

Sept. 12, 1933.

T. B. MOREHOUSE

1,926,628

ROLLED TUBE AND METHOD AND APPARATUS FOR PRODUCING SAME

Filed March 31, 1926

3 Sheets-Sheet 1

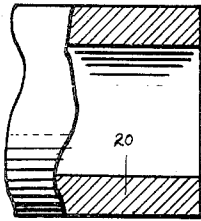


FIG. 1

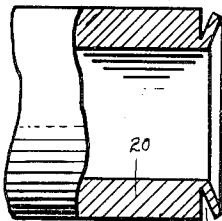


FIG. 2

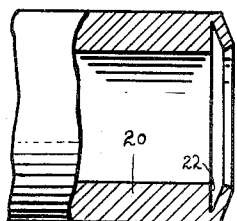


FIG. 3

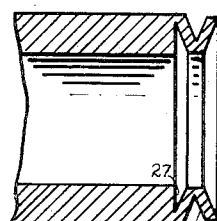


FIG. 4

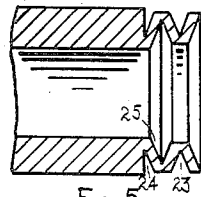


FIG. 5

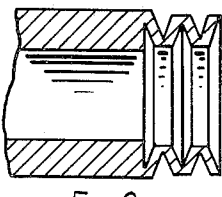


FIG. 6

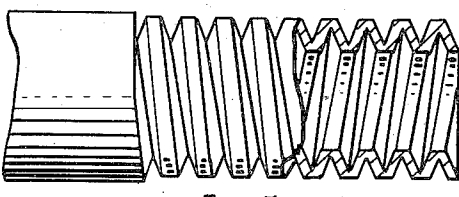


FIG. 7

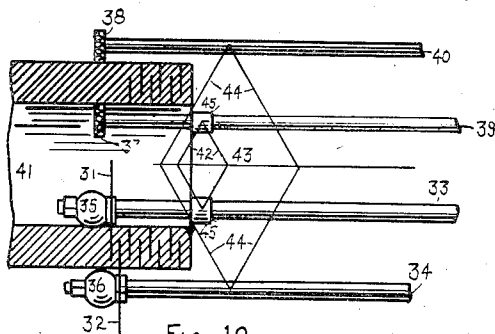


FIG. 10

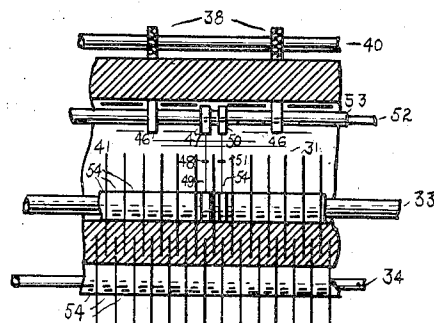


FIG. 11

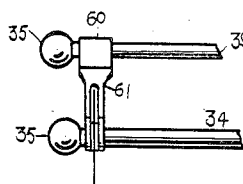


FIG. 12

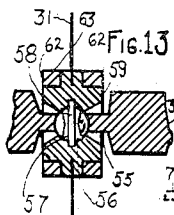


FIG. 13

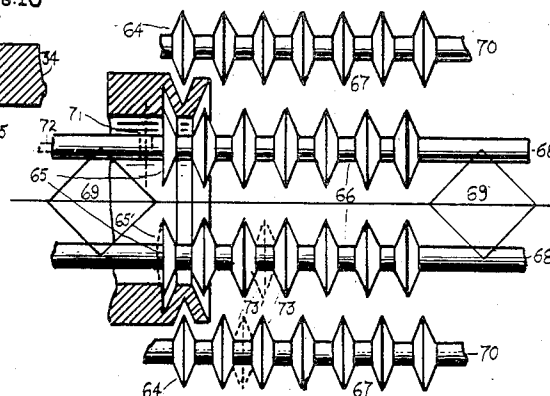
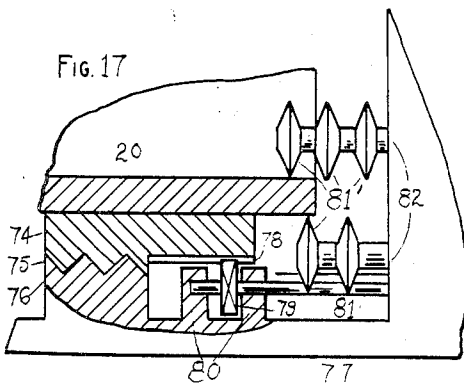


FIG. 16

FIG. 17



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FIG. 8

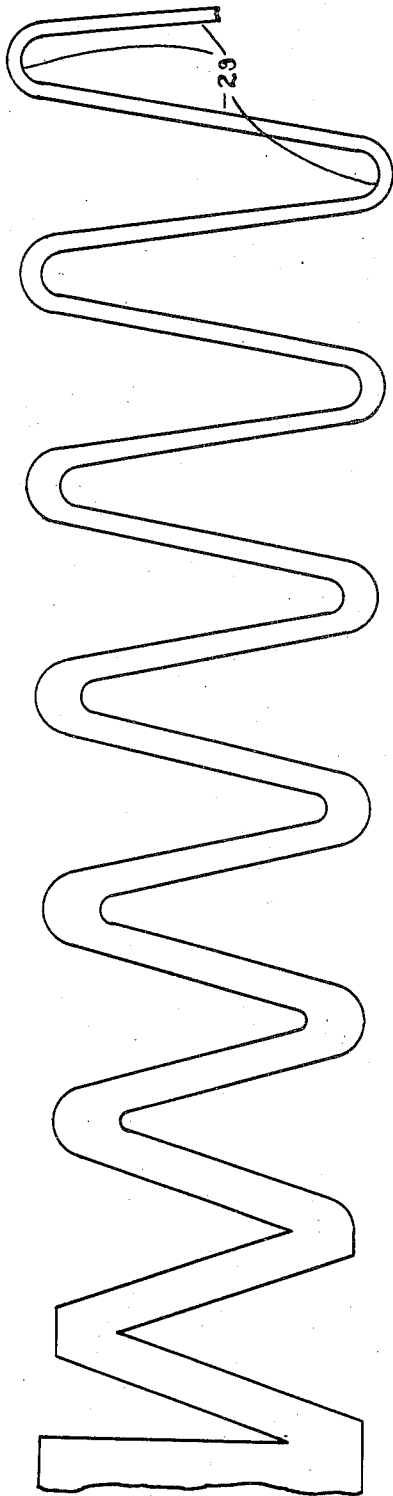
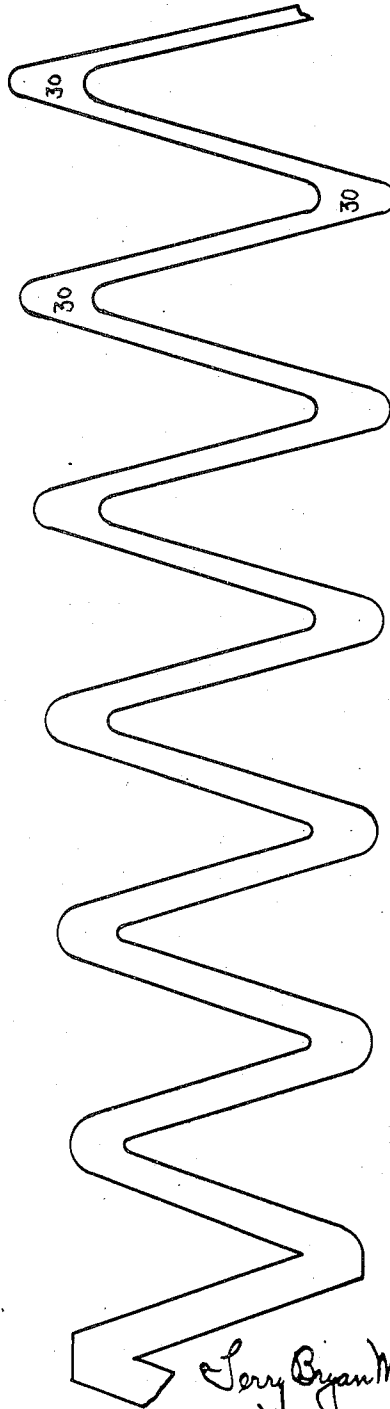


FIG. 9



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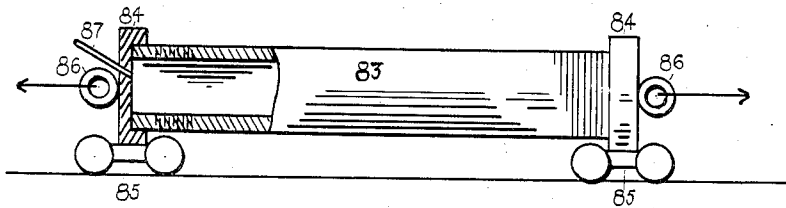


FIG. 14

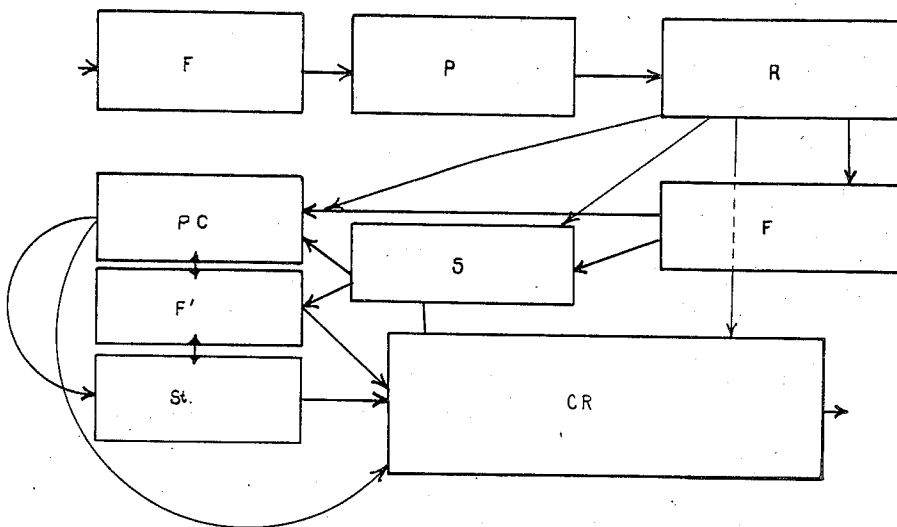


FIG. 15

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UNITED STATES PATENT OFFICE

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ROLLED TUBE AND METHOD AND APPARATUS FOR PRODUCING SAME

Terry Bryan Morehouse, Washington, D. C.

Application March 31, 1926. Serial No. 98,817

23 Claims. (Cl. 80—11)

My invention relates to a new type of flexible or corrugated tube and to the process of making the same. My invention also relates to certain instrumentalities for making my improved corrugated tube and for carrying out the steps of my new process.

With regard to the tube itself it is my purpose to make a tube which shall either be stronger than the present tube possessing the same flexibility or more flexible than the present tube of the same strength.

With regard to the process of manufacture of my new and improved flexible corrugated or expanded tube, it is my object to set forth a process by which said tube may be manufactured more expeditiously and more cheaply than at present without any loss in the strength or quality of the tube. It is my further object to set forth a process by which corrugated tubes may be made with greater strength and elasticity.

With regard to my improved apparatus it is my object to disclose means whereby my process may be performed in an expeditious and economical manner.

At present corrugated tubes are made by bending or corrugating thin gauge tubing into the desired form by the use of bending rolls. In the preliminary processes of rolling and drawing the metal down to a thickness suitable for bending, the grain of the metal assumes a direction parallel to the axis of the tube. Now when a corrugated tube is stretched or compressed, the greatest strain is in a circumferential direction and will therefore tend to split the tube in a line which is coplanar with the axis of the tube. Because of this fact corrugated tubes are usually made of such metals as do not acquire a distinct grain or fiber when worked. Because of the great difference in the strength of wrought iron and steel with and across the grain, these metals do not make good corrugated tubing and are seldom or never used for this purpose.

It is the principal object of my invention to so work the metal that the grain shall be circumferential and therefore in such a direction as to meet the heaviest strains. By doing this it is possible to use iron and steel and consequently obtain a tube which is not only more flexible but stronger than the tubes as at present made.

With these and other objects in view, which will be apparent as the description proceeds, the invention lies in the article made, the process of making it, and the construction and arrangements of the various instrumentalities for performing the process, as hereinafter set forth and

claimed, it being understood that changes can be made within the scope of what is claimed, without departing from the spirit of the invention.

The invention is illustrated in the accompanying drawings, wherein—

Figures 1 to 6 inclusive are fragmentary longitudinal cross sections of the tubular blank showing the successive operations of cutting and rolling performed thereon.

Fig. 7 is a partial cross section showing a modified type of tube.

Fig. 8 is a diagram showing the development of the corrugations.

Fig. 9 is a similar diagram showing a modified type of corrugations.

Fig. 10 is a cross section of the blank showing preliminary cutting.

Fig. 11 is a cross section of the blank showing a modified manner of forming the preliminary cuts.

Fig. 12 is an elevation of the rig for spirally, interiorly cutting the blank.

Fig. 13 is a fragmentary cross section showing the mounting of the cutter of Fig. 12.

Fig. 14 is an elevation partly in cross section showing one method of expanding a preliminarily cut blank.

Fig. 15 is a diagram showing the relation of the various steps composing my process.

Fig. 16 is a schematic plan view showing the arrangement of the rolls for carrying out my process.

Fig. 17 is a schematic elevation of the machine for starting the expansion of a blank.

The complete process will now be described reference being had to the above enumerated drawings.

A metal billet of circular cross section in which preferably no distinct grain has been formed is pierced by any of the well known processes and then reeled to such a size that the thickness of the resulting tube will be about the depth of the corrugations of the desired finished tube and the inside and outside diameters will be about the same as those of the finished tube. A tube so prepared is shown at 20 in Fig. 1. It will be understood that the piercing and the subsequent reeling will form a circumferential grain. The tube is then cut by any appropriate means partially through the thickness of the tube and in a circumferential direction either inside or outside near the end thereof as shown at 21 and 22 in Figs. 2 and 3 respectively. It will be seen that the first cut in each case has a half V cross section.

In the next cutting a new half V cut is made on the same side of the tube, a new V cut is made on the opposite side and the first cut is rolled into a V-shaped cross section. This is shown for a tube having an initial outside cut in Fig. 5, wherein 23 represents the initial outside cut after being rolled, 24 the new outside cut, and 25 the inside cut. Fig. 4 shows the process of alternately cutting on the outside and the inside, the cuts being represented as 26 and 27 respectively. When using this process Fig. 5 represents the next cut on the same tube.

After cutting and expanding as above described, the tube is rolled and the thickness of the cut portions reduced as desired and as represented in the diagrams of Figs. 8 and 9. Fig. 8 shows the development of the wall of the tube to a uniform thickness as at 29. Fig. 9 shows the development of the wall of the tube with reinforcing ribs 30.

Figure 6 shows the blank of Fig. 4 after having an inside and an outside cut made thereon.

Fig. 7 is a modification of the forms as shown and described above, wherein the cuts are in the form of a helix or spiral, thus forming an internal and an external thread. This form is otherwise the same and the wall thus formed is rolled down the same as is shown in the Figs. 8 or 9.

The cutting and expanding of the corrugations may be performed in various ways. Fig. 10 shows one means of preliminarily cutting the blank interiorly and exteriorly in staggered relation as shown. The device is schematically shown and consists of two saws or cutters 31 and 32 on the inside and outside of the tube, respectively, mounted on shafts 33 and 34 which are suitably mounted and driven in the machine (not shown). The shaft 33 is provided with an idle roller 35 loosely mounted beyond the cutter and adapted to guide the cutter in cutting to the correct depth. A similar roller 36 is provided on shaft 34. Opposite to cutter 31 on the inside of the tube and opposite to cutter 32 on the outside of the tube are knurled rollers 37 and 38 which are rigidly mounted on shafts 39 and 40, the latter being so mounted in the machine as to be driven in opposite directions and thus cause the blank 41 which is carried on rollers on a carriage (not shown) to rotate. The above mentioned carriage so supports the blank that it may rotate axially and is so arranged as to be translated bodily in the direction of the axis of the tube and thus feed the tube for the successive cuts. Toggle links 42 are connected to collars 45 on the shafts 33 and 39 and are actuated by a double screw 43 extending into the machine on the right to force the cutter and the drive roller 37 apart. Similar links 44 or other suitable means operate to bring 32 and 38 together. It is, of course, understood that these toggles must be spaced from the shafts 34 and 40 as on a yoke to permit the tube to pass between them. In operating this device the tube is brought into position between the cutters and drive rollers while they are apart, the shafts being sufficiently rigid to support themselves. The cutters are then rotated and brought into operative relation with the tube by operating the toggle gears, until the idlers 35 and 36 rest on the surface of the tube. The drivers are then rotated and the tube thus revolved and the cuts made clear around the tube.

Any number of cutters may be mounted on each shaft and in fact there may be enough to extend the length of the tube as shown in Fig.

11, or any desired part thereof. In Fig. 11 the shafts 33 and 34' are each provided with a series of cutters 31 and 32 and also with an idle roller 54 between each cutter. The outside drive shaft 40 is equipped with a series of rollers 38. In this embodiment however the shaft 39 of Fig. 10 is replaced by a double shaft consisting of the inner shaft 52 and the outer shaft 53 having mounted thereon the idle rollers 46. The outer shaft 53 has rigidly mounted thereon the toggle member 47, which latter is connected by pin 48 to the toggle member 49 loosely mounted on the shaft 33. The toggle member 50 is loosely mounted upon the shaft 53 but is rigidly pinned through slots in 53 to the inner shaft 52. Toggle member 50 is connected by means of a pin 51 to the toggle member 54. Shafts 52 and 53 are arranged to be forced to rotate in opposite directions and thus force the shaft 53 and the shaft 33 apart and the cutters 31 into operative relation. In Figs. 12 and 13 are shown the means for spirally cutting the inside of the blank. The shaft 33' is provided with a reduced portion 55, which has thereon a spherical enlargement 56, said enlargement having the hole 57 therethrough, providing for the circular pin 58 which passes therethrough, being secured at its ends in the cutter mounting 59. The cutter mounting has a recess therein fitting the enlargement 56, and also has journals 62 for the bearing members 63 of the guide 61. The guide 61 is adjustably secured to the member 60 in any well known manner and the latter is loosely mounted on the shaft 39. Thus the cutter is set to revolve at any given angle to the shaft 33' which drives it and thus a spiral cut may be made. Both the shaft 33' and the shaft 39 are provided with idlers 35. Inasmuch as the internal cut is made on a spiral by this device no means are provided to adjust the relative position of the two shafts as the cut can run through both ends and is continuous. The cutters may be high speed and should be provided with suitable cooling and lubricating means. The cutting may be done either hot or cold.

The machine for corrugating is shown schematically in Fig. 16. I have provided two sets of rolls 66 on the inside of the tube and 67 on the outside of the tube for cutting expanding and rolling the blank into a finished tube. The two inside rolls are mounted on the shafts 68 which are arranged to be rotated and supported by the body of the machine (not shown) and arranged with two sets of toggles 69 similar to those shown and described in connection with Fig. 10, for forcing them into spaced relation and into operative relation with the walls of the blank. Each of these inner rolls is equipped with a rotary cutter 65 which may either be fixed to the shaft or free to rotate. The remaining rolls which are all shown alike are graduated so as to gradually roll the cut and expanded metal as shown in the development plans in Figs. 8 and 9, with the aid of the cooperating rolls 67 suitably mounted on the outside of the blank on the shafts 70. These rolls 67 are also driven and are so mounted as to be brought into operative relation with the blank and with the cooperating roll. They are also equipped with the rotary cutter and expander 64 which serves to cut and open the outside corrugations.

The machine as shown in Fig. 16 is equipped to perform the process as shown in Figs. 4 and 6 and in order for it to perform as shown in Figs. 2 and 5 it is only necessary to exchange the inside and the outside rolls,

The blank is supported in this machine in a similar manner to that in which it was supported in the machine of Figs. 10 and 11, that is in such a manner as to be free to rotate and so that it can be advanced longitudinally step by step, as the successive operations are performed upon it. Both the inside rolls and the outside rolls may be equipped with a preliminary saw as shown in dotted lines 71 in Fig. 16, in which case the saw would be driven by an inside shaft 72 from the opposite end of the machine.

The work may be cut as shown in Fig. 10 or Fig. 11 and then expanded and rolled in the device of Fig. 16 or it may be cut and then expanded as will be described later and then rolled and finished in the corrugating machine.

When spirally corrugated pipe is being made the lower two rolls as shown in Fig. 16 must be moved to the left a distance equal to one half the pitch of the spiral being rolled as indicated by the position that corresponding rolls 73 would assume as indicated at 73' in dotted lines. In this case also modified rolls 65' as indicated in dotted lines must be provided in place of the rolls 65.

In order to properly start spirally corrugated pipe it may be necessary to use a special machine which is schematically shown in Fig. 17. The blank 20 is locked in a clamp 74 (lower portion only shown in cross section) which has made integral therewith a thread 75 whose pitch is the same as that of the tube being rolled, and also a rack 78 by means of which the clamp and tube are made to rotate by the gear 79 mounted on the shaft 81 which latter is journaled in bearings provided in projections 80 of the base or machine frame 77. The shaft is rotated by means not shown and the blank 20 is thus made to rotate and advance between the rolls 81' mounted on shafts 82, which latter are so mounted as to move toward each other and thus roll a screw thread on the end of the blank. After starting in this machine the blank is placed in the corrugating machine and completed.

When rolling spirally corrugated pipe means must be provided to advance the blank carriage at the proper rate of speed.

In case it is desired to expand the pre-cut pipe before rolling, this may be done as shown in Fig. 14. The pre-cut tube 83 is fitted with fluid tight caps 84 supported on carriages 85 and fluid under pressure is admitted to the closed cylinder by means of the pipe 87 passing into one of the caps. The tube is thus elongated or expanded the desired amount and the work of the rolls of the corrugating machine correspondingly lessened. The expanding may be aided or in fact entirely done by means of mechanical tension as indicated by the arrows leading from the eyes in the caps 84.

Fig. 15 is a diagram which illustrates the various sequences which may be followed in the manufacture of the corrugated tube by my process. F represents a heating or annealing furnace, P is a piercing mill of the "pilgren" or "Mannesmann" type or any other suitable type, R is a reeling mill which smoothes the inside of the blank and sizes it to some extent, S represents sizing rolls, PC is the preliminary cutting machine, F' is an additional heating or annealing furnace, St is the stretching machine, and CR is the corrugating machine previously described.

The blank is heated and pierced at P and then reeled and sized at R, from which it may either be reheated or annealed at F or pre-cut at PC

or further sized at S or sent directly to the corrugating mill CR. If it is reheated or annealed at F it may then either be sent to the precutter, to the sizing rolls, or direct to the corrugating machine. From the sizing rolls, S, the blank may go either to the PC, to the corrugating machine or to the third heating or annealing furnace F'. From the preliminary cutting machine the blank may go either to F', to the stretching machine St or direct to the CR. The blank which is sent from S to F' may also go to PC and thence through the channels noted above. From F' the blank may also go to the stretching machine provided it has been through PC, but otherwise it must go directly to the corrugating machine. From St the blank may go through F' to CR or may go directly to the latter. The above variations are for the purpose of meeting the varied requirements as to the material and size of the product and in all of the variations the same basic process of cutting, expanding and rolling a corrugated tube from a blank having thick walls, obtains.

Having thus described the invention, what is claimed as new is:

1. The process of making a corrugated tube consisting in circumferentially cutting alternately interiorly and exteriorly, and expanding a metal blank.

2. The process of making a corrugated tube consisting in interiorly cutting and longitudinally expanding a metal blank.

3. The process of making a corrugated tube consisting in alternately circumferentially cutting a tubular metal blank partially through the walls thereof internally and externally, and expanding the tubular blank thus cut in a longitudinal direction.

4. The process of making a corrugated tube consisting in circumferentially cutting partially through the walls of a tubular metal blank alternately from the inside and outside thereof, longitudinally expanding the cut blank and rolling the cut and expanded blank.

5. The process of making a corrugated tube consisting in interiorly and exteriorly cutting a tubular metal blank partially through the walls thereof and longitudinally expanding the cut blank and rolling the cut and expanded walls to a predetermined cross section.

6. The process of making a corrugated tube consisting in piercing a metal blank, reeling the pierced blank, reheating the blank, rolling the blank to a predetermined size, again heating the blank, cutting the blank alternately interiorly and exteriorly, expanding the cut blank, again reheating the expanded blank and rolling the cut and expanded walls thereof to a predetermined conformation.

7. The process of making a corrugated metal tube consisting in piercing a blank, reeling the pierced blank to predetermined size, heating the sized blank, cutting the blank, reheating the blank, expanding the cut blank, reheating the expanded blank, and thereafter rolling the cut and expanded walls thereof to a predetermined size and conformation.

8. The step in the process of making a corrugated tube which includes spirally cutting the walls of a tubular blank partially therethrough internally and externally, the internal cuts being half-way between the external cuts.

9. The process of making a corrugated tube consisting in spirally cutting the walls of a tubular blank partially through internally and

- externally the successive turns of the internal cut lying mid-way between the corresponding turns of the external cut, expanding the cut blank and rolling the cut and expanded walls thereof to a predetermined conformation.
10. In a device of the type described means for circumferentially cutting a tubular blank in a spiral direction interiorly and exteriorly, partially through the walls of said blank, the internal and external cuts being in spaced relationship, means for longitudinally expanding the cut blank, and means for rolling the walls of the cut and expanded blank to a predetermined cross section.
11. In a device of the type described, the combination of means for cutting a tubular metal blank, means for expanding the cut blank, and means for rolling the cut and expanded blank.
12. In a device of the type described, the combination of means for interiorly cutting a metal blank, and means for expanding said cut blank.
13. In a device of the type described, the combination of means for spirally cutting a metal blank interiorly and exteriorly and means for expanding the cut blank.
14. In a device of the type described the combination of means for spirally cutting a tubular metal blank interiorly and exteriorly, partially through the walls thereof, means for expanding the cut blank, and means for spirally rolling the cut and expanded blank.
15. In a device of the type described the combination of means for cutting a tubular blank interiorly and exteriorly, partially through the walls thereof, rotary means for expanding the cut blank, and means for rolling the cut and expanded walls to a predetermined cross section.
16. In a device of the type described, the combination of rotary means for cutting the walls of a tubular blank, rotary means for expanding the cut walls and rolling means for rolling the cut and expanded walls to the desired conformation.
17. A corrugated tube characterized by the fact that the grain of the metal thereof is a virgin grain and is essentially at right angles to the axis of the tube.
18. A spirally corrugated tube having the grain of the metal approximately at right angles to the axis of the tube and having said grain virginally formed in the corrugating of said tube.
19. A corrugated tube, the metal of which has a virgin grain approximately at right angles to the axis thereof, and having reinforcing ribs at the points of greatest strain.
20. A corrugated tube characterized by that the grain is virginally formed in the corrugating process by which said tube was made.
21. A corrugated tube characterized by that the grain is virginally formed in the expanding process by which said tube was made.
22. A corrugated tube in which the ridge portions, and web portions of the tube occupy the same relative position both longitudinally and radially as they occupied in the blank from which said tube was made.
23. A corrugated tube in which the inner ridge portion, outer ridge portion and web portions are formed of metal which comprised the inner surface, outer surface and intervening wall portion respectively of the blank from which the tube was made.
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