Nov. 16, 1965 W. BOA 3,217,501

APPARATUS FOR FORMING TUBES FROM STRIP MATERIAL

Filed Dec. 28, 1960 2 Sheets-Sheet 1

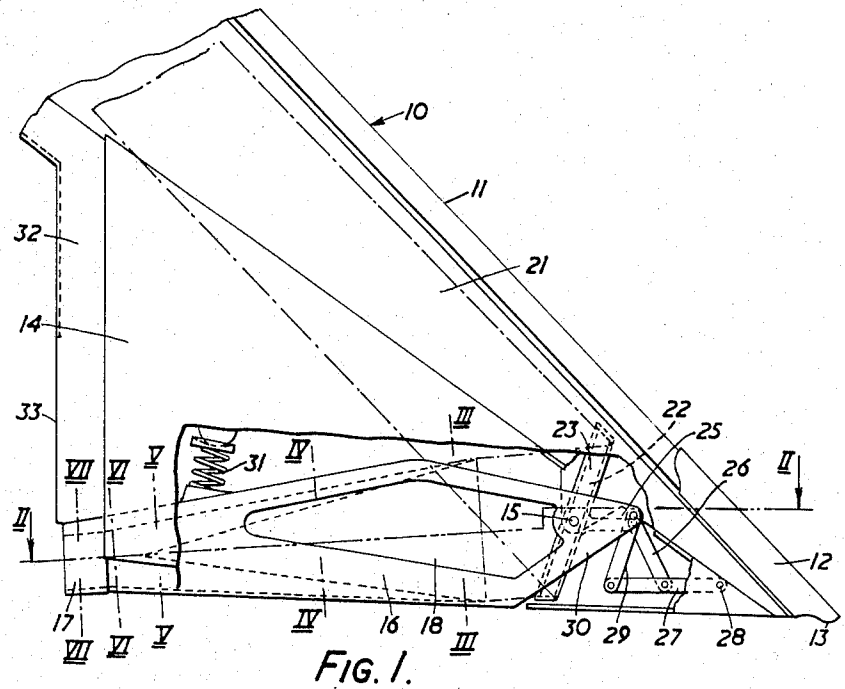

FIG. 1.

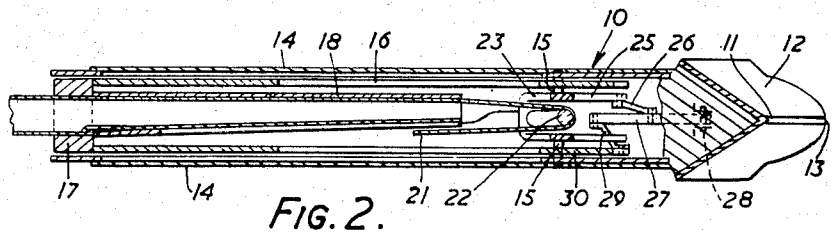

FIG. 2.

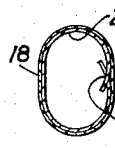

FIG. 7.

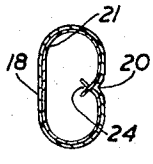

FIG. 6.

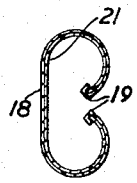

FIG. 5.

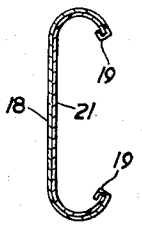

FIG. 4.

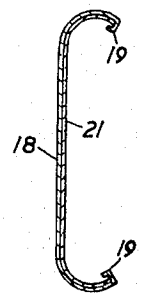

FIG. 3.

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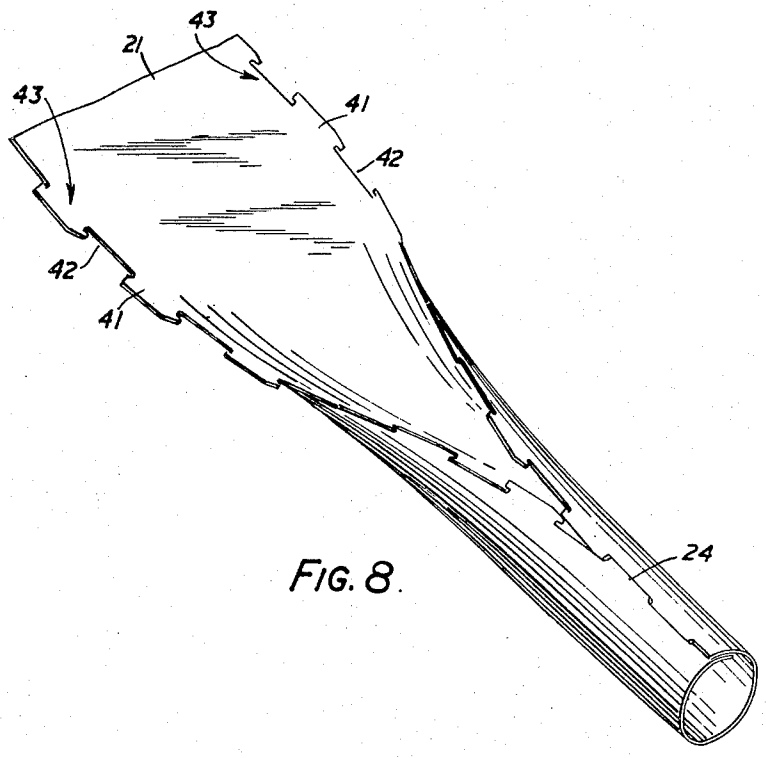

FIG. 8.

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APPARATUS FOR FORMING TUBES FROM STRIP MATERIAL

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Claims priority, application Great Britain, Dec. 31, 1959, 44,467/59
17 Claims. (Cl. 61—72.6)

This invention relates to apparatus for forming tubes from strip material which is sufficiently flexible to be rolled into the form of a tube but sufficiently rigid to be self-supporting in its tubular form, the strip having formations along one edge which are adapted to interlock with complementary formations on the opposite edge when the two edges are brought together. Such strip material will be referred to as strip material of the kind specified.

Strip material from which tubes may be formed by the apparatus of the invention may consist of thin metal, for example, but is preferably a flexible plastic material such as polyvinyl chloride which is thick enough to have the desired rigidity when in tubular form. Suitable forms of strip material are described in the present applicants' co-pending application Serial No. 73,869 filed December 12, 1960, now abandoned.

Apparatus according to the present invention for forming a tube from such strip material comprises a guide which at one end receives the strip in substantially flat form and, as the strip is passed through the guide, progressively curves the strip towards a tubular form until its edges overlap, and means for depressing the overlapping edges of the strip towards the centre of the formed tube to force the formations on these edges into interlocking engagement.

The means for depressing the overlapping edges of the strip may be an integral part of the guide.

The purpose of the guide is to receive the strip and progressively guide it towards a tubular form by bringing the two edges of the strip progressively closer towards each other until they are in overlapping relationship. The means for depressing the overlapping edges of the strip then forces these edges towards the centre of the formed tube whereby the complementary formations along the two edges interlock with one another to complete the tube.

For this purpose the guide may have channels which receive the marginal edge portions of the strip and guide the edges towards each other.

It is not necessary for the formed tube to be of circular cross-section. For example, it may be of oval or elliptical cross-section. This is sometimes desirable to enable the formed tube to be accommodated in a confined space, for example in a narrow trench.

The apparatus of the invention may have various applications, one useful application being in a pipe-laying machine for laying field drain pipes made of the strip material.

In one form of the invention, therefore, a pipe-laying machine has means for forming a furrow, groove or trench (hereinafter referred to simply as a trench) with the said apparatus incorporated therein, this apparatus being disposed to form the strip material into a continuous pipe and deposit this pipe in the trench. The trench-forming means is conveniently a hollow tine with the apparatus fitted therein. In such a case, it is advantageous to use a guide which forms the strip into a tube that is approximately oval or elliptical in cross-section, with its major cross-sectional axis vertical, so that a relatively narrow tine can be employed.

Since the machine may be required to work over rough or undulating ground, the angle between the leading edge of the tine and the line of the laid pipe may vary. To compensate for this, the guide may be pivoted to the tine so that the rear end thereof through which the formed pipe emerges can remain in contact with the bottom of the trench despite changes in angle between the leading edge of the tine and the line of the laid pipe.

In one form of the invention the tine carries a bar round which the strip passes on its way to the guide. Where the guide is pivoted, this bar is preferably also pivoted and is so connected to the guide as to tilt through approximately half the angle by which the guide tilts in relation to the tine. This enables the strip to be fed to the bar or roller at an unvarying angle in relation to the tine, despite the tilting movements of the guide.

The invention may be performed in various ways and a specific embodiment will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a fragmentary side view of a tine of a pipe-laying machine, partially broken away to show the guide;

FIGURE 2 is a sectional plan view taken on the line II—II in FIGURE 1;

FIGURES 3 to 7, inclusive, are sections of the guide taken respectively on the lines III—III to VII—VII in FIGURE 1; and

FIGURE 8 is a perspective view of the strip material being converted into tubular form, the surrounding parts of the apparatus being omitted for clarity.

Referring to the drawings, a tine **10** is mounted on a pipe-laying machine (not shown) with its lower end at a predetermined depth below ground level so that, as the machine advances, the tine forces its way through the ground and forms a narrow trench.

The tine has a sharp V-section leading edge **11** raked at an angle of approximately 45° to the vertical. The forward lower end of the leading edge **11** is provided with a share **12** the lower edge **13** of which is shaped to form a half-round bed for the formed pipe at the bottom of the trench.

The tine is provided with side plates **14**. Between the side plates **14** and pivotally connected thereto by pivot pins **15** is a guide carrier **16**. At its rear end the guide carrier **16** is connected to a die **17** having an aperture of oval cross-section. Connected to the front of the die and supported by the carrier **16** is a guide **18**. At its forward end this guide is substantially flat, but is provided at top and bottom with channels **19**. Regarded in cross-section, the shape of the guide changes progressively from right to left in the drawings, as shown in FIGURES 3 to 7, the channels **19** coming progressively closer together as shown in FIGURES 3 and 4, and then turning inwardly as shown in FIGURE 5. Between the section planes V—V and VI—VI the channels **19** meet and merge into a V-shaped portion **20** (FIGURE 6), the guide finally forming a complete oval at the section plane VII—VII as shown in FIGURE 7.

Strip material **21** for forming the pipe, as described in my said copending application Serial No. 73,869 filed December 12, 1960, and further illustrated in FIGURE 8, is fed from a reel (not shown) down through the tine in FIGURE 1 until it meets a pivotally-mounted bar **22** of round cross-section. This bar is mounted on a yoke **23** which is pivotally mounted on the pins **15**. The bar may be fixed to the yoke so that the strip slides round it, or it may be rotatably mounted so that it acts as a roller. Having passed round the bar **22**, the strip enters the guide **18**, its longitudinal marginal edges **43** (FIGURE 8) engaging in the channels **19**. As is apparent from FIG-

URES 3 through 8, the strip **21** is progressively curved towards a tubular form as it passes through the guide **18**. The edges of the strip are provided with alternate notches **42** and projections **41** (FIGURE 8), and as shown in FIGURES 6 and 7 these edges eventually overlap and interlock as shown at **24** in FIGURES 6 through 8, thus forming a tube or pipe of oval cross-section.

The yoke **23** which carries the rod **22** has rearwardly-extending arms **25** which are attached by a link **26** to the mid-point of a lever **27** pivoted by its front end to the tine **10** at the point **28**. The rear end of the lever **27** is pivotally connected by a link **29** to a portion **30** of the carrier **18** which extends forwardly of the pin **15**. The carrier **16** is urged in the downward direction by a compression spring **31**, so that the die **17** is pressed against the bottom of the trench formed by the tine **10** and the share **12**.

If, owing to unevenness of the ground, the tine **10** tilts in the fore-and-aft vertical plane so that the angle between the leading edge **11** of the tine **10** and the line of the laid pipe (i.e. the pipe which has already emerged from the die **17**) varies, this movement is accompanied by a pivotal movement of the guide carrier **16** about the pivot pin **15** relatively to the tine **10**, and a corresponding movement of the lever **27**. For any given angular movement of the tine **10** relatively to the guide carrier **16**, the mid-point of the lever **27** will move up or down through half the distance moved by the rear end of this lever. Consequently, since the pivots at the upper ends of the links **26** and **29** are at equal distances from the pivot pin **15**, the rod **22** will be tilted through half the said angle of movement of the tine **10** relatively to the guide carrier **16**. Consequently, the strip **21** will continue to be fed correctly into the guide **18**, even though its path as far as the rod **22** may change.

Behind the tine **10** there is fitted a chute **32** the lower rear portion of which is open at **33** so that gravel or the like can be tipped down the chute and discharged into the trench over the pipe as it emerges from the die **17**.

What I claim as my invention and desire to secure by Letters Patent is:

1. Plow apparatus for forming an elongated trench and simultaneously depositing a continuous length of an elongated flexible member, comprising: a hollow plow tine defining foot means for forming a trench by forcing forwardly through the ground, an elongated rearwardly extending guide means within and pivoted to the tine for relative pivotal movement therewith so as to remain in contact with the trench bottom over limited changes of angular attitude of the plow tine, said guide means having a forward end portion, means in the tine enabling feeding of a continuous length of flexible material down the interior of the tine to the foot means and rearwardly through the guide means and into the formed trench, said means enabling feeding comprising a bar pivotably mounted in the interior of the tine at the forward end portion of the guide means, the continuous length of flexible material passing around and in contact with the bar and being directed by the bar toward the guide means, the bar being connected to the guide means by pivot means enabling the pivoting of the bar in the same direction and through approximately half the angle by which the guide means pivots in relation to the tine for the limited changes of angular attitude of the plow tine.

2. Plow apparatus according to claim **1** wherein the pivoting means comprises a lever pivoted to the tine, a first link connecting the bar to a first point of the lever, and a second link connecting the guide means to a second point of the lever, the radial distance from the pivotal axis of the lever to the first point being one-half the radial distance from the pivotal axis of the lever to the second point.

3. Plough apparatus according to claim **1** wherein the tine comprises a hollow coulter having a rearwardly-inclining leading edge and a hollow casing depending from the rear edge of the lower part of the coulter and having a normally horizontal lower edge, the guide means being mounted within the hollow casing.

4. Plough apparatus according to claim **3** and further including duct means located behind the coulter and having a downwardly open mouth at its lower end behind the rear end of the guide means for discharging material into the trench to cover the flexible material laid in the trench.

5. A pipe laying machine comprising an inclined hollow tine for forming a trench and apparatus connected to and disposed at least partly within said hollow tine for forming a continuous pipe from a strip of flexible material having mutually interlockable marginal edge portions formed with alternate projections and notches and for laying the pipe in the trench, said apparatus including elongated hollow guide means having a longitudinal axis and including an inlet end portion, an outlet end portion and an intermediate portion disposed along said longitudinal axis, the inlet end portion having one substantially flat wall portion disposed in a plane substantially parallel to said longitudinal axis, the outlet end portion having a substantially complete tubular internal cross-section with a dimension parallel to the plane of the wall portion and transversely of the longitudinal axis which is substantially less than the transverse width of the wall as measured in the same sense, the intermediate portion having a smoothly profiled internal surface which merges from the cross-section of the inlet end portion to that of the outlet end portion, an internal deflector on the side of the intermediate portion away from the flat side wall of the inlet end portion and extending a limited distance inwardly toward the opposite side of the intermediate portion for progressively urging both marginal edge portions of the strip material inwardly into interlocking relationship as it passes through said guide means, and a bar guide for the strip material pivotably mounted in the hollow tine at the inlet end of the hollow guide means, the bar guide being connected to the hollow guide means by pivot means controlling the pivoting of the bar through approximately half the angle by which the hollow guide means pivots in relation to the tine.

6. A pipe laying machine according to claim **5** wherein the pivot means comprises a lever pivoted to the tine, a first link connecting the bar guide to a first point of the lever, and a second link connecting the hollow guide means to a second point of the lever, the radial distance from the pivotal axis of the lever to the first point being one-half the radial distance from the pivotal axis of the lever to the second point.

7. Apparatus for forming a continuous tube from flexible strip material having mutually interlockable marginal edge portions of alternate projections and notches, comprising an elongated hollow guide member through which the strip material can be moved, said guide member having a longitudinal axis and including an inlet portion at one end of said axis, an intermediate portion extending along said axis, and an outlet portion at the other end of said axis, said inlet, outlet and intermediate portions being substantially aligned along said axis, said inlet portion having one substantially flat wall portion, said outlet portion having a substantially complete tubular internal cross-section with a dimension parallel to said flat wall portion and transversely of said axis which is substantially less than the width of the wall measured in the same sense, said intermediate portion having a smoothly profiled internal surface which merges from the cross-section of the inlet portion to that of the outlet portion, said guide member having successive internal cross-sections from inlet to outlet for bringing the longitudinal marginal edges of the strip material progressively toward each other about said longitudinal axis on the opposite side of said axis from said flat wall and then bringing the longitudinal marginal edges further inwardly toward said longitudinal axis until the edges intersect and

interlock through the alternate projections and notches, said internal cross-sections including an internal deflector formation formed in the intermediate portion on the opposite side of the longitudinal axis relative to said flat wall portion but toward said outlet portion, said internal deflector extending toward said longitudinal axis so as to urge the marginal edges of the strip material toward said axis into interlocking engagement.

8. Apparatus according to claim **7**, wherein said deflector is integral with said guide member.

9. Apparatus according to claim **7**, wherein the intermediate portion of the guide member has an opening in the side thereof away from said flat wall portion of the inlet portion, and includes channeled edges at the transverse extremities of said opening facing away from said opening for receiving the marginal edges of the strip therein, the channeled edges converging progressively and terminating short of said deflector.

10. Apparatus according to claim **9**, wherein the longitudinal axis passes through the center of the tubular outlet portion, and said channeled edges adjacent the deflector and on the side thereof toward the inlet portion are directed inwardly towards the said longitudinal axis.

11. Apparatus according to claim **7**, in which the intermediate portion of said guide member has an opening in the side thereof opposite said flat portion of the inlet portion and progressively-inturned marginal portions on opposite longitudinal edges of said opening, which edges are channeled in opposite directions to have the channels face away from the opening, said progressively-inturned marginal portions converging progressively towards one another along the length of said intermediate portion and meeting at an angle, and in which the deflector comprises an inwardly directed V-sectioned longitudinal rib formed at the meeting of said marginal portions and extending along the interior of said guide member substantially to the end of the outlet portion.

12. Apparatus according to claim **7**, including a bar guide for the strip material mounted adjacent the inlet portion of said hollow guide member, the bar guide having a longitudinal axis lying in a plane parallel to the plane of said flat wall portion of the inlet portion.

13. Apparatus according to claim **12**, in which the axis of said bar guide is inclined at an acute angle to the longitudinal axis of said hollow guide member.

14. Apparatus according to claim **12**, in which said bar guide is pivotally mounted in relation to said guide member, and the attitude of the axis of said bar guide is variable in the plane containing said axis.

15. A pipe laying machine comprising an inclined hollow tine for forming a trench, and apparatus connected to and disposed at least partly within said hollow tine for forming a continuous pipe from a strip of flexible material having mutually interlockable marginal edge portions formed with alternate projections and notches and for laying the pipe in the trench, said apparatus comprising an elongated hollow guide member through which the strip material can be moved, said guide member having a longitudinal axis and including an inlet portion at one end of said axis, an intermediate portion extending along said axis, and an outlet portion at the other end of said axis, said inlet, outlet and intermediate portions being substantially aligned along said axis, said inlet portion having one substantially flat wall portion, said outlet portion having a substantially complete tubular internal cross-section with a dimension parallel to said flat wall portion and transversely of said axis which is substantially less than the width of the wall measured in the same sense, said intermediate portion having a smoothly profiled internal surface which merges from the cross-section of the inlet portion to that of the outlet portion, said guide member having successive internal cross-sections from inlet to outlet for progressively bringing the longitudinal marginal edges of the strip material toward each other about said longitudinal axis on the opposite side of said axis from said flat wall portion and then bringing the longitudinal marginal edges further inwardly toward said longitudinal axis until the edges intersect and interlock through the alternate projections and notches, said cross-section including an internal deflector formation formed in the intermediate portion on the opposite side of the longitudinal axis relative to said flat wall portion but toward said outlet portion, said internal deflector extending toward said longitudinal axis so as to urge the marginal edges of the strip material toward said axis into interlocking engagement.

16. A pipe laying machine according to claim **15**, wherein the guide member is pivoted to the hollow tine about a normally horizontal pivotal axis located at the front of the guide member, and further comprising spring member coacting between the rear end of the guide means and the hollow tine to urge the rear of the guide member downwardly relatively to the tine.

17. A pipe laying machine according to claim **15** and further including pivot means pivotally connecting the guide member to the hollow tine to permit relative pivotal movement between the guide member and the tine about the pivot means.

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