

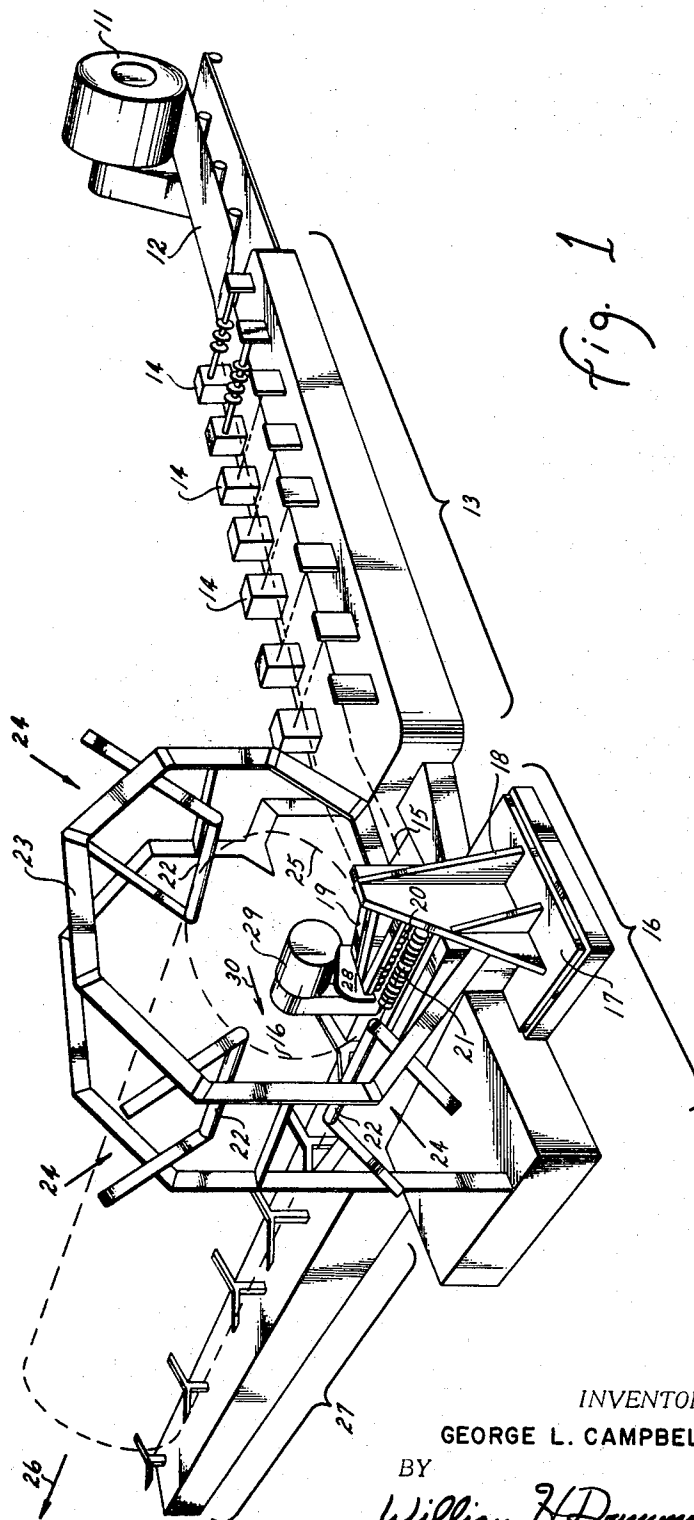
Dec. 24, 1968

G. L. CAMPBELL
SPIRAL PIPE MACHINE

3,417,587

Filed Aug. 15, 1966

6 Sheets-Sheet 1



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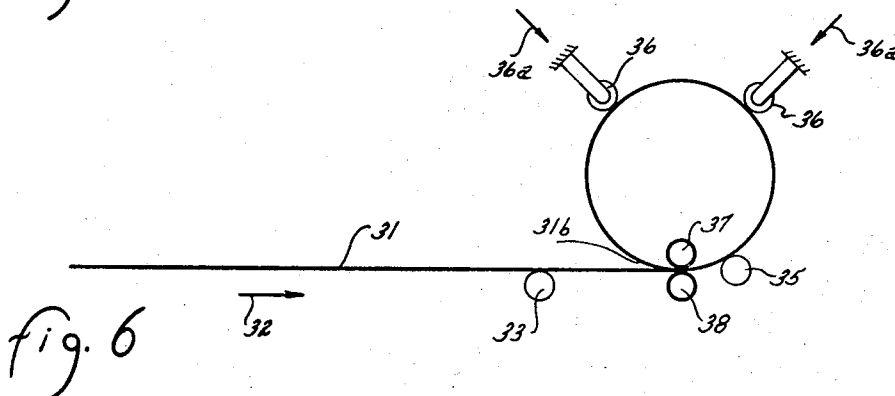
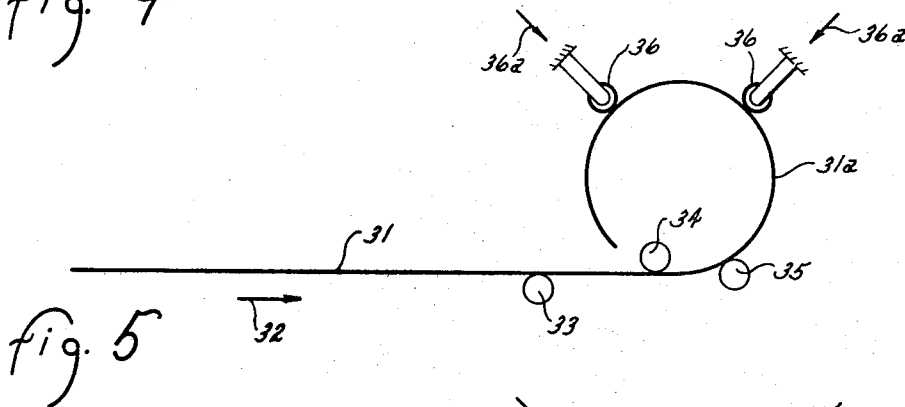
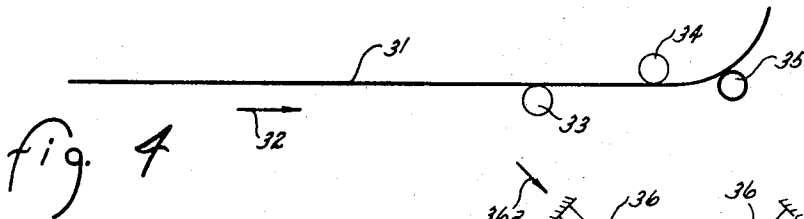
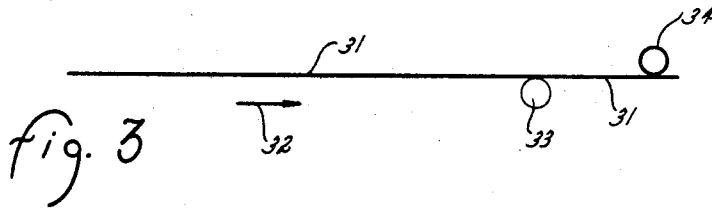
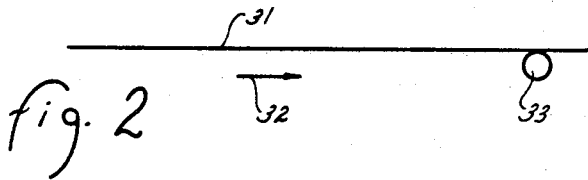
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6 Sheets-Sheet 2



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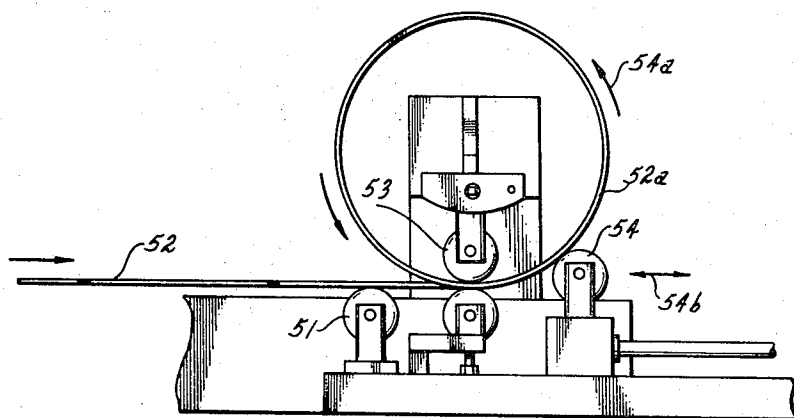
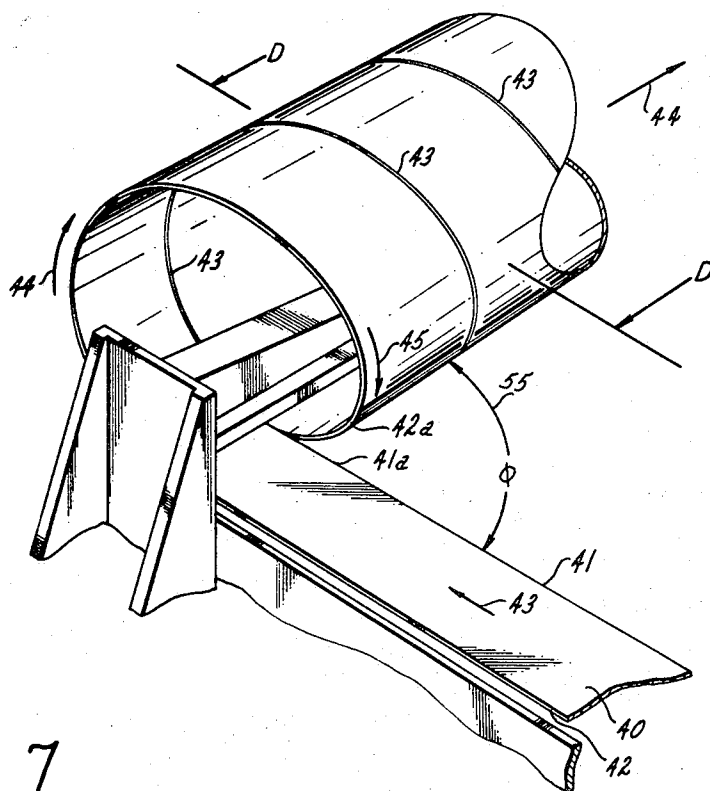
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SPIRAL PIPE MACHINE

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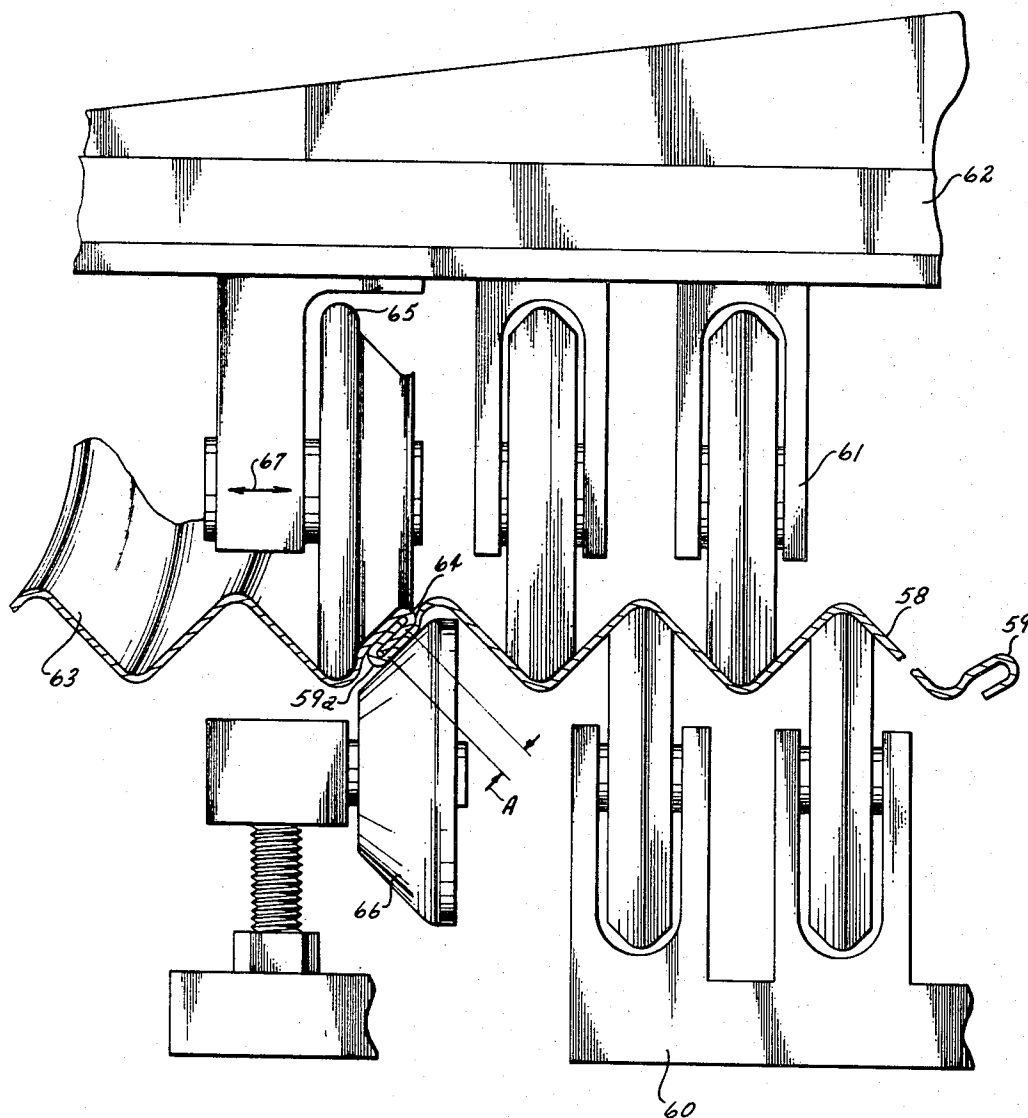


Fig. 9

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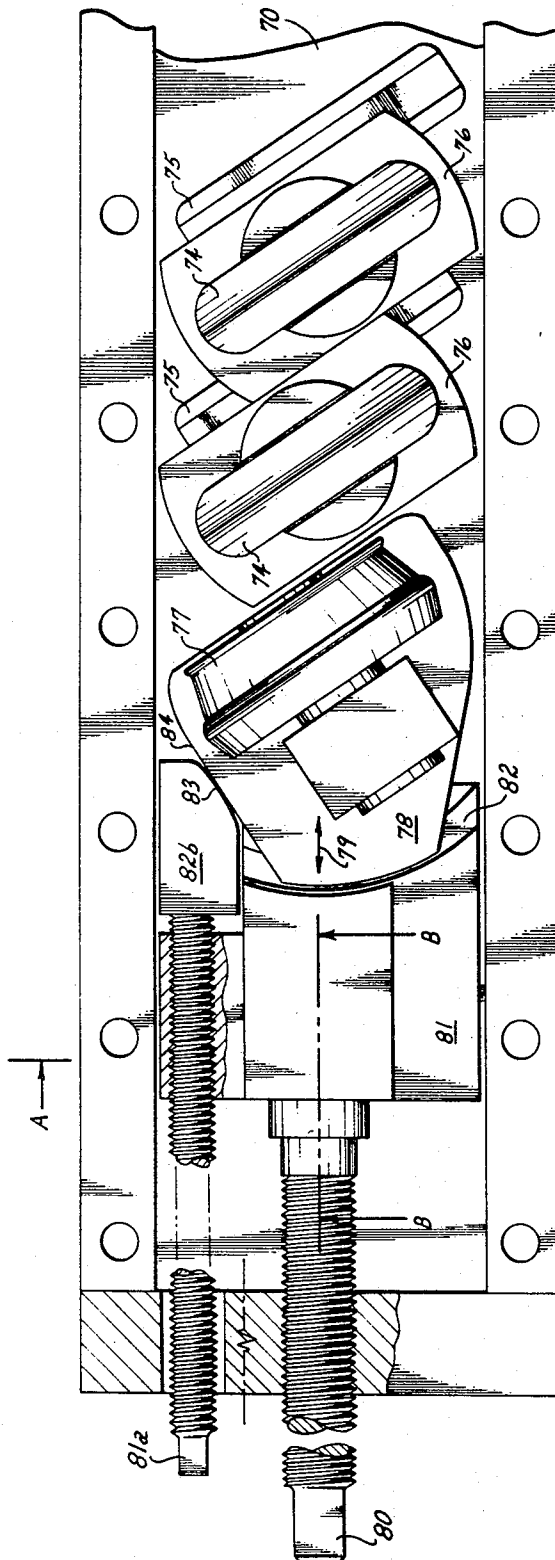


Fig. 10

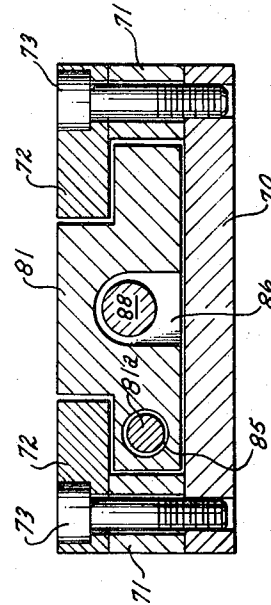


Fig. 11

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fig. 14

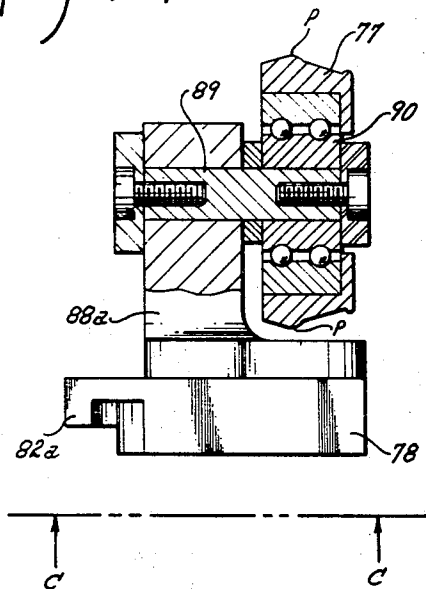


fig. 15

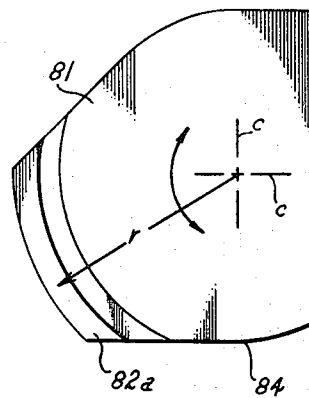


fig. 13

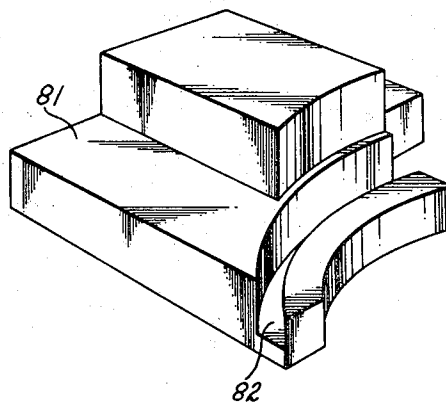
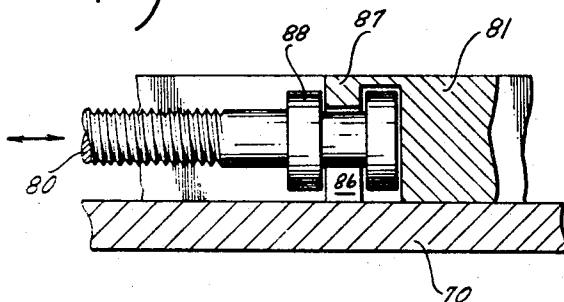


fig. 12



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SPIRAL PIPE MACHINE

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5 Claims. (Cl. 72—50)

ABSTRACT OF THE DISCLOSURE

An improved machine for producing spiral lock-seam pipe in which the diameter of the pipe is accurately controlled by providing means for adjusting the lap of the locking seams prior to crimping the seams into locking engagement.

This invention relates to improvements in spiral pipe machines.

More particularly, the invention concerns improvements in apparatus for manufacturing corrugated pipe having spiral corrugations.

In a further aspect, the invention relates to improvements in prior art spiral corrugated pipe machines, the improvements adapting such machines to manufacture spiral corrugated pipe of accurately controlled predetermined diameter.

In still another aspect, the invention concerns improvements in prior art spiral corrugated pipe machines which materially reduce the complexity of operation of the machine, such that such machines can be effectively operated by less highly skilled workers or, alternatively, such that the operator training time required is significantly reduced.

Spirally corrugated pipe fabricated from metals such as galvanized steel and the like has achieved wide commercial acceptance within the last few years, particularly in the larger diameters where such pipe is used in the construction of roadway culverts, waste and storm drainage sewers, irrigation conduits, and the like. Due to ease of handling and various economic factors, spiral corrugated galvanized pipe is replacing concrete pipe for many applications.

In general, spiral corrugated pipe is manufactured by rolling a flat strip of metal stock into a sheet having longitudinal corrugations, bending the corrugated sheet spirally and joining the edges of the spirally bent sheet in some suitable fashion, for example, by forming interlocking lips which are then crimped to form a spiral seam, or by welding or by any other suitable means of joining the sides of the spirally bent sheet to form a spiral seam.

In one prior art machine for manufacturing such pipe, the longitudinally corrugated sheet is forced into a solid die having a circular cross section, the internal surface of the die having "reverse" corrugations which accommodate the corrugations of the strip being fed into the machine and which cause the strip to be bent spirally to the desired diameter. The necessity of a different die for each desired diameter of pipe and for each desired depth of corrugation for the same diameter pipe is an obvious disadvantage of this prior art machine. However, more importantly from the standpoint of the quality of the product, the prior art machine employing a die to bend the corrugated strip frequently scrapes away or otherwise damages the galvanic coating of a piece of galvanized steel, thereby rendering the pipe more susceptible to corrosion and eventual failure under operating conditions.

In an attempt to remedy the deficiencies of the die-type pipe spiraling machine, another machine was developed. In this later machine the spiral bending of the corrugated strip was accomplished by passing the corrugated strip through a series of rolls which bent the strip

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into the desired spiral configuration without subjecting the surfaces of the strip to frictional engagement with various parts of the pipe spiraling machine. By appropriate adjustment of the position and pressure exerted by the various rolls, the diameter of the pipe could be varied as desired, thus making it unnecessary to change parts of the machine in order to produce pipes of varying diameter.

While the later "roller-type" pipe spiraling machine essentially eliminated the problem of damage to the galvanic coating of the pipe which was encountered in the "die-type" machine, it introduced new problems in that accurate control of the pipe diameter within the specifications required for many applications of such pipe was extremely difficult. The diameter of the pipe produced by the roller-type machine was almost never held constant but, rather, the pipe tended to grow or shrink as it was being formed and it required exceptional skill and long training and experience for the operator of such a machine to make the necessary minute-by-minute corrections to maintain any semblance of control over the diameter of the pipe. In fact, the wide variation in diameter encountered in spiral corrugated pipe produced by the roller-type machine severely limited the utility of such pipe, particularly where several sections of the pipe were joined to form an essentially liquid-tight conduit or where the diameter of the pipe had to be accurately controlled in order to fit with other elements of a structure. In the attempt to furnish spiral corrugated pipe manufactured by the prior art roller-type machine, it was often necessary that as much as 25% of the total production of the machine be relegated to the reject pile as unacceptable due to diameter variations.

It would be highly desirable to provide a spiral pipe machine which produces spiral corrugated pipe without the damage to the galvanic coating induced by the use of a die-type machine and without the gross variations in diameter encountered when the pipe was made by the prior art roller-type machine.

It is therefore a principal object of the present invention to provide an improved spiral pipe machine.

Another object of the invention is the provision of a spiral pipe machine which does not damage the galvanic coating of the metal from which the pipe is formed.

Another object of the invention is to provide an improved spiral pipe machine which fabricates spiral corrugated pipe of accurately controlled predetermined diameter.

Still another object of the invention is the provision of such an improved spiral pipe machine which practically eliminates the production of off-specification pipe which must be treated as "rejects" due to diameter variations.

A still further object of the invention is the provision of an improved spiral pipe machine which can be operated by workers of less skill and experience than was formerly required or, alternatively, which can be operated by workers having a significantly reduced training period.

Still another object of the invention is the provision of an improved spiral pipe machine which requires less time for adjustments and substitution of parts when changing the product size from one diameter to another.

These and other, further, and more specific objects and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the invention and the presently preferred embodiments thereof, taken in conjunction with the drawings in which:

FIG. 1 is a general perspective view of a roller-type spiral pipe machine in which the present invention may be advantageously embodied;

FIGS. 2-6 are a series of schematic drawings illustrat-

ing the general mode of operation of the spiral pipe machine of FIG. 1;

FIG. 7 is a perspective view of the pipe-spiraling and lock-setting apparatus of the machine of FIG. 1;

FIG. 8 is a sectional view of the apparatus illustrated in FIG. 7 taken along section line D—D thereof;

FIG. 9 is a detail sectional view of a lock-setting apparatus embodying the present invention which is useful in conjunction with the devices illustrated in FIGS. 1-8;

FIG. 10 is a detail plan view of the assembly for positioning the upper rolls of the apparatus of FIG. 9. For purposes of clarity of illustration, a pair of longitudinal plates ordinarily positioned along the sides of the assembly have been omitted;

FIG. 11 is a cross-sectional view of the assembly of FIG. 10, the longitudinal plates which were omitted in FIG. 10 being included in FIG. 11;

FIG. 12 is a sectional view taken along section line B—B of FIG. 10, illustrating the engagement of the adjusting screw with the support block for the internal lockup wheel;

FIG. 13 is a perspective view of the lockup wheel positioning plate of the assembly of FIG. 10;

FIG. 14 is a partial view of the lockup wheel of the assembly of FIG. 10 and its associated support plate; and

FIG. 15 is a bottom view of the lockup wheel support plate viewed from line C—C of FIG. 14.

Briefly, according to my invention, I provide improvements in the prior art spiral pipe machine of the so-called roller type. This prior art machine converts a longitudinally corrugated strip having locking lips on opposed longitudinal edges thereof into a circular pipe having spiral corrugations. The prior art machine includes a spiraling apparatus for bending the longitudinally corrugated strip into a circular pipe and for engaging the locking lips to form a spiral seam, and a lock-setting apparatus for locking the engaged lips to maintain the circular shape of the pipe.

My invention comprises the improvement, in combination with the spiral pipe machine described above, whereby the diameter of the resulting circular pipe can be accurately and conveniently controlled to a predetermined value, the improvements comprising means for adjusting the depth of engagement (the "lap") of the locking lips at the point where the circular pipe is formed. Those skilled in the art will understand that the terms "depth of engagement" and "lap" are synonymous and refer to the overlap of the engaged portions of the locking lips as indicated by the reference character A on FIG. 9.

In the presently preferred embodiment of the invention, the means for adjusting the depth of engagement of the locking lips comprise a pair of opposed lock-setting rolls located to position the engaged locking lips therebetween and adapted to exert crimping pressure on the engaged locking lips, thereby to lock the lips in engaged position and maintain the circular shape of the pipe. One of the lock-setting rolls is positioned internally of the pipe and the other of the lock-setting rolls is located externally of the pipe. At least one of the lock-setting rolls, preferably the internal roll, is adjustably locatable axially of the pipe, thereby providing for adjustment of the depth of engagement of the locking lips prior to crimping the lips into locking engagement.

As will be apparent from the following detailed description, my invention is to be carefully distinguished from the prior art roller-type pipe spiraling machine wherein neither of the lock-setting rolls could be adjustably located along the axis of the pipe being formed to vary the depth of engagement of the locking lips as a means of accurately controlling the diameter of the pipe.

Turning now to the drawings, which will enable persons skilled in the art to better understand and practice my invention, FIG. 1 is a perspective view of a typical roller-type spiral pipe machine of the prior art. The ma-

chine generally comprises a storage roll 11 for a coiled strip of material such as galvanized steel. The flat strip 12 is fed from the roll 11 into the rolling mill, generally indicated by reference numeral 13, which comprises a plurality of pairs of opposed corrugating rolls 14. As the strip passes through the successive sets of corrugating rolls 14, corrugations of successively greater depth are rolled into the sheet and locking lips are formed on the opposed longitudinal edges of the strip.

The corrugated sheet 15 (indicated by dashed lines) passes from the rolled mill 13 into the pipe-spiraling and lock-setting machine, generally indicated by reference numeral 16. The pipe-spiraling and lock-setting machine 16 includes a base member 17 supporting a yoke 18 which, in turn, supports an internal mandrel 19 which carries a set of internal mandrel rolls 20. A set of external buttress rolls 21 and a set of external lead rolls (not shown) are also supported by the base member 17. The corrugated strip 15 passes between the internal and external rolls and is bent upwardly by the buttress rolls 21 in an arc which, when closed, forms a pipe of the desired diameter. A plurality of external support rolls 22 carried by the truss frame 23 support the curved corrugated strip by maintaining radial pressure in the direction of the arrows 24. These support rolls assist in maintaining the curved sheet in its proper position for entry into the lock-setting portion of the machine and, in addition, can be used to assist somewhat in maintaining the desired pipe diameter. The curved corrugated strip 25 now re-enters the machine for engagement of the locking lips and for passage through the lock-setting portion of the machine. After engagement and locking of the locking lips, thus forming a circular pipe having spiral corrugations and a spiral seam defined by the engaged and locked locking lips, the pipe moves axially in the direction of the arrow 26 into the run-out and dump table portion of the machine, generally indicated by reference numeral 27. After the desired length of pipe has been produced, a cut-off saw 28 operated by an electrical motor 29 can be moved transversely of the run-out table in the direction of the arrow 30 to sever the desired length of the completed pipe.

The mode of operation of the spiral pipe machine of FIG. 1 is schematically illustrated in FIGS. 2-6. As the corrugated strip 31 having locking lips on opposed edges leaves the rolling mill (not shown) in the direction of the arrow 32, it first encounters a set of lead rolls 33, as shown in FIG. 2. The periphery of the lead rolls 33 ride in the concave surfaces formed by the corrugations and vertically support the strip 31. After passing the lead rolls 33, the strip 31 then rides under a series of internal mandrel rolls 34, as shown in FIG. 3. The internal mandrel rolls 34 and the lead rolls 33 position the corrugated sheet 31 for subsequent bending and prevent buckling of the sheet in the area therebetween. As shown in FIG. 4, the corrugated sheet 31, after passing the lead rolls 33 and the internal mandrel rolls 34, encounters the buttress rolls 35 and is bent arcuately upwardly, inducing in the corrugated sheet 31 a radius of curvature substantially corresponding to the desired radius of the finished pipe. As shown in FIG. 5, the arcuately bent corrugated sheet 31a, after leaving the buttress rolls 35, is positioned and supported by the external support rolls 36 which exert pressure radially inwardly in the direction of the arrows 36a, thus forming the desired circular cross section. Finally, as shown in FIG. 6, the leading edge 31b of the corrugated sheet 31 passes between a pair of lockup rolls 37 and 38 which crimp the now-engaged locking lips forming a spiral seam which maintains the circular cross section of the pipe.

The planar schematic illustrations of FIGS. 2-6 will be better understood by reference to FIG. 7 which is a general perspective view of the pipe-spiraling and lock-setting machine and which illustrates the general mode of operation of the machine. The corrugated sheet 40, having locking lips on opposed longitudinal edges 41 and 42

thereof, is received from the rolling mill (not shown) and passes in the direction of the arrow 43 into the pipe-spiraling and lock-setting machine. After passing the lead rolls and internal mandrel rolls (not shown), the sheet is bent arcuately upwardly in the direction of the arrow 44, thereby inducing a radius of curvature substantially equal to the desired pipe radius. The sheet then passes arcuately downwardly as shown by the arrow 45 and the locking lip of the outside edge 42a is engaged with the locking lip of the inside edge 41a. The engaged locking lips are then crimped into locking engagement by the lockup wheels (not shown) thus forming the spiral seam 43. The pipe thus formed moves axially in the direction of the arrow 44 to the run-out and dump table portion of the machine (not shown).

The operation of the various sets of rolls which perform the support, bending and lockup functions mentioned hereabove is further illustrated in FIG. 8. The lead rolls 51 comprise a plurality of individual rolls, the periphery of each of the lead rolls rides in the concave portions of a corrugation in the corrugated sheet 52 received from the rolling mill. The corrugated sheet 52, supported by the lead rolls 51, then passes under the internal mandrel rolls 53, which also comprise a plurality of individual rolls riding in the corrugations of the corrugated sheet 52 and is bent arcuately upwardly in the direction of the arrow 54a by the buttress rolls 54, which also comprise a plurality of rolls similar to the lead rolls 51 and the internal mandrel rolls 53. The buttress rolls 54 may be adjustably positioned horizontally as shown by the double arrow 54b to vary the radius of curvature of the arcuately bent corrugated sheet 52a. Also, the diameter of the pipe is effected by the angle θ (indicated by reference numeral 55 on FIG. 7) between the corrugated sheet 40 entering the pipe-spiraling machine and the longitudinal axis of the pipe thus formed. Also, all sets of rolls can be adjusted axially of the pipe to accommodate various widths of corrugated sheets and each of the individual rolls of the lead rolls, the internal mandrel rolls, and the buttress rolls can be angularly adjusted to ride in the corrugations of the pipe or corrugated sheet as the angle θ (reference character 55 of FIG. 7) is varied to adjust the pipe diameter.

In the roller-type prior art pipe-spiraling and lock-setting machine, the internal lock-setting roll cooperating with the external lock-setting roll to crimp the engaged locking lips, thereby forming the spiral pipe seam, was integrally included as the endmost roll of the internal mandrel rolls. The axial, vertical and angular adjustment of the internal mandrel rolls also governed the axial, angular and vertical position of the internal lock-setting roll. However, according to the present invention, the depth of engagement of the locking lips prior to crimping is adjustable because the position of the internal lock-setting roll can be adjusted independently of the internal mandrel rolls, as will be explained in the description of the remainder of the drawings. This feature of adjustability of the internal lock-setting roll permits one to continuously adjust and accurately maintain the desired predetermined pipe diameter without further gross adjustment of the entrance angle of the corrugated sheet into the pipe-spiraling machine or the horizontal position of the buttress roll. Formerly, these gross adjustments in entrance angle and horizontal position of the buttress roll were the only means available for controlling the diameter of the pipe being formed. These adjustments provided only very "coarse" control of the pipe diameter and attempts to adjust the pipe diameter while the machine was in operation by variation of the pipe entrance angle or buttress roll position induced growing or shrinking tendencies in the circular corrugated pipe which seriously affected the quality of the pipe and the ability of the operator to maintain the desired diameter specifications.

Referring to FIG. 9, which shows in detail the method of varying the depth of engagement of the locking lips, 75

according to a presently preferred embodiment of the invention, the corrugated sheet 58 provided with locking lips 59 and 59a on opposed longitudinal edges thereof is supported by the lead rolls 60 as it enters the lock-setting machine and passes under the internal mandrel rolls 61 supported by the internal mandrel 62. After encountering the buttress rolls (not shown) as described above and being bent arcuately upwardly to provide the desired radius of curvature, the bent sheet 63 then passes downwardly and the outer locking lip 64 of the bent corrugated sheet 63 engages the inner locking lip 59a of the corrugated sheet 58 entering the machine. After engagement of the locking lips 64 and 59a, the engaged lips pass between the internal lockup roll 65 and the external lockup roll 66, which rolls crimp the engaged locking lip to form the spiral seam which maintains the arcuately bent corrugated sheet in the form of a circular pipe having spiral corrugations. According to the presently preferred embodiment of the invention, the depth of engagement of the locking lips 64 and 59a is controlled by varying the axial position of the internal lockup roll 65 along a line indicated by the double arrow 67. The specific mode of adjustment of the axial position of the internal lockup roll 65 is illustrated in the remaining drawings.

As previously explained, in the prior art roller-type machines for producing spiral corrugated pipe, the diameter of the pipe was controlled only by adjustments in the angle of entry of the corrugated sheet into the pipe-spiraling machine and by adjustments in the horizontal position of the buttress rolls. According to the present invention, the diameter of the pipe is controlled by first making the necessary gross adjustments in entrance angle and buttress roll position, and then adjusting the depth of engagement of the locking lips, followed by further small changes in buttress roll position, if necessary. According to the presently preferred embodiment, the adjustment of depth of engagement of the locking lips is performed by adjusting the position of the internal lockup roll (reference numeral 65 of FIG. 9). As will be appreciated by those skilled in the art, other methods of adjusting the depth of engagement of the locking lips can be employed to produce the same degree of control over the pipe diameter. Thus, in another embodiment of the invention, the external lockup roll (reference numeral 66 of FIG. 9) can be made similarly adjustable to provide the desired adjustment of depth of engagement. It is therefore to be understood that I do not limit the scope of my invention to any specific means for adjusting the depth of engagement of the locking rolls. Rather, the invention, considered in its broader aspects, resides in the discovery that the diameter of the pipe can be accurately controlled by varying the depth of engagement of the locking lips and the specific means employed to accomplish this function can be varied to suit the requirements of the individual machines involved and according to other relevant factors.

Turning again to the drawings which illustrate the presently preferred embodiment of the invention chosen for purposes of illustration, the particular mode of adjustably positioning the internal lockup roll is illustrated in FIGS. 10-15, in which the reference numerals identify the same elements in the various views. FIG. 10 is a detail plan view of the assembly for positioning the internal mandrel rolls of the apparatus of FIGS. 1-9. The rolls are positioned on the underneath side of the internal mandrel by means of a frame assembly comprising a floor plate 70, longitudinal riser member 71 and longitudinal cap members 72. The elements are maintained in assembled position by the cap screws 73 positioned at spaced points along the sides of the assembly. For convenience of illustration, in FIG. 10 cap members 72 and cap screws 73 are omitted. Referring specifically to FIG. 10, the internal mandrel rolls 74 (two shown) are positioned along the longitudinal axis of the floor plate 70 in abutting relation, the position of each roller being maintained by grooved locking inserts 75 which receive projecting run-

ners extending downwardly from the base members 76 which support each of the internal mandrel rolls 74. Thus, the plurality of individual internal mandrel rolls 74 is maintained in coequal angular position by the grooved locking inserts 75 and will self-adjustably engage the corrugations of the corrugated strip entering the pipe-spiraling machine at the proper entrance angle which is pre-selected to provide the desired pipe diameter. The internal lockup roll 77 is mounted upon a base plate 78 which is received within the channel formed by the frame members 70, 71 and 72 and is positioned within the channel independently of the internal mandrel rolls 74. The axial position of the internal lockup roll 77 along a line indicated by the double arrow 79 is adjusted by means of an adjusting screw 80 acting upon a positioning block 81 which has an arcuate groove 82 which receives an arcuate runner 82a projecting downwardly from the internal lockup roller base 78. The angular position of the internal lockup roll is adjusted and maintained by means of an adjusting screw 81a acting upon a locking follower 82b having a cam face 83 which engages a cam surface 84 on the side of the base 78.

Referring specifically to FIG. 11, which is a sectional view taken along section line A—A of FIG. 10, the positioning block 81 is slidably received in the channel formed by the floor plate 70, the longitudinal riser members 71 and the longitudinal cap members 72. A longitudinal hole 85 receives the adjusting screw 81a for the locking follower 82b. A slot 86 having a downwardly projecting forward edge 87 is provided in the face of the positioning block 81. This slot 86 receives a spool piece 88 on the end of the adjusting screw 80. This assembly is shown more specifically in FIG. 12.

A more complete understanding of the general contours and shape of the adjusting block may be had by reference to FIG. 13 which shows the block 81 provided with the arcuate groove 82.

FIGS. 14 and 15 further illustrate the shape and various elements of the lockup roller base and lockup roller assembly. The base 78 is provided with a downwardly projecting arcuate lip 82a which is received in the arcuate groove 82 of the positioning block 81. A vertical support portion 88a extends upwardly from the base 78 and is drilled to receive a bearing support shaft 89 which carries the bearing 90 upon which the internal lockup wheel 77 rotates.

The radius of curvature of the arcuate lip 82a is the distance r of FIG. 15. The entire lockup wheel base-lockup wheel assembly rotates about a vertical axis of rotation indicated by the crossed center lines c . This line, extending upwardly, would pass through the periphery p of the internal lockup wheel.

The invention herein described would, of course, be equally applicable to the production of smooth-wall spiral pipe, in addition to the spiral corrugated pipe mentioned hereinabove. The invention provides a means of accurate control of the diameter of a pipe formed by bending or otherwise deforming a flat sheet in a spiral and then joining the edges of the spiral to form a spiral seam by engaging and crimping locking lips on opposed edges of the sheet.

Various changes in the devices and methods chosen for purposes of illustration in the drawings and specification will readily occur to persons skilled in the art having regard for the disclosure hereof. To the extent that such modifications and variations do not depart from the spirit of the invention, they are intended to be included within the scope thereof which is not limited to the devices and methods specifically illustrated in the drawings and specification but, rather, only by a just interpretation of the following claims.

Having fully described the invention in such manner

as to enable those skilled in the art to understand and practice the same, the invention claimed is:

1. In a spiral pipe machine for converting a longitudinally corrugated strip having locking lips on opposed longitudinal edges thereof into a circular pipe having spiral corrugations including

a spiraling apparatus for bending the longitudinally corrugated strip into a circular pipe and for engaging said locking lips to form a spiral seam, and

a lock-setting apparatus for locking said lips to maintain the circular shape of said pipe,

the improvements in combination therewith whereby the diameter of the resulting circular pipe can be accurately controlled comprising

means for adjusting the lap of said locking lips at the point where said circular pipe is formed.

2. Improved spiral pipe machine of claim 1 wherein the means for adjusting the depth of engagement of said locking lips comprises a pair of opposed lock-setting rolls located to position the engaged locking lips therebetween and adapted to exert crimping pressure on said engaged locking lips, thereby to lock said lips in engaged position to maintain the circular shape of said pipe.

one of said lock-setting rolls being positioned internally of said pipe, and

the other of said lock-setting rolls being located externally of said circular pipe,

at least one of said lock-setting rolls being adjustably locatable axially of said pipe, thereby providing for adjustment of the lap of said locking lips prior to crimping said lips into locking engagement.

3. Improved spiral pipe machine of claim 1 wherein the means for adjusting the depth of engagement of said locking lips comprises

a lock-setting roll located externally of the circular pipe and

a lock-setting roll positioned internally of said pipe, said internally positioned lock-setting roll being adjustably rotatable axially of said pipe, thereby providing for adjustment of the lap of said locking lips prior to crimping said lips into locking engagement.

4. In a method of continuously producing spiral pipe comprising arcuately bending an elongate sheet into a spiral shape and continuously forming a spiral seam by engaging locking lips located on opposed edges of said elongate sheet and crimping said edges into locking engagement, the improvements in said method whereby the diameter of the resulting pipe is controlled to a predetermined value including the steps of

adjusting the lap of said locking lips prior to crimping them into locking engagement, and

crimping said lips into locking engagement after adjusting the lap thereof.

5. Method of claim 4 wherein said adjustment of the lap of said locking lips is accomplished by varying the axial position of lockup rolls positioned in opposed relation, one of said rolls being located internally of said pipe and the other of said rolls being located externally of said pipe.

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U.S. Cl. X.R.

72—135