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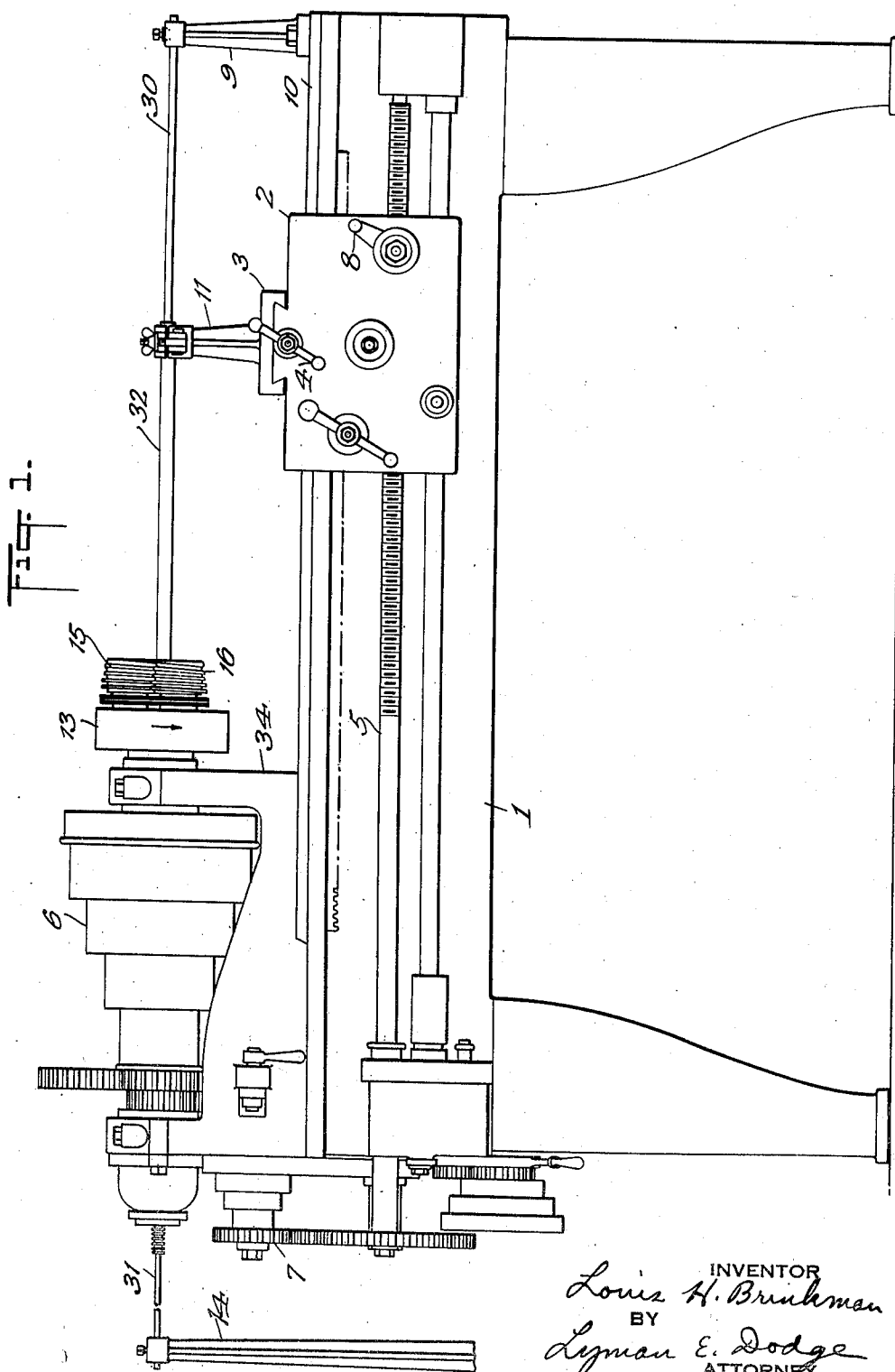
L. H. BRINKMAN

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METHOD AND MACHINE FOR MAKING CORRUGATED TUBES

Filed June 26, 1930

3 Sheets-Sheet 1



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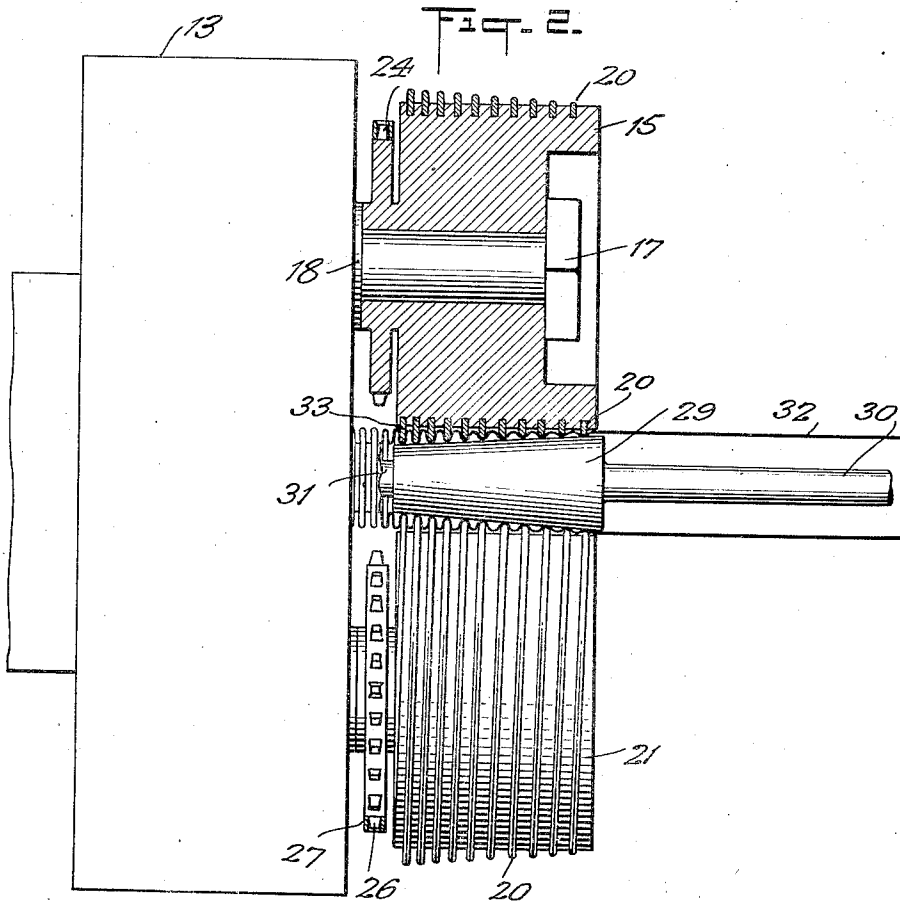
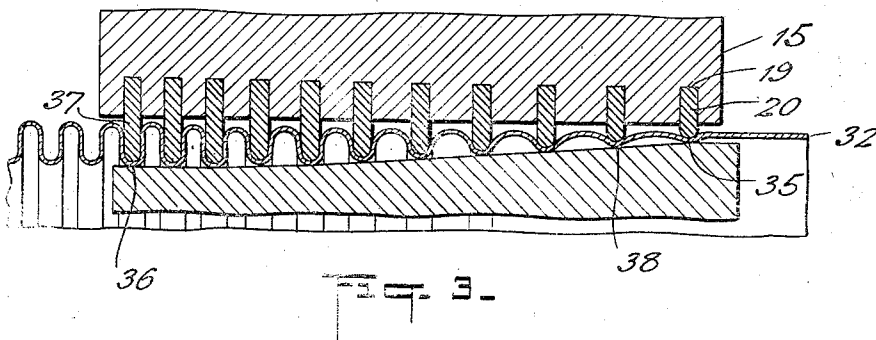
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

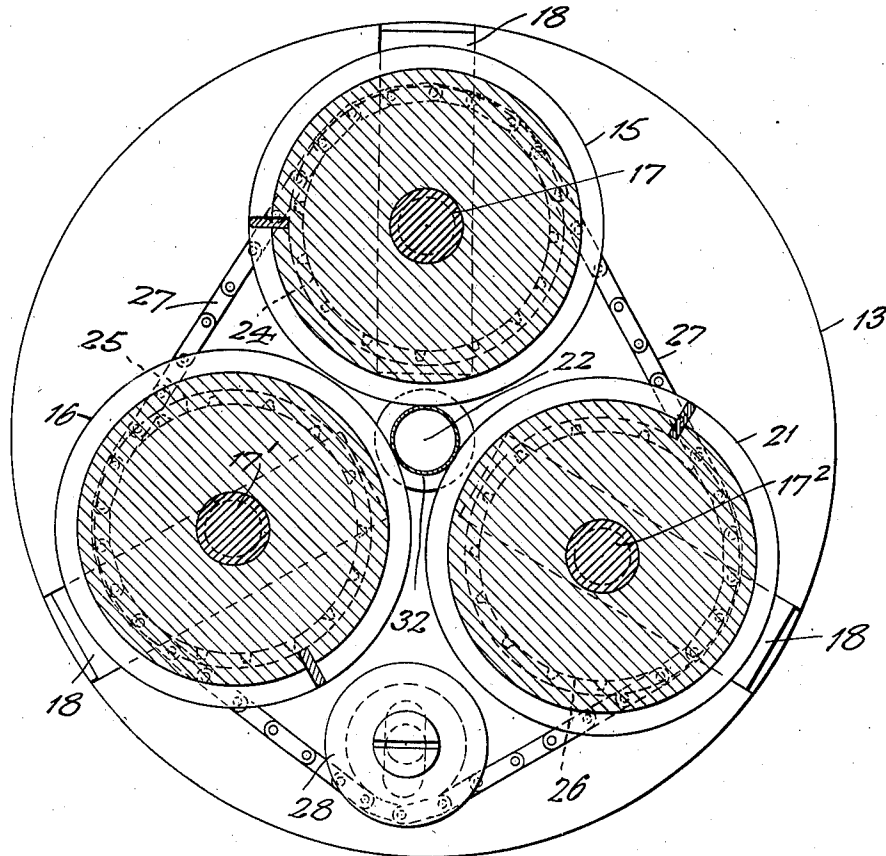


Fig. 4.

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METHOD AND MACHINE FOR MAKING
CORRUGATED TUBES

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Application June 26, 1930, Serial No. 463,858

18 Claims. (Cl. 153—73)

This invention relates to tubes, particularly metal tubes, and more especially metal tubes known as corrugated tubes.

A principal object of the invention is the provision of a method and a machine, whereby, using a plain thin-walled cylindrical tube as raw material, a tube having a plurality of corrugations at a right angle to the longitudinal axis of the tube, that is, a series of individual, identically shaped, longitudinal, wave forms in the wall, that is, a plurality of annular corrugations, may be made as a continuous progressive process.

Further objects and advantages will appear as a description of the method and a particular physical embodiment selected to illustrate the machine for practicing the method progresses, and the novel features thereof will be particularly pointed out in the appended claims.

The invention consists, as a method, in initiating the first wave or corrugation of a predetermined number of waves or annular corrugations, and while perfecting that wave, successively initiating, one after the other, the succeeding waves of the predetermined number, so that the last wave of the number will be initiated simultaneously with the perfection of the first wave, and the intermediate waves will have been progressively advanced toward perfection; and in repeating this process throughout the entire length of the tube to be corrugated or made with its wall in a wave form, the successive initiations and perfections succeeding one another continuously throughout the length of the tube.

As a machine; the invention consists, essentially, in the forming of a plurality of rolls spaced from each other and from a central point lying between them, each roll being mounted for free rotation on its longitudinal axis, each roll being identically formed, each roll having a periphery shaped in the form of a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the longitudinal wave to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end, at which it is the height of the distance of the crest from the trough of the wave form to be formed in the tube, to the other end, including means for rotating the roll around the periphery of the tube.

In describing the method and the particular physical embodiment selected to illustrate the machine, reference will be had to the accompanying drawings and the several views thereon, in which like characters of reference designate corresponding parts throughout, and in which:

Figure 1 is a side elevational view of a machine for practicing the method; Fig. 2 is a side elevational view partly in section, of rolls and their driving means used in the practice of my invention, also showing a tube being operated upon in accordance with my invention and a mandrel within the tube; Fig. 3 is an enlarged sectional view illustrating the construction and action of a roller of my invention in forming the corrugations or longitudinal wave forms in the wall of a cylindrical wall tube; and Fig. 4 is a view illustrating one assemblage of rollers which may be used to practice my invention.

The raw material used in the practice of my method and in the operation of my machine might well be the ordinary cylindrical metallic tube of commerce of the form, preferably, having a rather thin wall, but I prefer, as a raw material, a metallic tube which has been worked to a very thin wall by means of rotating ball dies, as the material of such a tube is in a better condition to more successfully withstand the working which it has to endure while having its wall formed into longitudinal waves or corrugations.

As in the practice of my invention either the tube to be corrugated must be rotated upon its own axis or the corrugating rolls must be rotated as a whole about the axis of the tube, or both rotated in opposite directions, means must be provided to secure this motion. In practice a specially constructed machine embodying the minimum of essentially necessary parts may be employed, but for the purpose of illustrating my method and describing a machine suitable for carrying out the method I have selected an ordinary and well-known type of lathe, slightly modified so as to answer my purpose.

As a preferable example of a means and method for forming corrugations in a tube I have selected the case wherein the tube is not rotated upon its longitudinal axis but in which the corrugating rolls are rotated about the longitudinal axis of the tube.

In Figure 1, numeral 1 designates, generally, a lathe of ordinary and well-known construction. This lathe is of the hollow spindle type, provided with a carriage 2, having a cross slide 3, operated by a handle 4. The lathe is provided with a lead-screw 5 driven from the cone pulley 6, by the usual gearing 7. The carriage 2 may be connected or disconnected to the lead-screw 5 by means of the handle 8. All of the parts of the lathe so far described are old and well known and common to most lathes.

For the purpose of my invention, the lathe as a machine for carrying out my process, requires in addition a standard 11, firmly attached to the cross-slide 3 together with a common form of combination chuck 13 attached to the hollow spindle in the usual manner, upon which are mounted the corrugating rolls of my invention, together with a standard 14, preferably separate and apart from the lathe and in line with the bore of the hollow spindle.

A particularly distinctive portion of my invention is the corrugating rolls as 15 and 16 of Fig. 1. The form of these rolls is, perhaps, best shown by Figs. 2 and 3, in which roll 15 is shown in section. Each roll is journaled on a stud, as 17, attached at the inner end to a jaw 18 of the chuck 13. I preferably employ a plurality of rolls, as 15, and preferably employ not less than three, each mounted on a stud, as 17, and each carried by a separate jaw of the combination chuck 13. By so mounting my corrugating rolls, as 15, I may, as is well understood, move the rolls together or apart simultaneously so that each will constantly bear the same relation to the horizontal center line of the chuck.

The periphery of each roll must be formed into a helical thread of practically constantly changing pitch and gradually decreasing height. The way preferred by me for forming a roll answering such description is by forming a plain roll of cylindrical shape and then forming a groove of uniform depth in the periphery of that roll in the form of a helix of practically constantly changing and increasing pitch, and then to fill into that groove a strip of uniform width, which is then suitably reduced in its outer portion so as to form a thread of constantly decreasing height. In Fig. 3, the roll is indicated 15, the groove in the periphery of the roll is designated 19, and the strip in the grooves or channels 19 is designated 20. By reference to Fig. 2, in connection with Fig. 3, it will be seen that the strip 20 forms a helical thread on the roll 15. This thread is of large pitch at the right-hand end of Fig. 3 being substantially equal to or if anything greater than the contour length of the finished wave form and the pitch constantly decreases toward the left-hand end of Fig. 3. It will also be seen that the extent to which the thread protrudes is great at the left-hand end of Fig. 3 and constantly decreases to the right-hand end of Fig. 3. The protrusion of the thread at the right-hand end of the roll as shown in Fig. 3 is designated by me as the initiating thread or end of the roll and the thread at the left-hand end of Fig. 3 is designated by me as a perfecting or finishing end of the roll or thread.

The corrugating rolls so formed are individually mounted as hereinbefore described and as a whole are mounted as shown in Fig. 4, in which 18 designates a movable jaw of the combination chuck. Each roll is mounted on a spindle, the spindle supporting roll 15 is designated 17, that supporting roll 16 is designated 17', and that supporting roll 21 is designated 17². Each of these spindles, as 17, 17', and 17², is mounted in a jaw 18.

In Fig. 4, I have illustrated three corrugating rolls, but it is to be understood that the number may be any plurality desired as I do not intend to exclude the use of a larger plurality.

Each of the rolls as 15, 16 and 21, in the form shown in Fig. 4, is positioned with its center an equal distance from the longitudinal center 22 of the tube 32 but they are not spaced equally dis-

tant one from the other around the circle struck from the center 22, that is, they are not exactly 120 degrees apart, but the center of roll 21 is a little more than 120 degrees from the center of roll 15, and the center of roll 16 is a little more than 120 degrees from the center of roll 21. This unequal spacing of the rollers is conducive to the production of a corrugated tube having a more nearly circular outline than might be produced if all of the rolls were equally spaced one from the other.

Rigidly attached to each roll is a sprocket wheel. The sprocket wheel attached to roll 15 is designated 24, that attached to roll 16 is designated 25, and that attached to roll 21 is designated 26. The sprocket chain 27 passes over and engages the sprocket wheels on each of the rolls and also passes over an idle-wheel 28, which may be moved toward and away from the center 22 so as to tighten or loosen the sprocket chain 27 to compensate for wear or compensate for the different distances the rolls as 15, 16 and 21 are positioned from the center 22.

The chuck 13 bearing the rolls 15, 16 and 21 being mounted upon the center of the lathe, a tube with a plain cylindrical wall has one end slightly scarfed by hammering or bending, and this scarfed end is pushed in between the rolls 15, 16, and 21 and the other end is firmly attached to the standard 11. A tapered mandrel 29, best shown in Fig. 2, is inserted in the pipe endwise and held in position by rods or wires 30 and 31 extending in opposite directions therefrom. The ends of the rods are clamped one, 30, to the standard 9, the other, 31, to the standard 14, so that the mandrel when positioned is held from moving. The proper position of the mandrel is such that the first tooth, 20, of roll 15, as shown in Fig. 2, is such a distance from the face of the mandrel that a proper groove may be initiated in the tube 32 and the other end of the mandrel is of such diameter and so positioned that the other end tooth 33, may perfect the trough of a corrugation by forcing the metal of the tube 32 into contact with the outer surface of the mandrel 29.

With the parts positioned as described, the carriage 2 may be disengaged from the lead-screw 5 and so be allowed to slide when pulled by tube 32, which tube is driven along the mandrel 29 towards the chuck 13 by the strips 20, or the carriage 2 may be put into engagement with the lead-screw 5, and the lead-screw 5 into engagement with the gearing 7 connected with the center of the lathe, so that the tube 32 will be gradually moved toward the head-stock 34 of the lathe as the operation proceeds.

With the parts positioned as hereinbefore described the cone pulley 6 may be driven thereby driving chuck 13 and the corrugating rolls 15, 16 and 21. The initiating thread 20 will first form a slight annular groove as shown at 35 in Fig. 3 and as the chuck 13 continues to revolve the tube 32 will advance toward and through the chuck, the helical thread remaining in the groove 35 and pulling the tube forward and gradually beginning and forming the groove until the groove arrives at the shape as shown at 36. As soon as the first groove 35 is advanced to the point indicated by 38 the tooth 20 will start forming a new groove identical with groove 35, and this new groove will continue along just as the first groove did, being perfected more and more as it arrives at the point where groove 36 is now.

In the process, as illustrated, the specific tube does not rotate on its longitudinal center line.

The rolls 15, 16 and 21 not only revolve about the tube, but each rotates on its spindle, as 17. This rotation on a spindle, as 17, is produced by the frictional engagement of the rolls and the tube. Each roll rotates equally because all rolls are interconnected by sprocket chain 27, so that the rolls keep "in step". If the rolls are originally set so that the starting points of the helical threads of each roll simultaneously engage the tube, then this condition will persist.

The longitudinal wave forms or grooves will be a series of individual corrugations, that is, the corrugations will not be a helix but each groove will be individual and shaped identically with adjacent grooves, that is, the corrugations will be annular, and after the tube gets to the point opposite thread 37, as shown in Fig. 3, there will be a whole series of grooves, that is, the grooves from the point 38 to the point 36 will be simultaneously carried toward perfection and the groove 35 will be in the period of initiation. As one groove, as 35, starts on its period of perfection another groove is then initiated, and so on, so that the working extends throughout the length of the tube.

Of course, it is a mere arbitrary matter how many grooves or troughs will be worked upon at one time, but after such number has been first determined, that is, the number which may be simultaneously worked into the tube, then throughout the whole operation, the initiation of the first wave of a succeeding number will begin just after the first wave of the preceding number has been perfected.

Although I have mentioned tubes throughout this specification, it is to be understood that I do not thereby intend to exclude the corrugating of what are known as pipes, that is, structures of the same general shape as tubes but with a thicker wall, as the invention is as equally applicable to pipes as it is to tubes, although, of course, it is understood that more difficulty is encountered in attempting to corrugate a heavy-wall pipe than in corrugating a very thin-wall tube.

Although I have described the principle of my method, and the construction, operation, and principle of a machine for practicing the method, and illustrated and described a particular physical embodiment thereof, nevertheless I desire to have it understood that the particular form selected is not exhaustive of the possible physical embodiments of the idea of means underlying my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a device for forming a series of individual identically shaped, longitudinal, wave forms in the wall of a cylindrical tube, in combination: a plurality of forming rolls spaced from each other and from a central point lying between them, each roll being mounted for free rotation on its longitudinal axis, each roll being identically formed, each roll having a periphery shaped to form a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the longitudinal wave form to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end at which it is the height of the distance from the crest to the trough of the wave form to be formed in the tube.

2. The method of forming the wall of a tube into a series of individual identical partial folds,

each at a right angle to the longitudinal axis of the tube while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means, which consists in initiating, and while gradually perfecting the first fold, initiating other folds, and perfecting them in sequence, by initiating each succeeding fold as each preceding fold is being perfected, so that a plurality of folds are always simultaneously being operated upon after the first few folds are initiated.

3. The method of forming the wall of a tube into a series of individual, identical partial folds, while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means, which consists in starting the formation of the first fold at one end of the tube while at the same time starting and gradually perfecting each succeeding fold.

4. In a machine for corrugating tubes, in combination a tapered body circular in cross-section, a plurality of rolls positioned about the body each spaced therefrom substantially the same distance, each roll freely rotatable on its longitudinal axis which is substantially parallel to the longitudinal axis of the body, each roll presenting a helical protuberance increasing in pitch from the small end of the body to the large end and decreasing in height in the same direction.

5. In a device for forming a plurality of annular corrugations in the wall of a cylindrical tube, in combination: a plurality of forming rolls spaced from each other and from a central line lying between them, each roll being mounted for free rotation on its longitudinal axis and for bodily revolution about the central line, each roll being identically formed, each roll having a periphery shaped to comprise a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the annular corrugations to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end at which it is the height of the distance from the crest to the trough of the corrugation to be formed in the tube, and means for causing bodily revolution of the rolls about the central line.

6. In a device for forming a plurality of annular corrugations in the wall of a cylindrical tube, in combination: a plurality of forming rolls spaced from each other and from a central line lying between them, each roll being mounted for free rotation on its longitudinal axis and for bodily revolution about the central line, each roll being identically formed, each roll having a periphery shaped to comprise a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the annular corrugations to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end, at which it is the height of the distance from the crest to the trough of the corrugation to be formed in the tube, means for causing bodily revolution of the rolls about the central line, and means for causing the rolls to rotate in unison.

7. In a device for forming a plurality of annular corrugations in the wall of a cylindrical tube, in combination: a plurality of forming rolls spaced from each other and from a central line lying between them, each roll being mounted for free rotation on its longitudinal axis and for bodily revolution about the central line, each roll being identically formed, each roll having a pe-

- riphery shaped to comprise a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the annular corrugations to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end at which it is the height of the distance from the crest to the trough of the corrugation to be formed in the tube, means for causing bodily revolution of the rolls about the central line, and a mandrel positioned centrally between the rolls with its axis coinciding with the said central line.
8. In a device for forming a plurality of annular corrugations in the wall of a cylindrical tube, in combination: a plurality of forming rolls spaced from each other and from a central line lying between them, each roll being mounted for free rotation on its longitudinal axis and for bodily revolution about the central line, each roll being identically formed, each roll having a periphery shaped to comprise a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the annular corrugations to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end at which it is the height of the distance from the crest to the trough of the corrugation to be formed in the tube, means for causing bodily revolution of the rolls about the central line, and a conical mandrel positioned centrally between the rolls with its axis coinciding with the said central line.
9. In a device for forming a plurality of annular corrugations in the wall of a cylindrical tube, in combination: a plurality of forming rolls spaced from each other and from a central line lying between them, each roll being mounted for free rotation on its longitudinal axis and for bodily revolution about the central line, each roll being identically formed, each roll having a periphery shaped to comprise a helical protuberance of gradually increasing pitch from one end, at which the pitch is substantially equal to that of the annular corrugations to be formed in a tube, to the other end, and which protuberance gradually decreases in height from the said one end at which it is the height of the distance from the crest to the trough of the corrugation to be formed in the tube, and means for causing bodily revolution of the rolls about the central line, and a conical mandrel positioned centrally between the rolls with its axis coinciding with the said central line, the said cone being largest opposite that portion of the rolls which has the smallest protuberance and of such diameters that an annular corrugation in a tube may be initiated over it at substantially its largest diameter and a corrugation in the tube may be finished over it at substantially its smallest diameter with the bottom of the trough of the corrugation in each case resting against the outer periphery of the cone.
10. The method of forming the wall of a tube into a series of individual, identical partial folds, each at a right angle to the longitudinal axis of the tube which consists in initiating, and while gradually perfecting the first fold, initiating other folds, and perfecting them in sequence, by initiating each succeeding fold as each preceding fold is being perfected, so that a plurality of folds are always simultaneously being operated upon after the first few folds are initiated while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means.
11. The method of forming the wall of a tube into a series of individual, identical partial folds, which consists in starting the formation of the first fold at one end of the tube while at the same time starting and gradually perfecting each succeeding fold while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means.
12. The method of forming the wall of a tube into a series of individual, identical partial folds as a continuous gradual process, which consists in initiating the formation of a first fold and as that fold reaches a certain stage of perfection initiating the next succeeding fold and so on, and as the first fold is further perfected, also simultaneously further perfecting the next succeeding fold, and so on while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means.
13. The method of forming a plurality of annular corrugations in the wall of a cylindrical tube, as a continuously progressive process, while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means which consists, in first determining upon the complete number of corrugations to be simultaneously worked into the tube, and then initiating the first annular corrugation of that number, and, while perfecting that corrugation, successively initiating one after the other, the succeeding annular corrugations of that number, so that the last corrugation of the number will be initiated simultaneously with the perfection of the first corrugation and the intermediate corrugations will have been progressively advanced toward perfection, and so continuing longitudinally of the tube, the first corrugation of each following number of a complete number being initiated immediately following the initiation of the last corrugation of the preceding number.
14. The method of forming an annular corrugated tube having a plurality of corrugations at a right angle to the axis of the tube which consists in sequentially perfecting each fold while simultaneously sequentially initiating each fold while the tube is moving bodily longitudinally continually substantially uniformly.
15. The method of forming the wall of a tube into a series of individual, identical partial folds as a continuous gradual process, while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means which consists in initiating the formation of a first fold and as that fold reaches a certain stage of perfection initiating the next succeeding fold and so on, and as the first fold is further perfected, also simultaneously further perfecting the next succeeding fold, and so on.
16. The method of forming an annular corrugated tube having corrugations at a right angle to the longitudinal axis of the tube from a plain tube, which consists in initiating the end fold and succeeding folds in sequence each after the preceding fold, and simultaneously perfecting each fold in sequence each after the preceding fold while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means.
17. The method of annularly corrugating a tube having a plurality of corrugations at a right angle to the longitudinal axis of the tube which consists in initiating a corrugation and in gradually perfecting it while initiating further corrugations and advancing them toward perfection

while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means.

18. The method of annularly corrugating a tube, having a plurality of corrugations at a right angle to the longitudinal axis of the tube which consists in initiating a corrugation and

in gradually perfecting it while initiating further corrugations to be perfected, while the tube is moving bodily longitudinally continually substantially uniformly relative to the forming means.

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