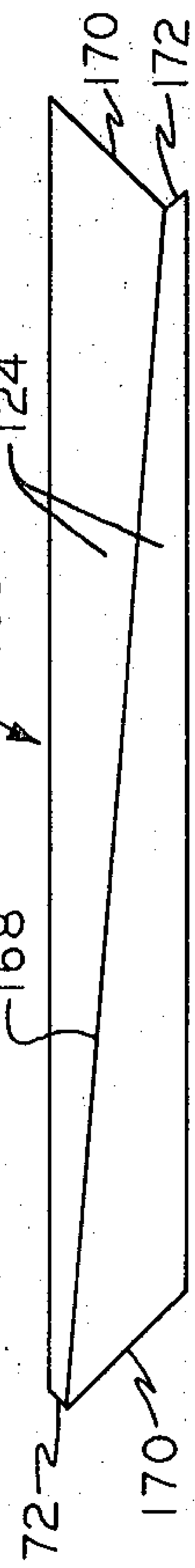

FIG. 12

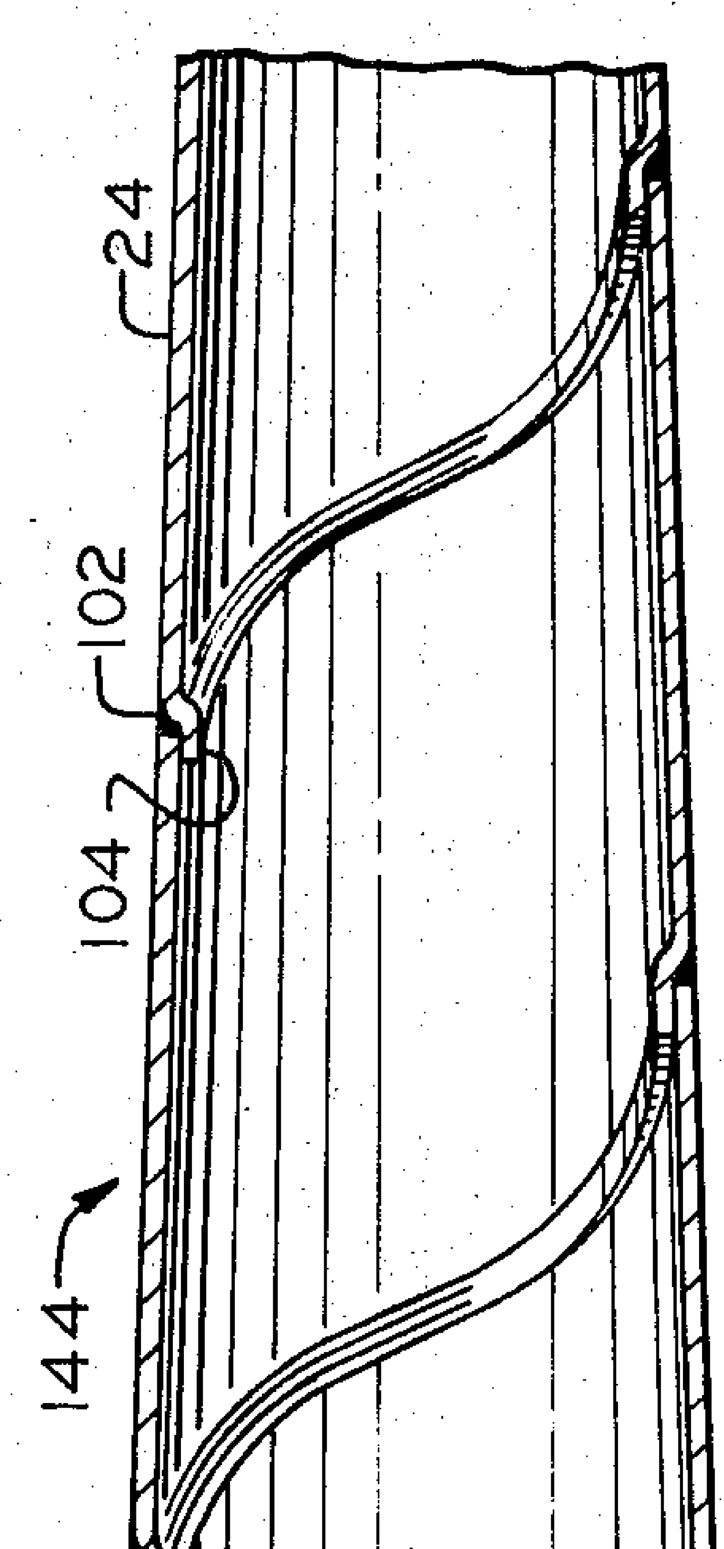

FIG. 11

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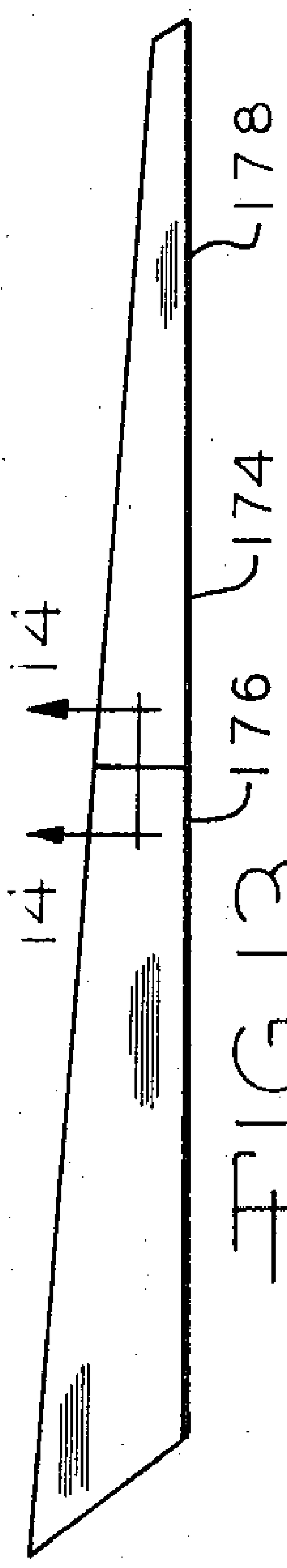

FIG. 13

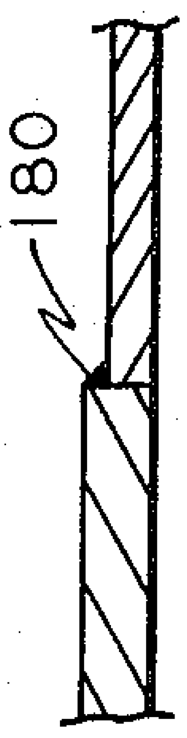

FIG. 14

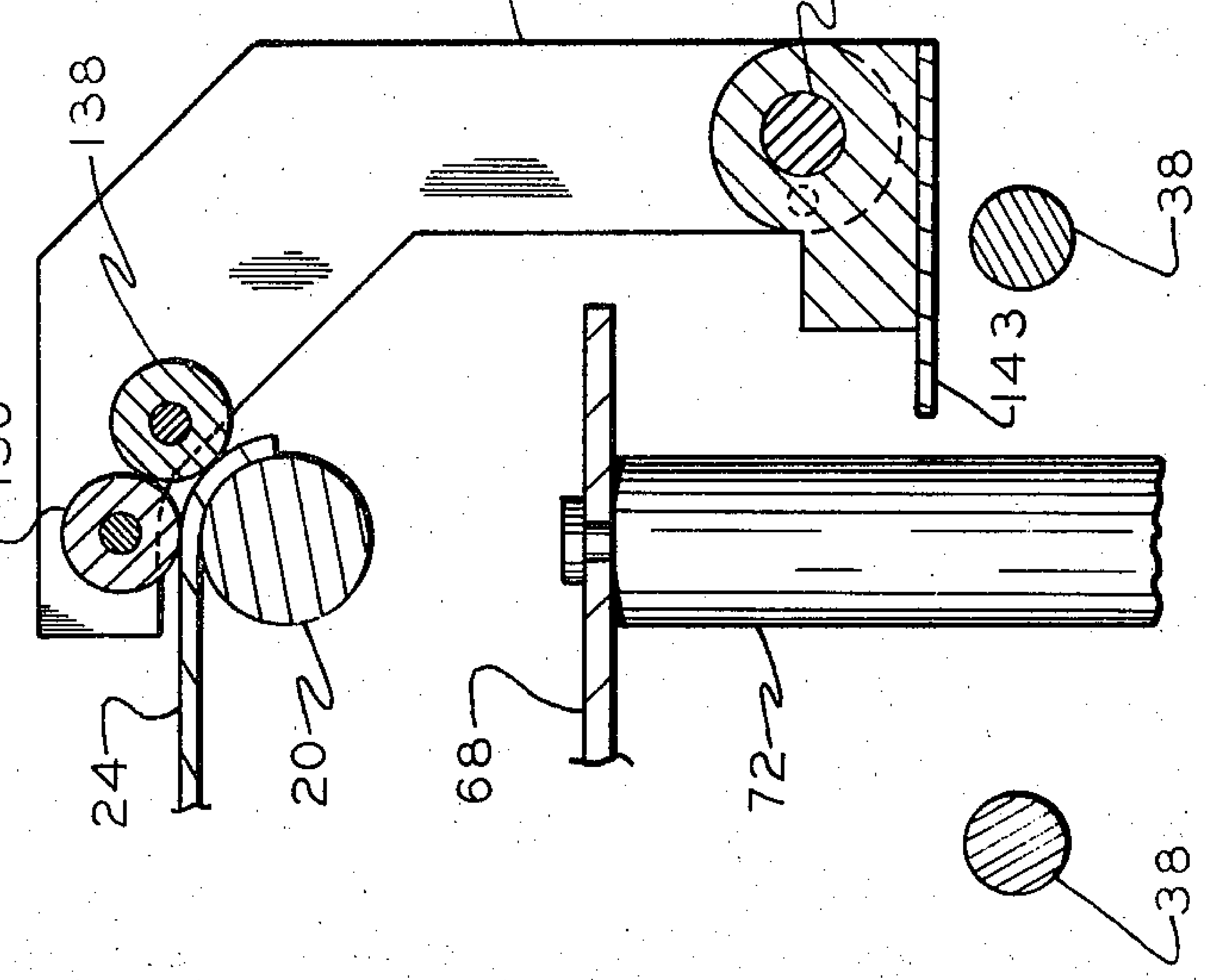

FIG. 8

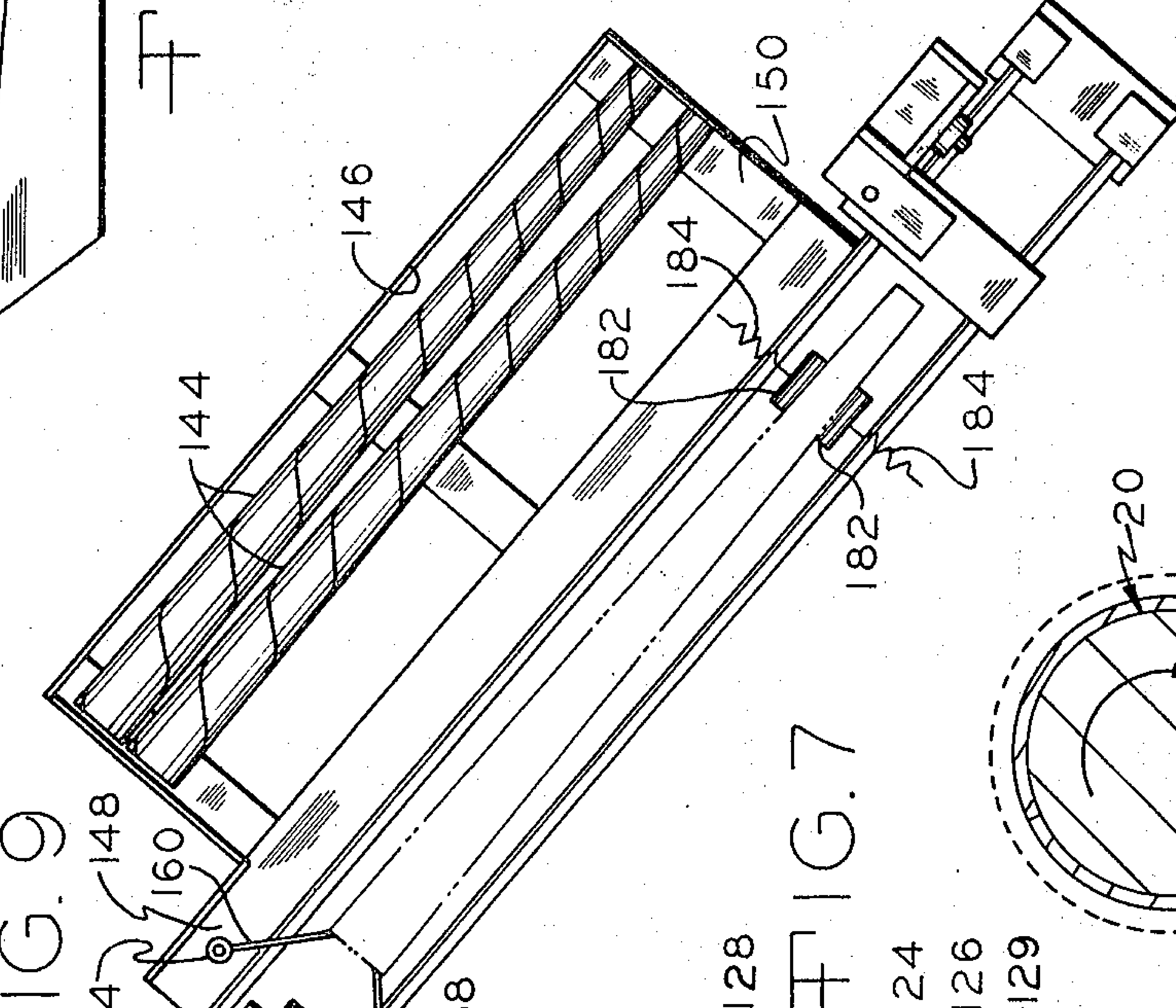

FIG. 9

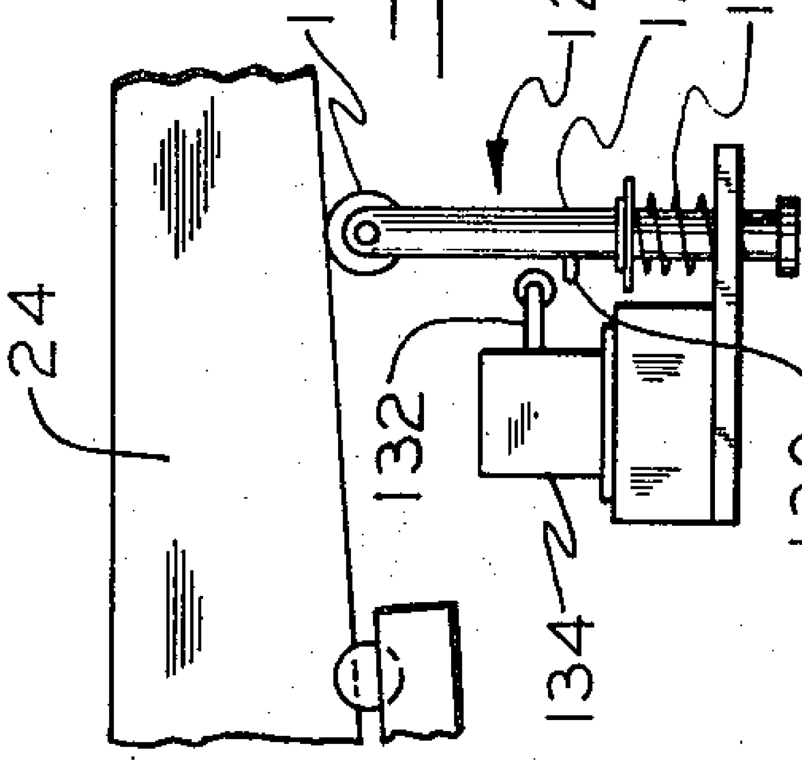

FIG. 7

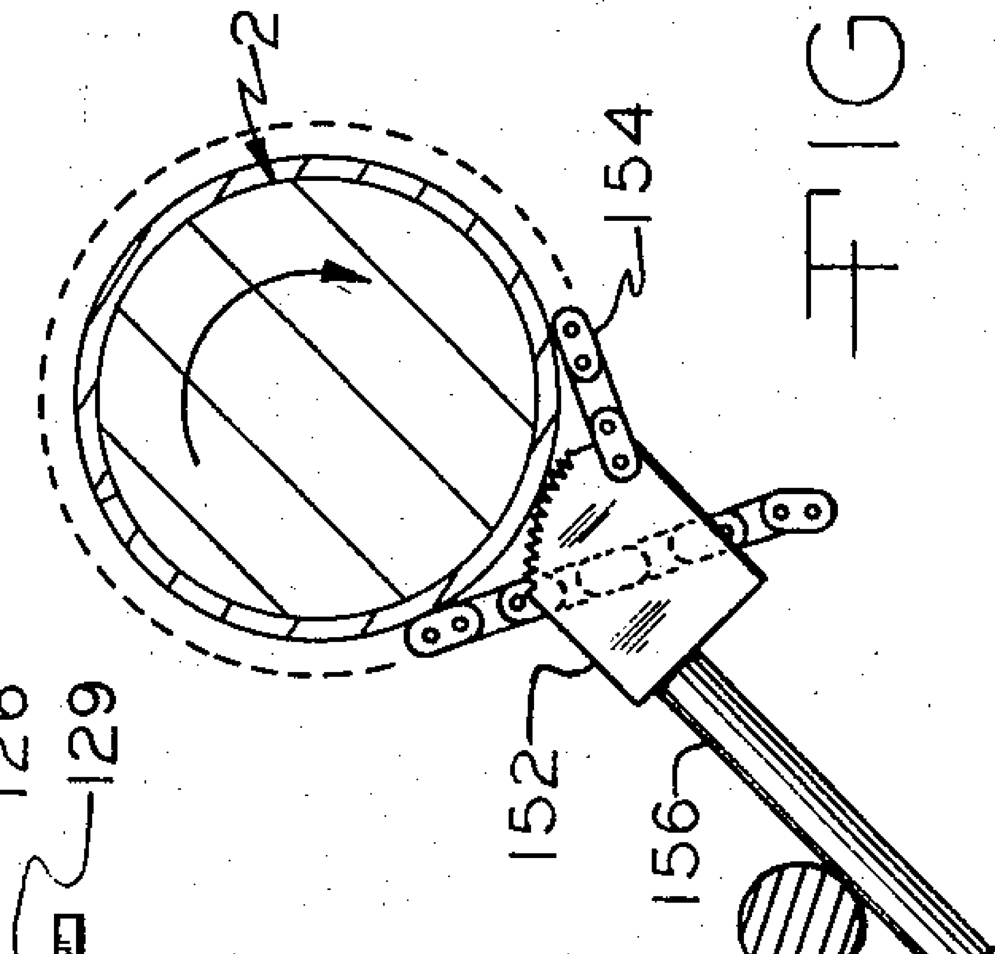

FIG. 10

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TAPERED POLE CONSTRUCTION AND MANUFACTURE OF SAME

This invention relates to a tapered pole construction and to apparatus for making same.

Metal poles of the type used for street lights, by way of example, are often made from nested cylindrical tubes or pipes of varying diameter which nest within one another and are welded togehter. The techniques heretofore known for making tapered poles or tubes are relatively slow and expensive, use more metal than is necessary, and also require machinery which is costly and which consumes considerable floor space.

The present invention provides a tapered pole made from a spirally-wound, tapered strip of metal which preferably is offset at its edges to provide an overlapping seam which is welded as the strip is wound onto a mandrel. The mandrel is advanced in a generally longitudinal direction by sensing means which sesnes the position of the strip being wound thereon. The overlapping seam of the pole projects inwardly and the mandrel has a spiral groove on which the seam is received. When the pole is completely fabricated and it is to be removed from the mandrel, the pole can be held in place while the rotation of the mandrel is reversed, to cause the pole to unscrew, in effect, from the mandrel and render it relatively easy to take off.

The tube can be made from several strips of metal of different thicknesses or gauge which are butt-welded in end-to-end relationship. The thinner gauge strip is used toward the top of the pole and the thicker toward the bottom. This enables the proper amount of metal to be placed where needed for strength.

It is, therefore, a principal object of the invention to provide apparatus for making tapered poles which apparatus is less expensive and requires less floor space than apparatus heretofore known.

Another object of the invention is to provide apparatus for making tapered poles which includes a mandrel, means for advancing the mandrel, and sensing means responsive to the strip position for controlling the advancement.

A further object of the invention is to provide apparatus for making a tapered pole with an overlapping seam, which apparatus includes a mandrel having a spiral groove therein in which the seam is received.

Yet another object of the invention is to provide an improved tapered pole construction having overlapping welded seams and which can be made of tapered strips of metal of different thicknesses.

Other objects and advantages of the invention will be apparent from the following detailed description of preferred embodiments thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a somewhat schematic, overall plan view of apparatus for making tapered poles according to the invention;

FIG. 2 is a somewhat schematic front view in elevation of the apparatus of FIG. 1;

FIG. 3 is a view in transverse cross section taken along the line 3—3 of FIG. 1 and showing guide means for a tapered strip;

FIG. 4 is a plan view of the guide means of FIG. 3, showing the strip in a different position;

FIG. 5 is a view in transverse cross section, taken along line 5—5 of FIG. 1, of offset rollers forming an offset in the strip for an overlapping seam;

FIG. 6 is a somewhat schematic view of a sensing device for the strip being wound on the mandrel, taken along the line 6-6 of FIG. 4;

FIG. 7 is a schematic plan view of an alternate sensing device for sensing the position of the strip being wound on the mandrel;

FIG. 8 is a view in corss section, showing in particular rollers for initiating winding of the strip on the mandrel;

FIG. 9 is a somewhat schematic, plan view of the pole-forming apparatus beyond the guide means, where the finished poles are removed from the mandrel and temporarily stored;

FIG. 10 is a schematic view of apparatus for engaging and holding a finished pole while the mandrel is rotated in reverse;

FIG. 11 is an enlarged, fragmentary view in longitudinal cross section of a finished tapered pole made with the apparatus of FIGS. 1—9;

FIG. 12 is a plan view of a blank from which two tapered strips can be cut for making tapered poles;

FIG. 13 is a plan view of a modified strip for making a tapered pole of varying thickness; and

FIG. 14 is a schematic, fragmentary view in cross section, taken along the line 14—14 of FIG. 13.

Referring particularly to FIGS. 1 and 2, a mandrel 20 has a spiral groove 22 formed thereon with the spacing of the groove corresponding with the width of a tapered metal strip 24 which is wound on the mandrel. The leading, smaller end of the mandrel 20 is rotatably held by a bearing 26 mounted on a stand 28 which, in turn, is located on a platform 30 pivotally mounted by a pin 32 on a base 34. The base 34 has sleeve bearings 36 mounted on guide rods or ways 38. These, in turn, are held by blocks 40 at the discharge end and by blocks 42 at the drive end.

The larger or base end of the mandrel 20 is rotatably mounted in a bearing 44 located on a stand 46 which is supported on a base 48 also having bearings 50 mounted on the ways 38. A ring gear 52 is concentrically affixed to the mandrel 20 at the base end and is engaged by a worm 54 (FIG. 1) driven by a motor 56 which is mounted on a plate 58 extending upwardly from the base 48. The motor 56 thereby travels with the gears 54 and 52 and the mandrel 20 during movement along the ways 38.

The mandrel 20 can be advanced or driven along the ways 38 by a fluid-operated cylinder 60 having the rod end affixed to a stationary framework 62 above the blocks 42. The cylinder 60 has a piston rod 64 which is connected with the mandrel 20 near the bearing 44 to cause the mandrel 20 to advance, along with the bases 34 and 48 and the related components.

The bearings 26 and 44 are positioned so that the upper extremity of the mandrel 20 lies horizontally, with the longitudinal axis of the mandrel 20, the axis of rotation, actually being at an angle to the horizontal. This is important in enabling the strip 24 fed onto the mandrel 20 to lie in a horizontal plane and not twist as it moves onto the mandrel. Additionally, the upper extremity of the mandrel 20, along the line whre the strip 24 moves tangentially onto the mandrel, remains in a constant horizontal plane, with the upper extremity of the mandrel 20 and the strip 24 thereby always being in a common, horizontal plane. Thus, the strip 24 remains in a constant plane for all positions of the mandrel 20.

Guide means indicated at **66** for the strip **24** are mounted on a platform **68** which is supported on a framework **70** (FIGS. **2** and **3**) with the entire platform **68** being pivoted about a pin or cylinder **72**, which is located directly below the axis of the mandrel **20.** With this arrangement, the entire platform **68** can be pivoted, along with the strip **24,** to change the angle of the strip **24** relative to the mandrel **20,** preferably before the strip is fed onto the mandrel. The framework **70** can be slidably mounted on the floor or can be mounted on casters or other suitable means for this purpose. During such pivotal movement, the strip **24** can simply slide back and forth on a supporting table **74.**

The guide means **66** includes a supporting frame **76** which is affixed to the platform **68** and carries a plurality of first, grooved rollers **78** mounted thereon in a row. The rollers **78** are thereby located in fixed positions and provide a fixed guide line for one edge of the strip **24.** As shown particularly in FIG. **3,** fluid operated cylinders **80** are mounted on the supporting frame **76** and have piston rods **82** extending therethrough and pivotally connected to slides **84.** The slides **84** are engaged in guide blocks or ways **86** for lineal movement parallel to the piston rods **82.** A supporting frame or channel **88** is mounted on the slide blocks **84** and carries rollers **90** in a row thereon. The fluid-operated cylinders **80,** in this instance, are supplied with a constant amount of pressure on the rod sides of the pistons to urge the rollers **90** toward the rollers **78** and thereby maintain the strip **24** in engagement with the fixed rollers **78.**

A pair of pinch or offset rolls **92** and **94** (FIG. **5**) are supported by a drive housing **96** which is also mounted on the frame **88** between two groups of the rollers **90.** The upper roll **92** has an outwardly facing, offset **98** therein and the lower roll **94** has an inwardly facing offset **100,** the two cooperating to produce an offset **102** and a lip **104** on the strip **24.** Both of the rolls **92** and **94** can be driven to produce the offset initially in the strip as it is fed toward the mandrel **20,** before and during forming the first wrap thereon.

As the strip **24** is wound onto the mandrel **20,** the offset lip **104** is received in the groove **22,** with the other edge of the next wrap of the strip **24** then being received over the lip **104** to provide an overlapping seam. This seam is then welded at the point designated X in FIG. **1,** no welding apparatus being shown for clarity of illustration. The specific type of welding employed with the apparatus according to the invention does not specifically constitute part of the invention, but a high-speed welding technique is desired since a substantial length of weld is required for each of the poles which are fabricated. Resistance welding can be employed with the overlapping seam or high-speed radio frequency welding can be used, particularly if the edges of the adjacent wraps of the strip **24** are in abutting relationship.

The mandrel **20** can be advanced by the cylinder **60** through suitable controls. As shown schematically in FIG. **1,** a four-way valve **106** controls the supply of fluid to the blind and rod ends of the cylinder **60.** In one position, the valve **106,** which can be manually or automatically operated, supplies fluid from a pump or source **108** to the blind end of the cylinder and returns it from the rod end to a reservoir **110.** In a second position of the valve **106,** the fluid is supplied from the source **108** to the rod end of the cylinder and is returned from the blind end to the reservoir **110.**

When the valve **106** is in the first position, the fluid to the blind end of the cylinder **60** can be controlled by a solenoid-operated valve **112.** The valve **112** can be incrementally opened and closed to slowly advance the mandrel **20.** Sensing means can be employed with the strip **24** to determine when the valve **112** should be opened and the mandrel **20** advanced. One sensing means or device **114** (FIGS. **1, 2, 4,** and **5**) includes an electric eye or sending unit **116** positioned above an edge of the strip **24** and a receiving unit **118** positioned below the strip **24.** The units **116** and **118** are mounted on a bracket **120** carried by an arm **122** which is affixed to the stationary frame **76** for the stationary rolls **78.**

The receiving unit **118** of the sensing device **114** is adjusted so that when it receives a predetermined amount of light from the sending unit **116,** it actuates the solenoid valve **112** to open the corresponding fluid line and supply fluid to the blind end of the cylinder **60.** This causes the mandrel **20** to be advanced. When the mandrel **20** advances, it moves the strip **24** forwardly and moves the edge thereof further between the sending and receiving units **116** and **118.** This reduces the light transmitted to the receiving unit **118** and causes it to close the vavle **112.** The mandrel **20** is being continuously rotated so that as the mandrel is stopped in its longitudinal motion, the strip **24** continues to be wrapped therearound and the offset lip **104** tracks into the groove **22** with the straight edge of the strip abutting the offset **102** of the previous wrap of strip. Hence, as the mandrel **20** is rotated and the strip tracked in this manner, it tends to move away from the sensing device **114** and again the receiving unit **118** receives more light and operates the valve **112** to advance the mandrel **20** by means of the cylinder **60.** Thus, the mandrel **20** moves forward incrementally bo assure that the strip **24** always tracks properly onto the mandrel with the offset lip **104** in the groove **22.**

Another example of a sensing device is indicated at **124** in FIG. **7.** This device includes a feeler arm **126** with a roller **128** at the outer end engaging the edge of the strip **124** opposite the offset edge. The arm **126** is urged outwardly by a spring **129** maintained in compression. The arm **126** has a projection **130** thereon which engages a lever **132** of a limit switch **134.** When the mandrel **20** is stationary and the strip **24** tends to move or bend away from the arm **126,** the arm is moved outwardly by the spring **129,** causing the projection **130** to engage the limit switch lever **132** and open the solenoid-operated valve **112** to supply fluid to the blind end of the cylinder **60** and advance the mandrel **20.** Other sensing devices can also be used. For example, a proximity sensor can be employed at the same position as the sensing devices **114** and **124.** In this instance, the proximity sensing device can operate an infinitely variable valve which can slowly bleed more fluid to the blind end of the cylinder to slowly but constantly move the piston thereof forwardly and accordingly move the mandrel.

When a strip is first fed onto the mandrel **20,** it must be bent in a manner to wind around the mandrel **20** until at least one wrap is completed and the overlapped or abutting edges of the strip can then be welded. In that instance, the strip will then continue to follow around the mandrel without any bending apparatus being required. To initiate the first warp of the strip **24,** however, two pressure rollers **136** and **138** (FIG. **8**) can be located adjacent the samll end of the mandrel **20** for the first wrap of the strip thereon. The rollers are positioned to bend the initial part of the strip **24** sufficiently that it will follow around the mandrel. The pressure rollers are mounted on an arm **140** which is pivoted by a pin **142** to a portion **143** of the base **34.** Once the strip is fully wrapped around the mandrel, the arm **140** can be swung out of the way and the welder moved into position to initiate the welding of the adjacent strip portions.

Referring to FIG. **9,** when poles **144** are completed, being fully wound and welded, the mandrel **20** is advanced slightly farther until it is in alignment with a storage bin **146.** The mandrel is then retracted with the pole left in position to roll down an unloading table **148** and ramps **150** to the storage position, as shown. This storage position is only slightly beyond the point of intersection of the mandrel and the strip **24** so that the overall floor space for the equipment can be held to a minimum.

With the pole **144** having overlapping welded seams, and with the offset lips **104** in the groove **22** of the mandrel, the completed pole can be relatively easily removed from the mandrel by holding the pole stationary while the mandrel **20** is reversed in direction. This, in effect, unscrews the pole from the mandrel due to the cooperation of the offset lip **104** and the groove **22.** One way of engaging and holding the pole stationary is shown in FIG. **10.** Here, a chain-type of wrench is shown which is similar to a commercially-available tool, but larger. A toothed body **152** has a chain **154** pivoted thereto with the other end of the chain wrapped around the pole and engaged in a trough in the body **152,** as is known in the art. A handle or rod **156** extending from the body holds the tool stationary while the mandrel is rotated.

Antoher means of removing the pole **144** from the mandrel **20** is shown schematically in FIG. **9.** Here, a pair of spring-loaded bars **158** and **160** are resiliently urged toward the mandrel by coil springs **162** and **164** and when they engage the mandrel behind the base edge of the pole, they push the pole off the mandrel as it is retracted.

Referring to FIG. **12,** two appropriate ones of the strips **24** can be made from a single blank **166.** This is cut diagonally on a line **168** with the ends of the strips also cut on appropriate angles, indicated at **170** and **172.** This provides maximum utilization of the metal for the poles.

The tapered poles also can be made of several strips of metal of different gauge with the thicker gauge being used toward the base of the pole and the thinner toward the top. Thus, the thicker metal is utilized where the greater strength is needed. A strip **174** of this nature is shown in FIGS. **13** and **14.** Here, a thicker gauge strip part **176** is located at the wider end of the overall strip which will form the base of the pole, and a thinner gauge strip part **178** is used for the upper part of the pole. The two strip parts are butt-welded in end-to-end relationship at **180** to form a continuous strip which is subsequently wound around the mandrel to form the pole, substantially as before.

After the tapered pole **144** is completed on the mandrel **20,** the motor **56** can be rotated at a higher rate of speed. Pressure rolls **182,** shown schematically in FIG. **7,** can then be brought into engagement with the pole, being backed by springs **184,** also shown schematically. Hydraulic pressure cylinders can be used in place of the springs. The pressure rolls are moved longitudinally of the pole **144** as the pole is rotated to cold work the outer surface of the strip **24** and further increase the tensile strength thereof as well as straighten the pole. The resulting pole is thereby stiffer and straighter than it would otherwise be. Also, with the motor **56** rotating at the higher speed, the weld at the adjacent edges of the strip can be shaved to enhance the appearance of the pole. This step can be taken whether or not the cold working strip is used.

Various modifications of the above described embodiments of the invention will be apparent to those skilled in the art and it is to be understood that such modifications can be made without departing from the scope of the invention, if they are within the spirit and the tenor of the accompanying claims.

I claim:

1. A method of making a tapered, tubular pole comprising providing a tapered mandrel, rotatably supporting both ends of said mandrel, positioning said mandrel with the upper extremity in a horizontal position, rotating said mandrel at a predetermined rate, forming a first, pre-cut, tapered strip of metal, forming a second, pre-cut, tapered strip of metal and affixing a narrower end of said second strip to a wider end of said first strip, advancing the narrow end of said first strip onto an end portion of said mandrel, applying opposed forces to said strips as they are being wound on the mandrel, forming the pre-cut, tapered strips into a helical coil on said mandrel with longitudinal edges thereof lying in adjacent relationship, welding all of the adjacent edges of both of said strips together while on the mandrel and while the mandrel is rotating with the coil still being formed, and removing projecting portions of the weld metal at said adjacent edges of said strips to smooth the outer surface of the pole.

2. The method according to claim **1** characterized by guiding said strips relative to said mandrel to place adjacent edges of said strip in contiguous relationship.

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