Feb. 15, 1927. 1,617,583

J. FENTRESS ET AL

METHOD OF AND MACHINE FOR MANUFACTURING SPIRAL METAL TUBES

Filed May 3, 1926 2 Sheets-Sheet 1

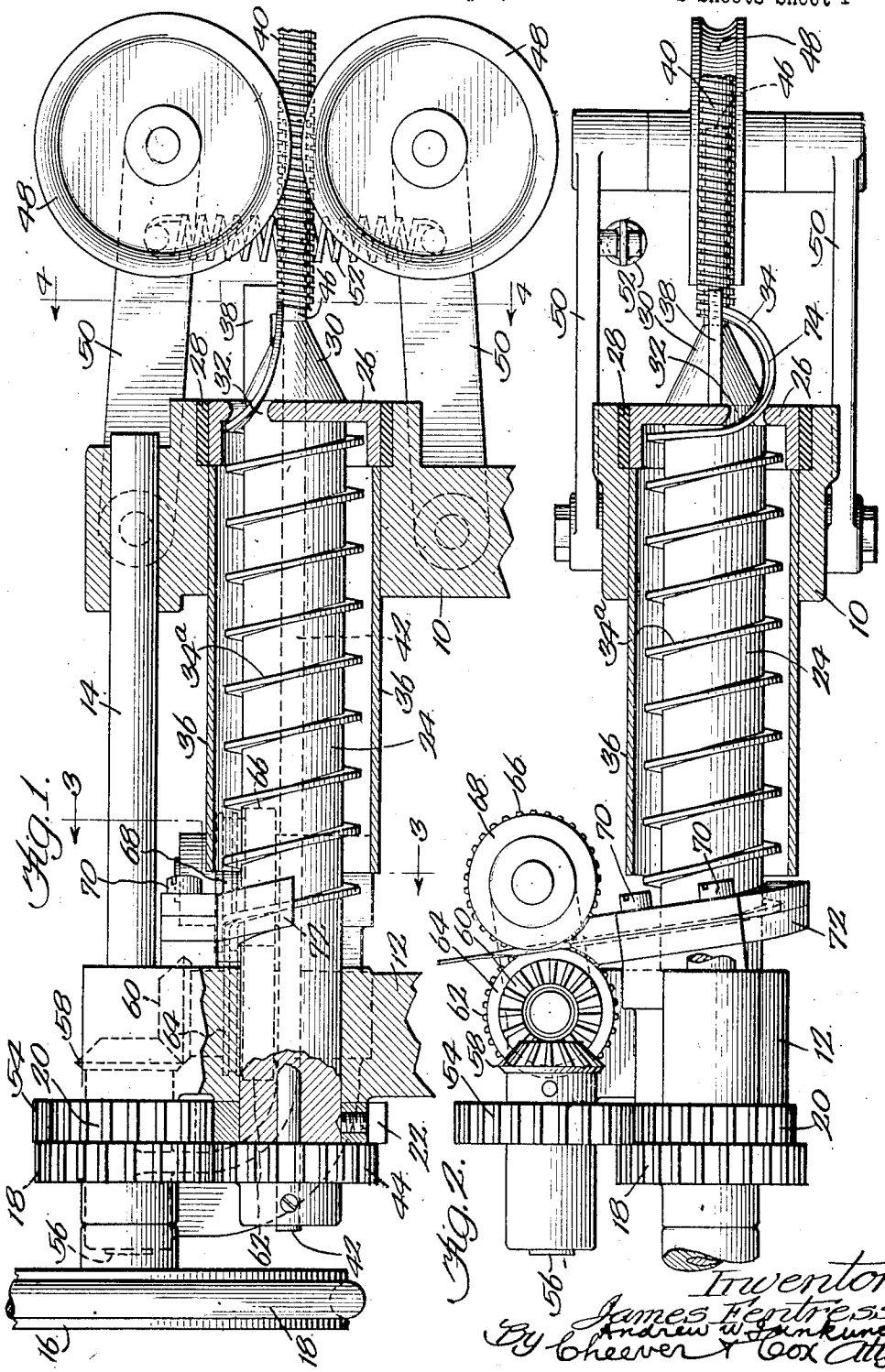


Fig. 1.



Fig. 2.

Inventor:
James Fentress
Andrew W. Frankum
By Cheever & Cox Attys.

Feb. 15, 1927. 1,617,583

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Filed May 3, 1926 2 Sheets-Sheet 2

Fig. 3.

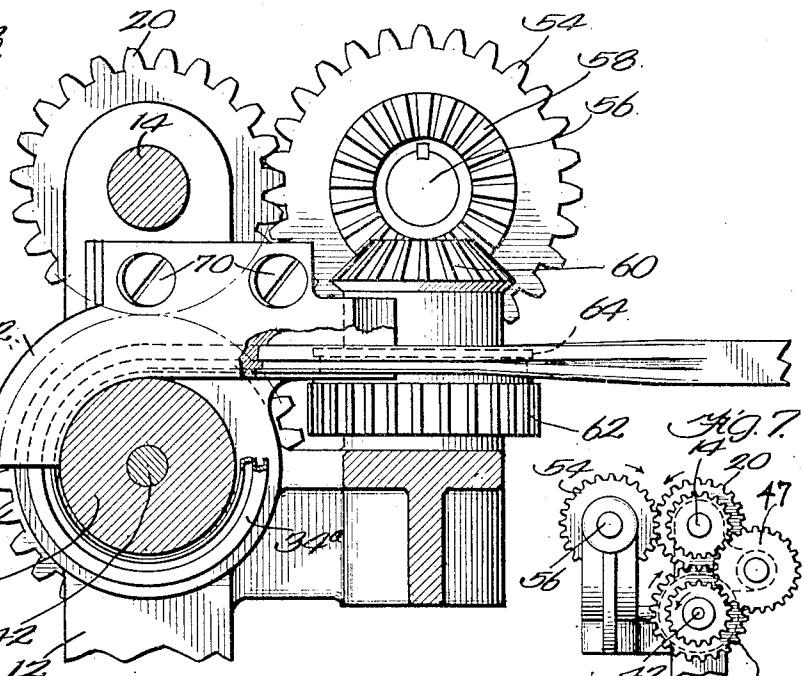



Fig. 7.




Fig. 4.

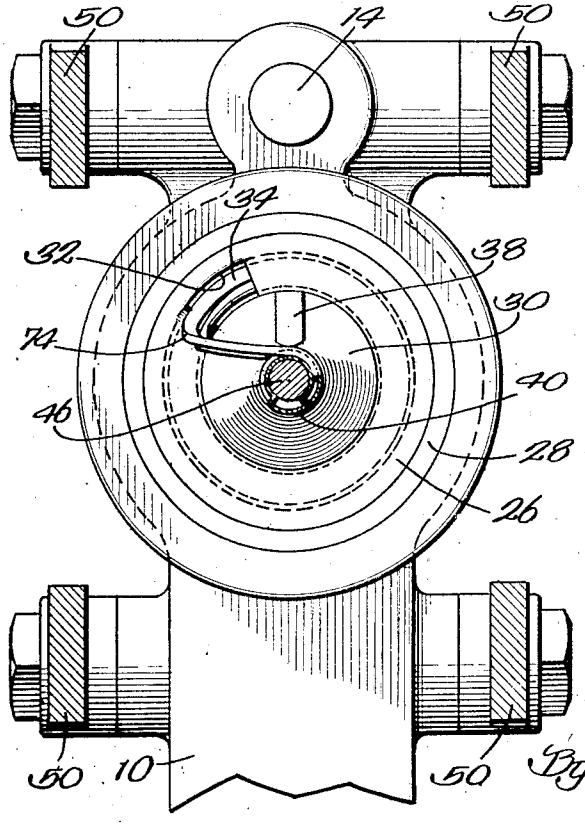



Fig. 5.

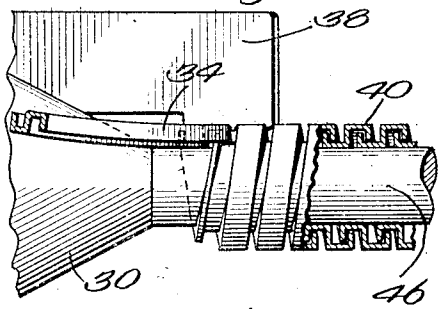
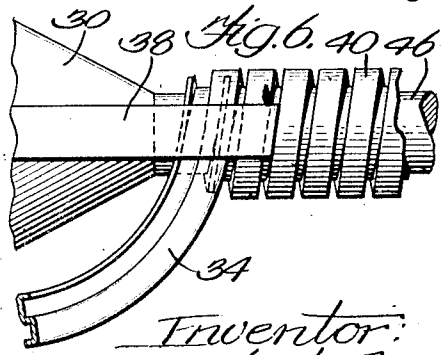



Fig. 6.




Inventor:
James Fentress
Andrew W. Junkunc
By Cheever Cox Atty's.

Patented Feb. 15, 1927. 1,617,583

# UNITED STATES PATENT OFFICE.

JAMES FENTRESS, OF WINNETKA, AND ANDREW W. JUNKUNC, OF CHICAGO, ILLINOIS, ASSIGNORS TO CHICAGO TUBING AND BRAIDING CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## METHOD OF AND MACHINE FOR MANUFACTURING SPIRAL METAL TUBES.

Application filed May 3, 1926. Serial No. 106,295.

This invention relates to a method of and machinery for making spiral helices, more specifically springs or metal tubing of the conventional types now in use for conducting various gases and liquids or for conduits for wires, etc.

There are now on the market and in commercial use several styles of machines in which the steel strip entering into the construction of the tube or spring is passed to a tube or spring forming tool and onto a rotating mandrel with the resulting production of a finished tube or spring rotating with the mandrel so long as the finished tube or spring remains attached to the tube or spring making machine, i. e., until a finished section of the tube or spring is severed from the tube or spring being produced by the machine.

Owing to the fact that the finished tube thus projecting from the machine continues to rotate as long as it is in operative connection with the machine, the length of tube which such a machine can produce is necessarily limited:

(*a*) By the power required to rotate the finished tube; and

(*b*) By the friction of the rotating finished tube either on the mandrel which it encloses or the trough in which it lies, the result being that in actual commercial practice, 100 feet is about the maximum length of producible finished tube.

The objects of this invention are to produce a method and machine by which the finished product does not rotate as it leaves the tube or spring forming tool, with the result that a commercial tube or spring of any desired length may be produced by the machine; in which the power required to operate the machine is materially reduced; in which the speed of the machine may be greatly increased; and in which the factory space occupied by the long troughs, commonly used with prior machines to hold the rotating finished product, is saved.

The invention consists in a method and machine capable of attaining the foregoing and other objects; which can be easily and cheaply made; which is satisfactory in use and not readily liable to get out of order. More particularly the invention consists in numerous features and details of construction which will be hereafter more fully set forth in the specification and claims.

Referring to the drawings in which like numerals represent the same parts throughout the several views:

Fig. 1 is a side elevation largely in section of a machine illustrating this invention in its preferred form;

Fig. 2 is a plan view, certain parts being shown in section, of the mechanism of Fig. 1;

Fig. 3 is an end elevation taken on the irregular line 3—3 of Fig. 1;

Fig. 4 is an end elevation taken on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged side, and Fig. 6 an enlarged plan view taken at approximately the machine's center, intersected by line 4—4 of Fig. 1, showing the details of the construction and operation of the tube forming tool; and

Fig. 7 is an alternative construction, left-hand end view of the machine showing a gear arrangement to make shaft 24 and spindle 42 turn in opposite directions.

The preferred form of machine illustrated in the drawings is sustained in suitable upright supports 10 and 12, spaced, as shown, some little distance apart. Suitably journaled in these supports is a main horizontal drive shaft 14 carrying at its outer end a power transmitting mechanism, specifically a pulley 16, energized by a belt 18 of conventional form, driven by a source of power not shown. Rigidly secured to this main drive shaft are two conventional gears 18 and 20.

Intermeshing with the gear 20 is gear 22 rigidly secured upon the end of a comparatively large shaft 24 journaled at its rear or left-hand end, as viewed in Fig. 1, in upright support 12. The opposite end of shaft 24 is rigidly secured in a hollow collar bearing 26 journaled on a suitable packing ring 28 on the extreme right-hand end of upright support 10, as clearly seen in Fig. 1. The extreme right-hand end of shaft 24 terminates in a cone 30. Immediately adjacent to the base of this cone in collar bearing 26 is an opening 32 for the free passage of tube strip 34. Concentrically enclosing shaft 24 and projecting to the left from collar bearing 26 and rigidly secured to upright 10 is a tubular case member 36, adapted to receive and protect the immediate supply 34ª of

tube strip 34 which is ultimately to be engaged by the tube forming tool 38 and be made into the finished tube 40. This tube forming tool 38 is rigidly attached to and carried by the conical end 30 of shaft 24.

Shaft 24 is hollow and has rotatively mounted inside it a small shaft or spindle 42, bearing at its left-hand end gear 44, meshing with and driven by gear 18. The sets of gears 18—44 and 20—22 in Figs. 1, 2 and 3 are so proportioned that spindle 42 rotates faster than shaft 24 but in the same angular direction. Experiments, however, show that better results are obtained by placing between gears 18—44, an intermediate gear 47 (Fig. 7), so as to rotate mandrel 42 in the direction opposite to the rotating of shaft 24 and wiping tool 38. The forward or right-hand end 46 of spindle 42 extends a substantial distance to the right of the end of cone 30 and inside of finished tube 40 to a point beyond the grip of pressure wheels 48.

Each pressure wheel 48 is rotatively mounted upon levers 50 suitably pivoted to upright support 10. These levers 50 are connected by a retractile spring 52 which forces the pressure wheels 48 onto the finished tube 40 with sufficient tension to prevent its rotation about its own axis.

Gear 20 on main drive shaft 14 meshes with and drives a gear 54 rigid on a shaft 56 carrying a beveled gear 58 which in turn meshes with another bevel gear 60. Bevel gear 58 drives a spur gear 62 integral with which is a forming wheel 64. Gear 62 meshes with an adjacent spur gear 66 carrying opposite forming wheels 68 cooperating with forming wheel 64.

Rigidly secured to upright 12 by any suitable means, as, for instance, screw 70, is a conventional tube strip deflecting tool or die 72, partially encircling shaft or drum 24, the same being adapted to give tube strip 34, fed through it by forming wheels 64 and 68, the spiral form shown in Figs. 1 and 2 about shaft 24 and inside of case 36, with the result that such a spiral of tube strip 34 fed into case 36 is carried by shaft 24 and thus fed along to the right in case 36 until it reaches and emerges from opening 32 in rotatable collar bearing 26.

When the end of tube strip 34 thus emerges from opening 32, it is bent by the operator through the reverse curve or zero point 74 and after being passed under tool 38, held by the operator in stationary position in reference to the right hand end of spindle 24. Power now applied to wheel 16 causes tool 38 to wipe over successive portions of tube strip 34 continuously delivered through opening 32 from the interior of case 36 and thus wind the tube strip 34 into the finished tube 40 on the right hand end of spindle 42. As soon as sufficient finished tube 40 has been formed to reach and be engaged by pressure wheels 48, the tube is rigidly held by those wheels against rotation and requires no further attention from the operator. As the tube is thus formed, it may, so far as the machine is concerned, be extended indefinitely, as without rotation, it is collected in drums, this because, as explained in the opening statement, there is no rotation of the finished tube 40.

The drawings show finished tube 40 is of a smaller diameter than the supply coil $34^a$ of tube material 34 within case 36. There is, however, nothing in the principle of the device to prevent the machine being initially constructed of such a size that the finished tube will be the same size as the diameter of the supply material passing through case 36. When this occurs, there is theoretically no limitation whatever to the length of tube which may be made by this machine without stopping it. In practice, however, with the diameters of the parts 24 and 42 as shown, less tube strip 34 is consumed in the finished tube 40 at each revolution of shaft 24 than is fed into case 36 during the same revolution. The result of this is that tube material accumulates in case 36, the pitch of the spiral of the tube strip in the case being less and less until the case 36 becomes filled up, at which point it is necessary to sever the tube strip adjacent to the delivery end of forming tool 72 and allow the accumulated tube strip in case 36 to be consumed in tube 40 before additional material is again fed into case 36 and about shaft 24.

Another way of operating the machine is to fill case 36 with a cartridge of tube strip material closely compacted along shaft 24 before connecting the end of such tube strip material in operative position with reference to spindle 42 and forming tool 38 and then operate the machine without adding additional material to the original supply of material until all of the material contained in the cartridge has been formed into a tube. The cartridge of tube material may be formed on a machine shown in the drawings by feeding it in in the manner shown between the feed rolls 68 and 64, stopping the feeding in of such material when the cartridge is completely formed within case 36 and thereafter starting the feeding of the material from the cartridge to the forming tool 38, or the machine may be so modified as to entirely omit, in direct connection with the machine, the feeding devices 64—68 and associated parts, and simply provide means for introducing previously prepared cartridges of material into case 36, one such cartridge being used for each length of tube which is to be made.

No matter whether large spirals $34^a$ are right or left hand, wiping the strip 34 onto mandrel 46, as shown in Fig. 1, in a right-

hand way, will produce a left-hand spiral; wiping strip 34 onto mandrel left-handed, regardless of strip 34a's spirality will produce a right-hand spiral.

Attention is called to the fact that in the particular machine shown and described, the tube strip 34 in passing through the zero point 74 changes from a right-hand spiral winding to a left-hand spiral winding, or vice versa. While this is desirable, it is not a limiting feature of the invention for the strip material 34 may be so laid upon the spindle 24 that the resulting tube will be of the same angularity as the portion of such material within case 36 without departing from the broad principle of this invention, viz: the production of a tube product, non-rotating on its axis as it leaves the machine.

The spindle 42 is made rotatable within the finished tube 40 merely to prevent the tubes binding, one convolution on the next, intermediate between the tool 38 and the gripping point of the wheels 48.

One advantage of the machine of this invention, not heretofore mentioned, lies in the fact that the finished tube, being non-rotating, is not opened by the drag of the rotating length of finished tube, frictionally engaging the trough or the like in which it moves, as is the case with prior devices.

Forming tool 38 is a conventional form of die or tube forming member which causes the tube strip 34 to assume the square locked form required in making the finished tube, all as well understood in the tube making art.

The machine is applicable to making of interlocking tubing, semi-interlocked and square locked tubing, as well as the making of springs of almost any shape or design.

Attention is called to the fact that in making one complete turn of finished tube 40, the supply strip 34a has to make more than a complete revolution on shaft 24—this because the circumferential length of one turn of tube 40 has been taken off, in a rotational manner, the end of strip 34 and consumed in tube 40, and that the pitch of the supply strip 34a is, in a given tube making operation, of one pitch only; that is to say, right-hand or left-hand, as the case may be but never both.

Generically speaking, the finished tube 40 is a multiplicity of helices. By providing the supply helix 34a in a coil of a single diameter and on the same axis as the finished tube, a much higher speed of operation can be obtained than in prior machines and this with increased safety to the attendants.

Two or more supply strips 34a parallel to each other and laid into tube 40 in parallel coils may be used without departing from the invention.

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

1. In a machine for making spiral helices, in combination, means non-rotatively holding finished helices while permitting movement of the helices therethrough, and means adjacent said holding means for continuously making the helices.

2. The herein described method of making spiral helices, consisting in providing a source of supply spirally wound in one direction, passing it through a zero point to a helix spirally wound in the opposite direction, and winding the strip into the helical formation without rotating the finished helices.

3. The herein described method of making a spiral metal tube, consisting in providing a source of tube strip in one sort of spiral winding, passing it through a zero point to a tube of another sort of spiral winding, and winding the strip into the tube formation without rotating the tube.

4. In a machine of the class described, in combination, a rotatable shaft carrying a quantity of spirally wound tube strip, an alined support for finished tube including means permitting feeding of finished tube but preventing its rotation, means conducting strip material from said shaft toward the tube supporting device, a wiping tool rotatable with reference to the shaft for laying the strip material into a tube, a spindle entering the finished tube, and a source of power rotating said shaft and said spindle.

5. In a machine of the class described, in combination, a rotatable shaft carrying a quantity of spirally wound tube strip, an alined support for finished tube including means permitting feeding of finished tube but preventing its rotation, means conducting strip material from said shaft toward the tube supporting device, a wiping tool rotatable with reference to the shaft for laying the strip material into a tube, a spindle entering the finished tube, and a source of power rotating said shaft and said spindle at different rates of speed.

6. In a machine of the class described, in combination, a rotatable shaft carrying a quantity of spirally wound tube strip, an alined support for finished tube including means permitting feeding of finished tube but preventing its rotation, means conducting strip material from said shaft toward the tube supporting device, a wiping tool rotatable with reference to the shaft for laying the strip material into a tube, a spindle entering the finished tube, a source of power rotating said shaft and said spindle, and means constantly replenishing said spirally wound tube strip on the spindle.

7. In a machine of the class described, in combination, a rotatable shaft carrying a quantity of spirally wound tube strip, an

alined support for finished tube including means permitting feeding of finished tube but preventing its rotation, means conducting strip material from said shaft toward the tube supporting device, a wiping tool rotatable with reference to the shaft for laying the strip material into a tube, a spindle entering the finished tube, a source of power rotating said shaft and said spindle, and means constantly replenishing said spirally wound tube strip on the spindle operated by the same source of power.

8. In a machine of the class described, in combination, a rotatable shaft carrying a quantity of spirally wound tube strip of substantially one diameter, an alined support for finished tube including means permitting feeding of finished tube but preventing its rotation, means conducting strip material from said shaft toward the tube supporting device, a wiping tool rotatable with reference to the shaft for laying the strip material into a tube, a spindle entering the finished tube, and a source of power rotating said shaft and said spindle.

9. In a machine of the class described, in combination, a rotatable shaft carrying a quantity of spirally wound tube strip of substantially one diameter, an alined support for finished tube including means permitting feeding of finished tube but preventing its rotation, means conducting strip material from said shaft toward the tube supporting device, a wiping tool rotatable with reference to the shaft for laying the strip material into a tube, a spindle entering the finished tube, and a source of power rotating said shaft and said spindle in such manner that the supply of material is rotated more than one revolution in making one finished tube helix.

10. In a machine of the character described, means for forming a strip of material into spiral helices, and yieldable means for gripping the formed helices and holding them against rotation, said means permitting movement of the formed helices axially therethrough.

11. In a machine of the character described, means for forming a strip of material into spiral helices, a pair of rollers between which the formed helices are adapted to pass, and means whereby said rollers hold the formed helices against rotation.

12. In a machine of the character described, means for forming a strip of material into spiral helices, a pair of rollers between which the formed helices are adapted to pass, and yieldable means urging said rollers towards one another to hold the formed helices against rotation.

13. In a machine of the character described, a rotatable shaft on which a strip of material is adapted to be spirally wound, a flange carried by said shaft having an opening therein through which the strip is adapted to be taken off of said shaft, a second shaft axially alined with said first shaft, and means for winding the material taken off of said first shaft through the opening in said flange onto said second shaft.

In witness whereof, we have hereunto subscribed our names.

JAMES FENTRESS.
ANDREW W. JUNKUNC.