Dec. 13, 1938. A. BENSON 2,139,714

MACHINE AND PROCESS FOR MAKING CORRUGATED TUBING

Filed Jan. 2, 1936 3 Sheets-Sheet 1

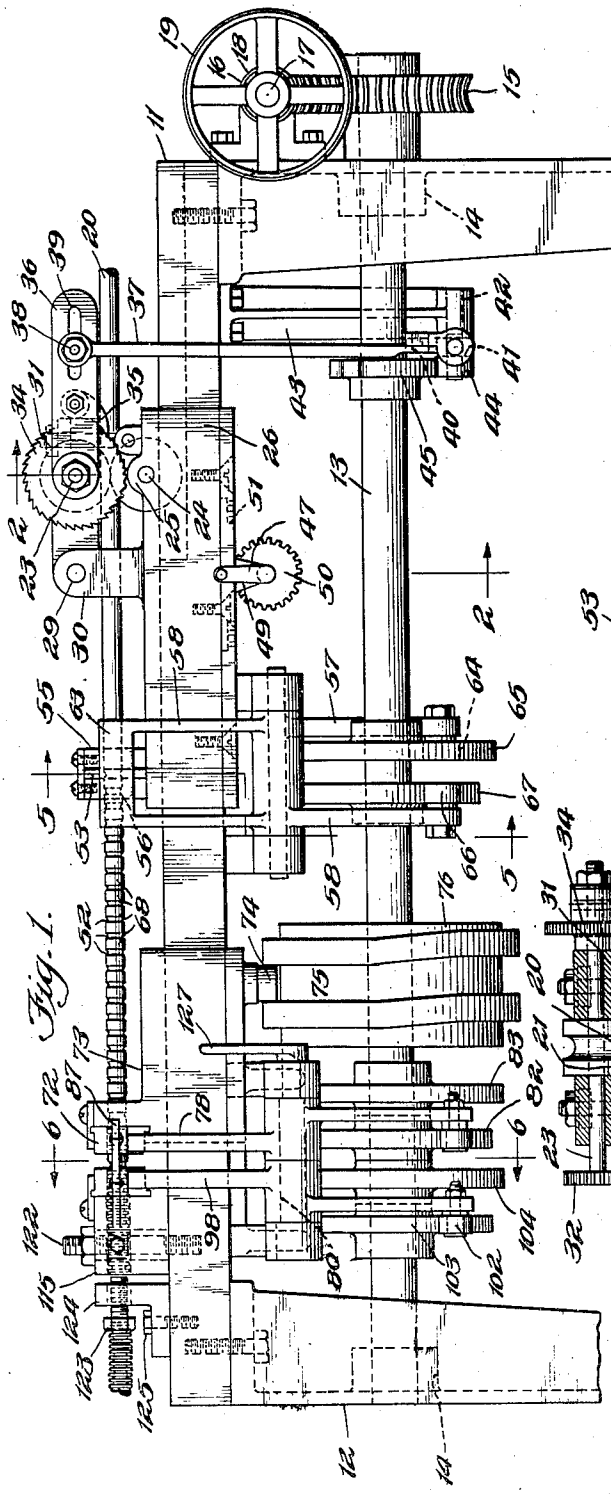


Fig. 1.

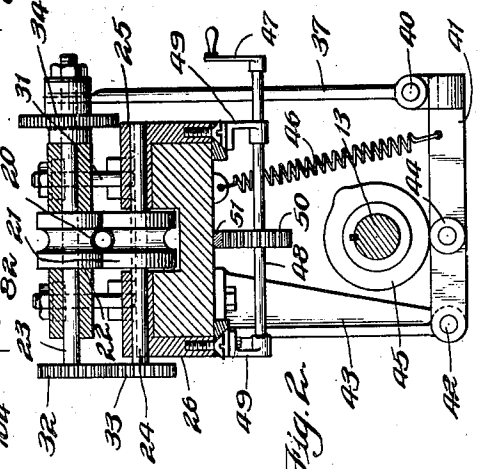


Fig. 2.

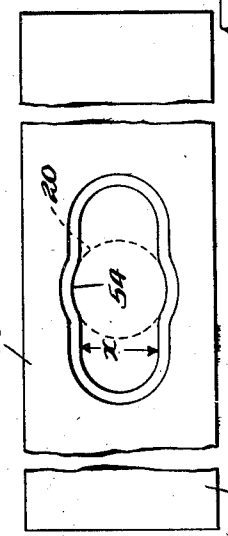


Fig. 3.

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Filed Jan. 2, 1936 3 Sheets-Sheet 2

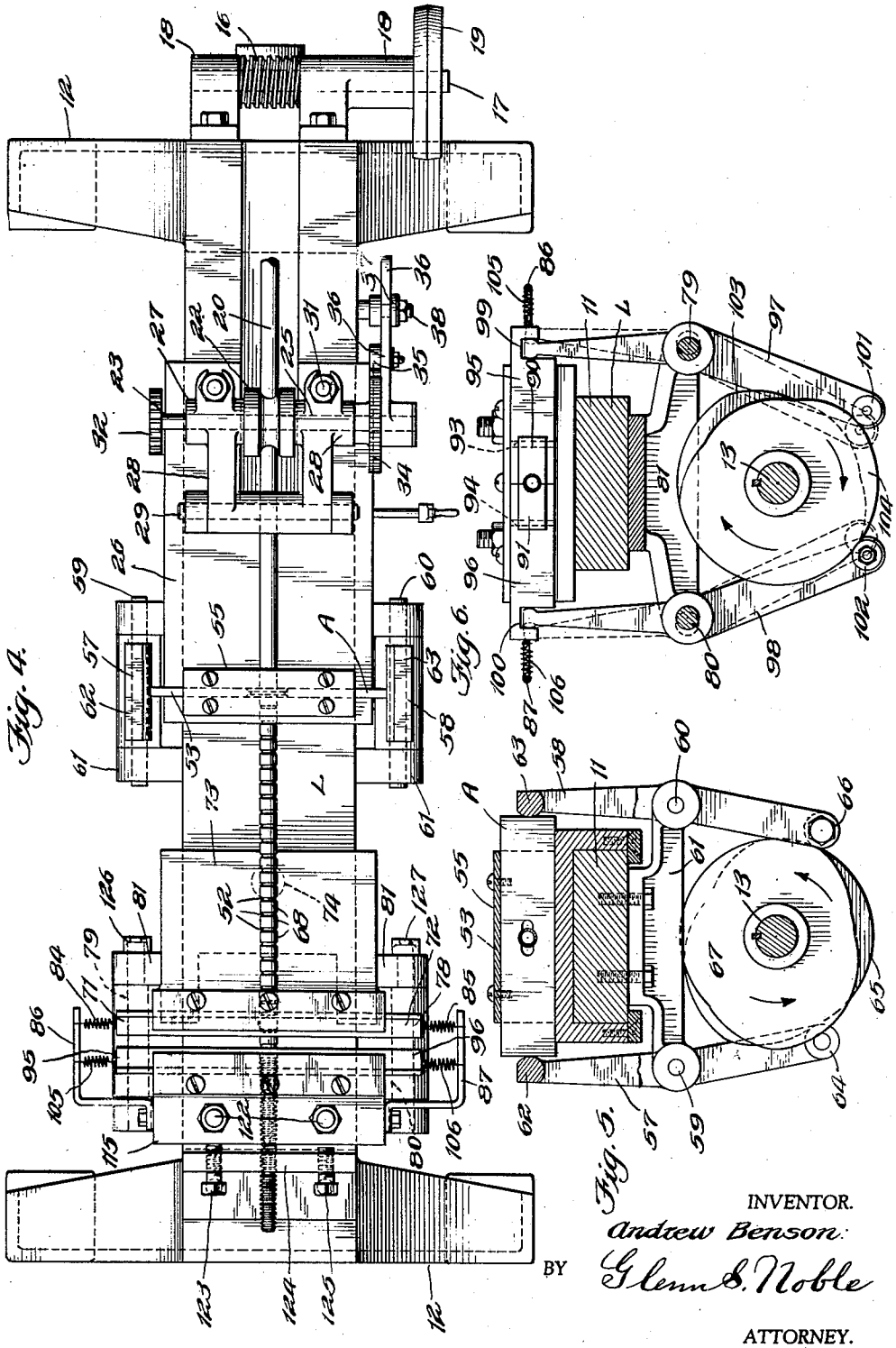


Fig. 4.

Fig. 6.

Fig. 5.

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Filed Jan. 2, 1936 3 Sheets-Sheet 3

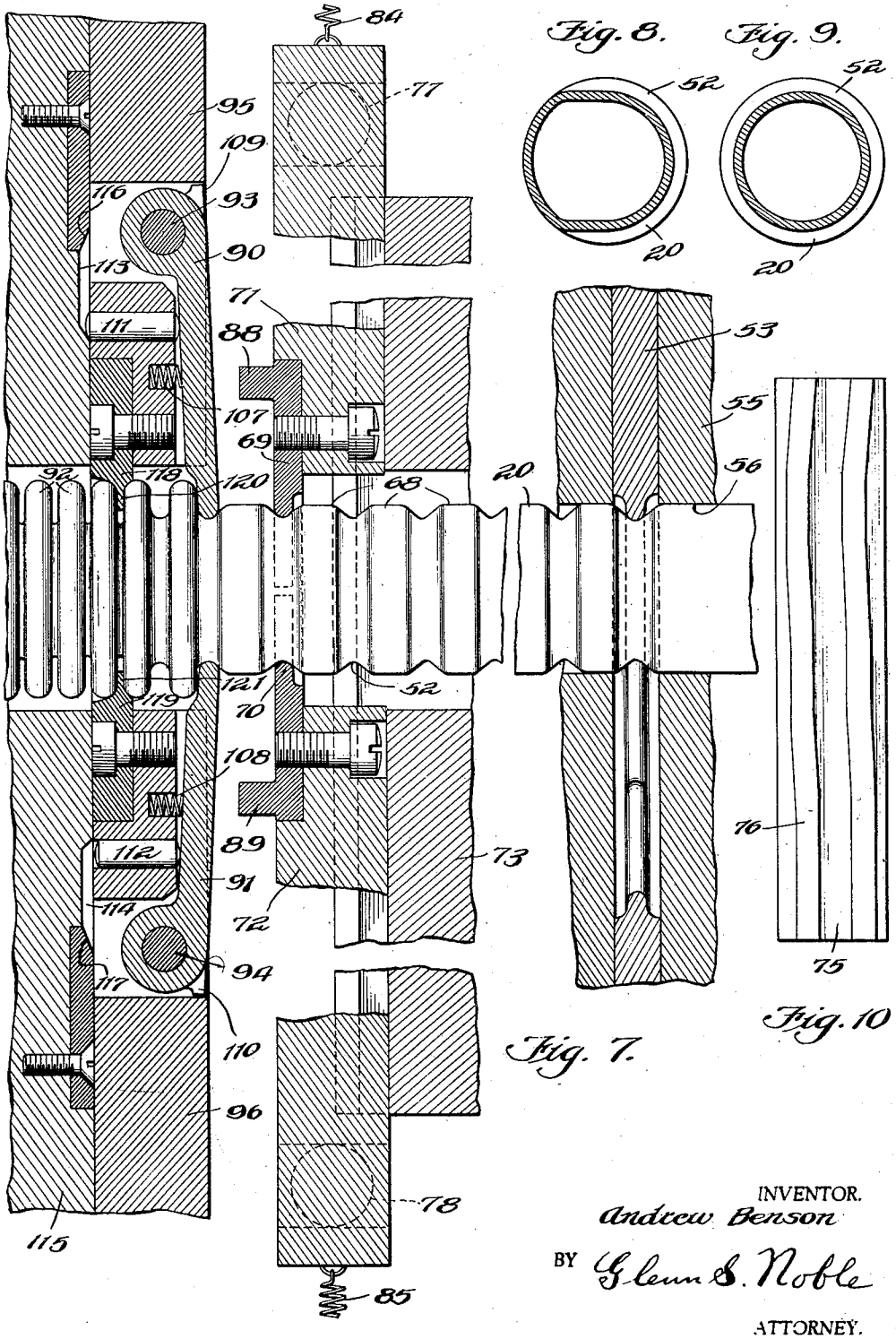


Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10

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MACHINE AND PROCESS FOR MAKING CORRUGATED TUBING

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Application January 2, 1936, Serial No. 57,141

15 Claims. (Cl. 153—73)

Corrugated tubing is a well known product and is desirable for many purposes, particularly where flexibility is desired. Various methods have been heretofore used or proposed for making such tubing but such methods and apparatus therefor have been subject to various objections and have not proven satisfactory. One of the objections common to some of such methods is that the process does not provide for compressing the partly formed corrugations to complete the compressed tube.

The present invention relates generally to an improved method for making such tubing whereby tubes of any length, or continuous tubing, may be made in an economical and satisfactory manner, and the corrugations compressed and spaced to complete the forming of the tube.

Other objects of this invention reside in a step-by-step series of operations whereby the tubing is first grooved and then the sections between the grooves compressed to complete the corrugations; to provide an improved method of making corrugating tubing in continuous lengths; to provide improved apparatus for making corrugated tubing in an expeditious and an economical manner; to provide an apparatus for first grooving the blank tubing and then compressing the intermediate material to complete the corrugations; to provide a novel die or forming means and operation for forming grooves in the tubing; to provide novel means for compressing the grooved sections and spacing the same to complete the corrugating operation; and to provide such other improvements in operation and in the apparatus as will appear more fully from the following description.

In the accompanying drawings illustrating this invention,

Figure 1 is a side elevation showing one form of my tube corrugating machine;

Figure 2 is a sectional view taken on the line 2—2 of Figure 1;

Figure 3 is a detail showing a preferred form of groove-forming die;

Figure 4 is a plan view of the machine;

Figure 5 is a sectional view taken on line 5—5 of Figure 1;

Figure 6 is a sectional view taken on the line 6—6 of Figure 1;

Figure 7 is an enlarged sectional detail illustrating the grooving and compressing operations, parts being omitted or shown in section for convenience in illustration;

Figures 8 and 9 are enlarged sectional views illustrating the groove forming operations; and

Figure 10 is a face view of one of the operating cams.

The sequence of operations in carrying out my improved method are substantially as follows: circumferential grooves are first formed in the tubing blank by means of unique forming means such as a die or dies which first partially form the grooves and then complete the forming operation, leaving intermediate annular sections which are to be acted upon to form the corrugations. The next operation consists in compressing these intermediate portions to form the corrugations and to properly space the same to complete the corrugated tube, all of these operations being carried on in a step-by-step or substantially continuous manner.

In order to carry out these operations I provide a machine having a main frame or bed 11 which is supported on legs 12. A main operating shaft 13 is carried in bearings 14 and may be driven in any suitable manner as by means of a worm wheel 15 which is driven by a worm 16 on a transverse shaft 17 carried in bearings 18 and actuated by a pulley or driving wheel 19 from any suitable source of power.

The blank tube or work piece 20 is first engaged by feed rollers 21 and 22 which are carried respectively on shaft 23 and 24. The shaft 24 is carried in bearings 25 on a carriage 26 which is slidably mounted on the bed or main frame member 11. The shaft 23 is carried in bearings 27 on arms 28 which are pivotally mounted on a shaft 29 carried in upwardly extending brackets or bearings 30 on the carriage 26. The free ends of the arms 28 may be fastened in adjusted position by means of eye bolts 31 as shown in Figures 1 and 4.

The shafts 23 and 24 are connected or driven in unison by gears 32 and 33. The shaft 23 is actuated to provide for the feeding movement by means of a ratchet wheel 34 which is engaged by a pawl 35 mounted on an arm 36 pivoted on the shaft 23. The free end of the arm 36 is pivotally connected with one end of a reciprocating rod 37 by means of a bolt or pivot 38 which may be adjusted along the slot 39 in order to vary the length of the feed. The rod 37 is pivoted at 40 to one end of a lever 41 which in turn is pivoted at 42 on a bracket 43 extending downwardly from the main frame. The lever 41 is actuated by means of a roller 44 which is engaged by means of a cam 45 on the shaft 13 whereby the rod 37 will be moved downwardly to actuate the pawl 35 and other parts to turn the feed rollers. The lever 41 and parts connected therewith are held

in normally raised position by resilient means such as a spring 46. It will be readily seen that as the cam 45 is rotated, the pawl 35 will be actuated to turn the ratchet wheel 34 and the length of the stroke may be varied by adjusting the bolt 38.

The carriage 26 may be adjusted manually along the bed 11 by means of a crank 47 on a shaft 48 which is mounted in bearings 49 secured to the carriage 26. A gear 50 on the shaft 48 engages with a rack 51 on the bed 11 so that when the handle is turned the carriage will be caused to move longitudinally of the bed for adjustment purposes which will presently be explained.

The circumferential grooves in the tube or work piece 20 such as shown at 52 are formed by means of a die 53 having an opening therethrough of the form shown in Figure 3. The central part of the opening 54 has sides of segmental form, this part of the opening being sufficiently large to permit the tube or work piece 20 to pass freely therethrough. The sides of the opening adjacent to the central portion are substantially parallel and the distance between the same as shown at x is substantially the same as the diameter of the bottom of the groove 52. The ends of the opening are of semi-circular form, each of which conforms to the shape of one-half of the groove. The cross section of the inner edge of the die forming the periphery of the opening is substantially the same as the cross section of the groove to be formed in the tube. The die 53 is slidably mounted in a supporting block 55 carried by the carriage 26, which block has a hole 56 for receiving the tube 20, as shown in Figure 7, and serves as a support or coacting die member.

The die 53 may be actuated by any suitable mechanism for reciprocating the same, which in the form shown comprises two levers 57 and 58 which are pivotally mounted at 59 and 60 on a bracket 61 secured to the bed 11 as shown in Figure 5. The upper ends of these levers are bifurcated and connected by bars or contact pieces 62 and 63 which engage with the ends of the die 53 as shown in Figure 5, and are of sufficient length to maintain engagement therewith at any point of adjustment of the die longitudinally of the bed 11. The lever 57 has a roller 64 at its lower end which engages with a cam 65 on the shaft 13 and the lever 58 has a roller 66 at its lower end which engages with another cam 67 also mounted on the shaft 13. These cams are so shaped that the die 53 will be moved from a central position in one direction to groove one side of the tube and then in the opposite direction to finish the groove and then return to central position to permit the free longitudinal movement of the tube for the next operation.

The forming of the grooves 52 leaves intervening annular ribs or sections 68 which are of the same diameter as the tube and somewhat elongated as shown at the right in Figure 7. The next step in the operation is to compress these sections longitudinally of the tube in order to complete the corrugations. To accomplish this I provide one set of jaws 69 and 70 which are secured respectively in slides 71 and 72 which are mounted transversely to the work piece in a second carriage or table 73 which is also slidably mounted on the bed 11. This carriage is reciprocated by means of a roller 74 which engages with a cam groove 75 in a cam wheel 76 on the main shaft 13. The inner periphery of the opening between the jaws 69 and 70 is substantially the same as the diameter of the bottom of the grooves 52 and the edges of the jaws forming such opening is of approximately the same cross section as the bottom of the grooves, as shown in Figure 7, so that when the jaws are closed they will grip the tube at the bottoms of the grooves preparatory to compressing the intermediate uncrimped portion 68. The slides 71 and 72 are moved inwardly by means of levers 77 and 78 which are pivoted on shafts 79 and 80 carried in a bracket 81 on the bottom of the bed 11. The lower ends of these levers are provided with rollers which engage respectively with cams 82 and 83 on the shaft 13, these cams being formed to cause the jaws to move inwardly to closing position. The slides are normally urged toward open position by means of springs 84 and 85 which are connected at their outer ends with brackets 86 and 87 which extend outwardly from a fixed portion of the main frame structure. The jaws 69 and 70 are also provided with lugs or projections 88 and 89 which cooperate with other jaws 90 and 91.

The jaws 90 and 91 coact with the jaws 69 and 70 and also with other operating parts to complete the compressing or forming of the completed corrugations 92 as shown in Figure 7. The jaws 90 and 91 are pivoted at 93 and 94 respectively on slides 95 and 96, which slides are operated by a cam and lever means which are substantially duplicates of the operating means just described for the slides 71 and 72. For this purpose levers 97 and 98 are pivoted on the shafts 79 and 80 and have their upper ends engaging with recesses 99 and 100 in the ends of the slides as shown in Figure 6. The lower ends of the levers are provided respectively with rollers 101 and 102 which coact with cams 103 and 104 mounted on the main shaft 13. These cams move the lower ends of the levers outwardly at the proper times to force the slides together to holding position. The slides and parts coacting therewith are moved outwardly or to free position by means of springs 105 and 106 which are connected with the slides and with the brackets or pins 86 and 87 as shown in Figures 4 and 6.

The jaws or compressing dies 90 and 91 have a limited swinging movement on the pins 93 and 94 and are urged outwardly by means of springs 107 and 108 as shown in Figure 7. The jaws are also provided with stop lugs 109 and 110 to limit their outward swinging movement. While the springs will ordinarily be sufficient to provide for such swinging movement, I also provide pins 111 and 112 which are mounted in the slides 95 and 96 transversely to the jaws and have their inner ends engaging with the jaws. The opposite ends of these knock-out pins project into slots or recesses 113 and 114 in the block or frame member 115 in which the slides are mounted and at the ends of the opening strokes of the slides these pins engage with the tapered portions of cams or plates 116 and 117 which force the pins inwardly against the jaws and consequently swing the jaws on their pivots.

Tube holding and corrugation compressing jaws 118 and 119 are also mounted in the slides 95 and 96 to cooperate with the jaws 90 and 91 in completing the corrugations. The jaws 118 and 119 have inwardly extending annular gauge or blade portions 120 and 121 which determine the final spacing between the corrugations as will be seen from Figure 7.

The block or frame piece 115 is secured to the bed 11 by means of bolts 122 and has a limited adjustability on account of having the bolts pass through elongated slots therein. This block may

be adjusted longitudinally of the bed by means of set screws 123 which pass through a bracket 124 which is secured to the bed by screws 125. In order to release the sets of jaws from the tubing the shafts 79 and 80 are mounted eccentrically in their bearings in the bracket 81 and are provided with handles 126 and 127 for turning the same which will permit or throw the upper ends of the levers outwardly and thereby withdraw the slides from engaging position.

When a tube or work piece such as the tube 20 is to be corrugated the end is passed between the feed rollers 21 and 22 and its forward end inserted in the hole in the supporting block and grooving slide housing 55 and through the central opening 54 in the grooving die 53. The machine may then be started and will reciprocate the grooving die whereby the margin or periphery forming one end of the opening therein will be forced against the tubing and will form the groove around approximately one-half thereof as shown in Figure 8. During this movement it will be noted that the shoulders in the edges of the die adjacent to the central opening will first engage with the surface of the tube and start to depress the groove therein and as the movement of the die member progresses the adjacent engaging edges will gradually press the walls inwardly until the groove is formed. When the die has moved to its extreme position in one direction the cams will actuate the same to move it in the opposite direction so that the periphery or engaging portion around the opposite end of the opening will act upon the opposite side of the tubing and thereby complete the groove as shown in Figure 9. While this operation may be made with one movement in either direction for ordinary tubing, the same operations may be performed in a series of steps if necessary for other kinds of material or tubing and for this purpose a plurality of similar dies (not shown) may be utilized. After the groove has been formed the cams will bring the die 53 to central position preparatory to the forward feed of the tube which is accomplished by the rack and pawl mechanism above described and which is adjusted to move the tube forward one step or for one corrugation. This operation is continued until the forward end of the tube is approximately in position to be engaged by the jaws 69. In order to bring these jaws into register with the first groove it may be necessary to adjust the carriage 26 which may be done by means of the handle 47 and parts connected therewith as heretofore described. When the forward groove is in position to be engaged by the jaws 69 and 70 the machine is again actuated and the formation of the grooves will be continued throughout the length of the tube. At this time the jaws 69 and 70 will move inwardly until they encircle the grooved portion of the tube and fit tightly around the same. In the meantime the jaws 90 and 91 have also moved into position to engage with the tube. The table 73 then moves forwardly which causes the jaws 69 and 70 to compress the intermediate portion 68 of the tube between these jaws and the jaws 90 and 91, thus partially forming the corrugations or folds in the tube. During the forward movement of the table 73 the projections 88 will engage with the jaws 90 and 91 and move their inner ends forwardly, thus advancing the partially formed corrugation and pressing the same toward the jaws 118 and 119 which act as stops or abutments to hold the tube during such forward movement. After the slide 73 has moved forward to perform the above operations, the cams and coacting parts permit the withdrawal of the jaws 69 and 70 and the table 73 moves back preparatory for the next operation. The sets of jaws 90 and 91 and 118 and 119 are then withdrawn from engagement with the tube which is fed forward another step or corrugation and these jaws are then moved inwardly to engage with the partially formed corrugations preparatory for the next operation and as these operations are continued the completely formed corrugated tubing will be discharged from the machine in a step by step movement. It will be noted that the space between the corrugations may be regulated or determined by the thickness of the annular blades or gauge pieces 120 and 121.

The necessary adjustments and details of the operation will be readily understood by those familiar with this art and it is thought that the above description is sufficient to fully disclose the operation of the machine. It will also be noted that changes may be made in the construction as well as in the operation in order to adapt the same to different conditions or different forms of tubing and therefore I do not wish to be limited to the particular construction herein shown and described or to the method of operation, except as specified in the following claims, in which I claim:

1. In an apparatus of the character set forth, the combination of support means for supporting a tube, a coacting die member having an opening therein with the central portion larger than the tube and the end portions of less diameter than the tube, with their peripheries shaped to conform to grooves to be made in the tube, and means for reciprocating said die member to bring the end portions alternately into engagement with the tube to form annular grooves therein.

2. In a machine for operating on a tube of any desired length, the combination of means for supporting the tube which engages with the outside of the tube only, means for feeding the tube with a step-by-step movement, a die having a groove forming portion defining an opening in the die for engagement with the sides of the tube to form an annular groove therein, and means for reciprocating said grooving die to cause it to engage with the opposite sides of the tube to form the grooves.

3. In a machine for corrugating a tube, the combination of die means for forming annular grooves in the tube, means for actuating said die means, means for feeding the tube to the die means with step by step movement, a pair of corrugating dies for compressing the portions of the tube between the grooves longitudinally of the tube, means for actuating said last named dies to bring them into and out of engagement with the grooves in the tube, and means for causing said last named dies to move relatively toward each other lengthwise of the tube to compress the intermediate portion of the tube.

4. In a machine for corrugating tubing, the combination of die means for engagement with the tube to form annular grooves, means for actuating said die means, means for feeding the tube through the die means, a pair of jaws which engage with one of the grooves in the tube, a second pair of jaws which engage with the next adjacent groove of the tube, means for moving the last named jaws longitudinally of the tube to compress the intermediate portion thereof to form an outwardly extending corrugation, and

spacing means coacting with said jaws for spacing the corrugation.

5. In a machine for corrugating tubing, the combination of a pair of spacing and holding jaws having inwardly projecting annular blade portions which are pressed between two adjacent corrugations on the tube to space the corrugations uniformly, said jaws also serving to hold the tube against longitudinal movement during the corrugating action, means for reciprocating said jaws, a second pair of jaws pivotally mounted adjacent to the first named jaws with their free ends having annular portions for engagement with grooves in the tube, means for reciprocating the second named jaws, means for forcing the free ends of the second named jaws toward the first named jaws for completing the corrugating action, a third pair of jaws having annular portions for engagement with grooves in the tube, means for reciprocating the last named jaws, and means for moving them longitudinally of the tube to compress portions of the tube to form annular corrugations in the tube.

6. In a machine for corrugating tubing, the combination of a support, a pair of slides mounted in said support, means for reciprocating said slides, a pair of holding and spacing jaws mounted in the slides and having segmental blade portions to be inserted between adjacent corrugations, a second pair of jaws pivotally mounted in said slides and having their free ends shaped to engage with grooves in the tube, yielding means tending to hold the free ends of the pivoted jaws in normal position, a second pair of slides mounted in the support adjacent to the first named slides, means for reciprocating the last named slides, jaws mounted in the last named slides having their inner portions shaped to engage with grooves in the tube, and means for moving the last named slides toward and away from the first named slides, and projections on the last named jaws which engage with the free ends of the pivoted jaws to cause them to move toward the holding jaws.

7. In a machine for corrugating tubing, the combination of a frame having a longitudinal bed, a carriage slidably mounted on the bed, a die block on the carriage having a hole therethrough for receiving the blank tube, a die slidably mounted in the block and having an opening with its central portion of greater diameter than the tube and having segmental end portions with their peripheries of less diameter than the tube and adapted to form annular grooves in the tube, a driving shaft mounted in said frame, cams on said shaft, levers pivotally mounted on the frame and coacting with the cams for reciprocating the die, a pair of feed rollers mounted on the carriage, means actuated by the shaft for turning said rollers intermittently to feed the tube, means for adjusting the feeding means, manually operable means for adjusting the carriage longitudinally of the bed, a table slidably mounted on the bed, a projection on said table, a cam on the shaft engaging with the projection for reciprocating the table, a pair of slides mounted in the table, cams on the shaft, levers pivotally mounted on the frame and coacting with the cams for forcing said slides inwardly, yielding means for moving the slides outwardly, jaws mounted in said slides and having segmental portions which engage with the grooves in the tube, a block adjustably secured to the bed, a pair of slides mounted in said block adjacent to the first named slides, cams on said shaft, levers pivotally mounted on the frame and coacting with the cams for moving the last named slides inwardly, yielding means for moving the last named slides outwardly, a pair of holding and spacing jaws rigidly secured in the last named slides and having segmental portions for engagement with the corrugations in the tube, a pair of corrugating jaws pivotally mounted in the last named slides and having segmental portions which engage with grooves in the tube and coact with the first named jaws for partially forming the corrugations, and means coacting with the last named jaws to move their free ends toward the holding jaws during the corrugating operation and to return them to normal position after the corrugating operation.

8. In a machine of the character set forth, the combination of a frame having a longitudinal bed, a shaft mounted in said frame, means for turning said shaft, a carriage slidably mounted on the bed, rack and gear mechanism for manually adjusting the carriage longitudinally of the bed, a feed roller mounted on the carriage, levers pivotally mounted on the carriage adjacent to the feed roller, a shaft carried by said levers, a second feed roller mounted on the shaft and coacting with the first named roller for feeding the tube, a cam on the shaft, a lever having a roller coacting with the cam, a rod pivotally connected with the lever, an arm on the last named shaft, means for adjustably connecting the arm with the rod, a pawl carried by said arm, a ratchet wheel on the last named shaft which is actuated by the pawl for turning the feed rollers, a die block on the carriage having a hole therethrough for the tube, a grooving die mounted in said block, means actuated by the shaft for reciprocating the die to form grooves in the tube, crimping means mounted on the bed in alignment with the feeding and grooving means for engagement with the tube to compress and space the portions of the tube between the grooves to form annular folds, and means actuated by the shaft for operating said crimping means.

9. In a machine of the character set forth, the combination of a frame having a longitudinal bed, a main shaft mounted in the frame, means for turning said shaft means on the bed for receiving and feeding a tube therethrough, means actuated by the shaft for operating said feeding means, means on the frame for forming annular grooves in the tube, means actuated by the shaft for operating said grooving means, crimping and spacing means mounted on the frame for folding the portions of the tube intermediate the grooves to form annular projections spaced evenly apart, and means actuated by the shaft for operating said crimping and spacing means.

10. The method of corrugating tubing which includes placing the tube in a support which engages with the outer surface thereof, then forming annular grooves therein by means of an external reciprocating die having an opening through which the tube passes, provided with oppositely disposed groove forming portions whereby a substantially semi-circular portion of the groove will first be formed in one side of the tube and then a similar portion of the groove formed on the other side to complete an annular groove in the tube.

11. The method of corrugating tubing which consists in forming a plurality of evenly spaced grooves in the tube, then subjecting the portions of the tube between the grooves to longitudinal pressure by means of suitable dies to compress

said portions and form peripheral corrugations in the tube.

12. The method of corrugating tubing, pipe or the like, which consists in first forming annular grooves in the tube which are spaced evenly apart, then holding the tube against longitudinal movement and simultaneously compressing the portion of the tube between two of the grooves to form an annular corrugation, and simultaneously compressing the tube between two previously formed corrugations to complete the regular spacing of said corrugations.

13. An apparatus for forming grooves in tubing, including a support adapted to engage with the outer surface only of the tubing for supporting the same during the grooving operation and coacting die means having oppositely disposed U-shaped grooved portions, and means for reciprocating said die means to cause the opposite grooving portions to engage alternately with the opposite sides of the tube whereby a complete annular groove will be formed in the tube.

14. An apparatus for operating on tubing, including a die having a recess with a peripheral portion shaped to conform to a groove to be made in the tubing, a coacting support engaging with the outer surface only of the tubing for supporting the same during the grooving operation, and means for actuating the die to force it into engagement with the tubing to form a groove therein.

15. In a machine for operating on a tube of any desired length, the combination of means for supporting the tube which engages with the outside of the tube only, means for feeding the tube with a step-by-step movement, a die having a groove forming portion defining an opening in the die for engagement with the sides of the tube to form an annular groove therein, said groove forming portion being shaped to conform to the groove to be made in the tube, and means for operating said grooving die to cause it to engage with the opposite sides of the tube to form the groove.

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