May 10, 1966 A. N. EDE 3,250,077

METHOD AND APPARATUS FOR FORMING STRIP MATERIAL INTO TUBE

Filed March 3, 1961 4 Sheets-Sheet 1

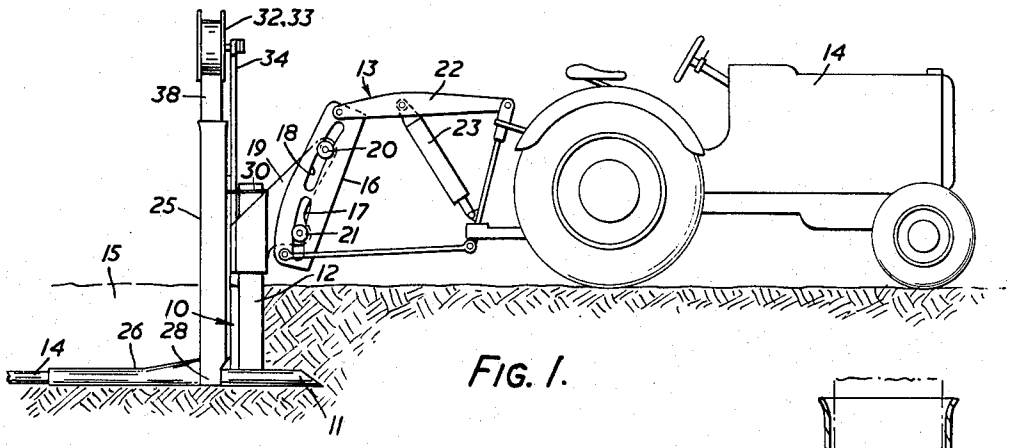


FIG. 1.

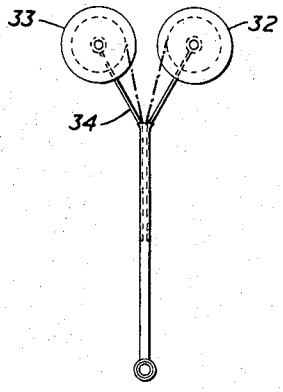


FIG. 6.

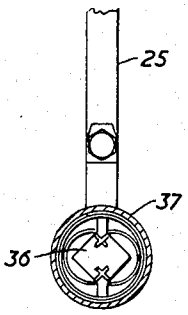
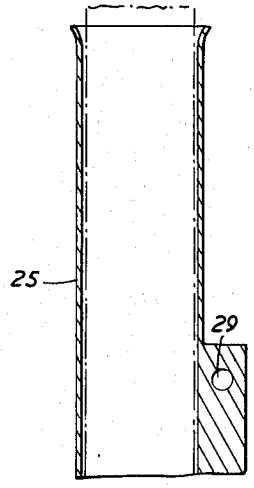


FIG. 4.



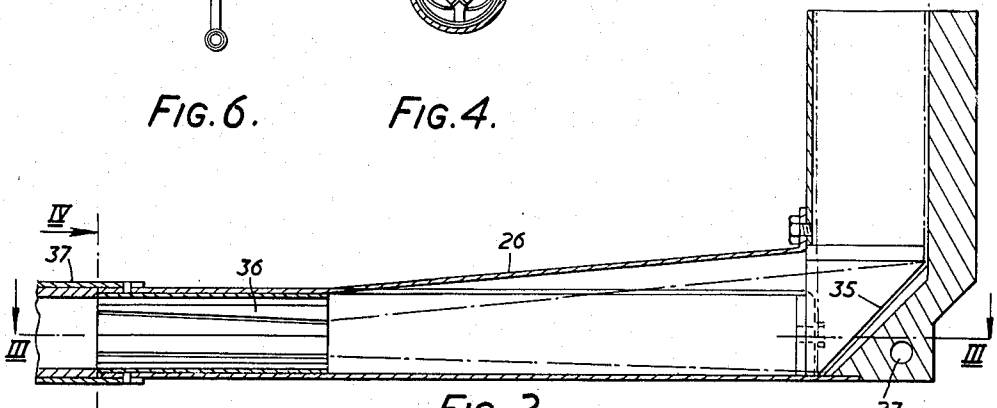


FIG. 2.

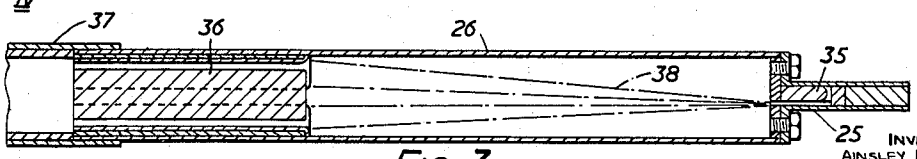


FIG. 3.

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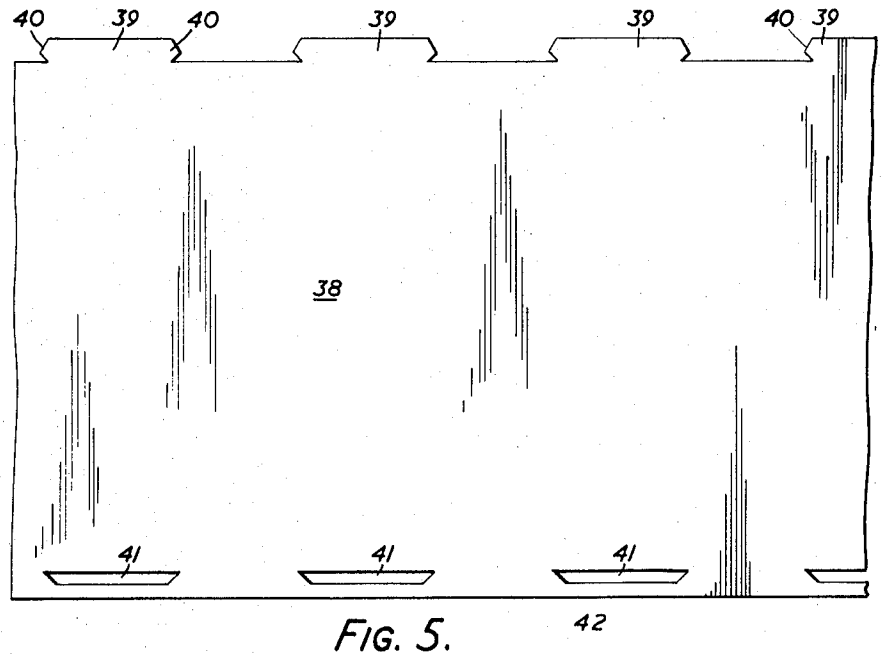

FIG. 5.

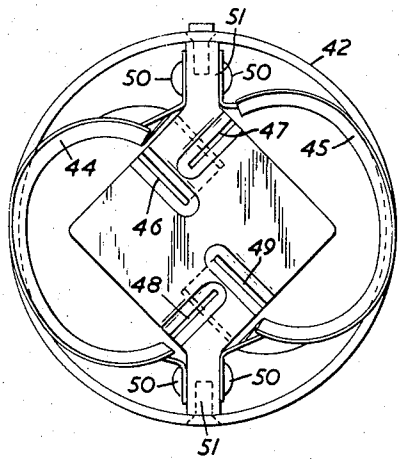

FIG. 9.

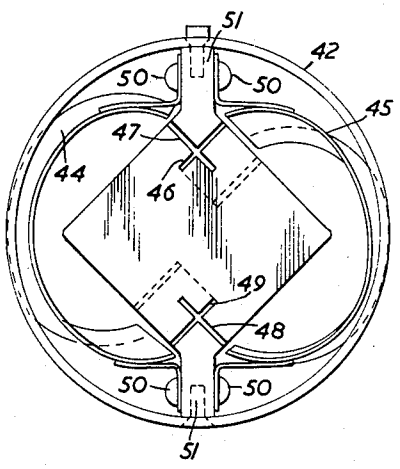

FIG. 10.

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METHOD AND APPARATUS FOR FORMING STRIP MATERIAL INTO TUBE

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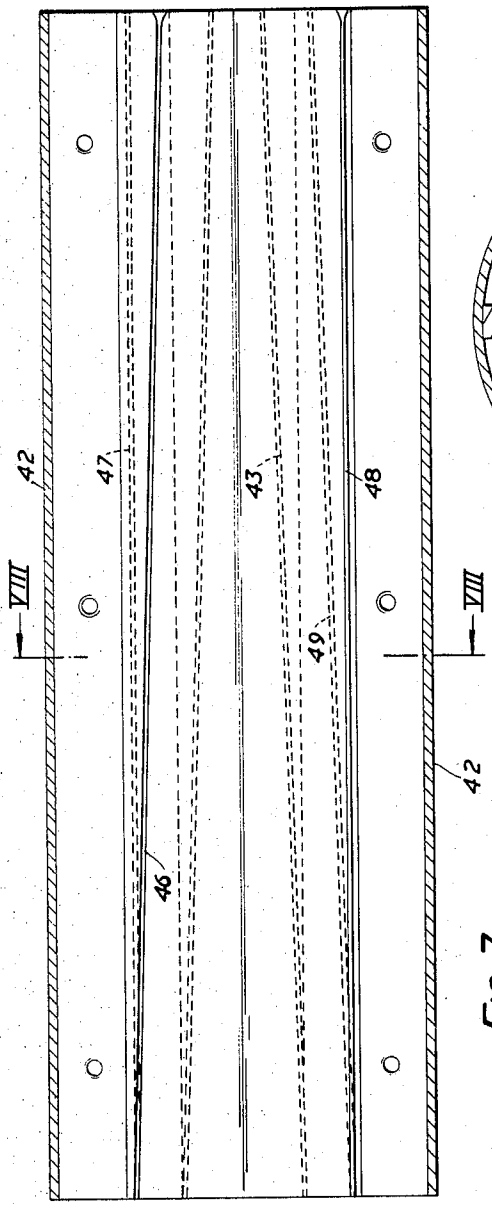

FIG 7

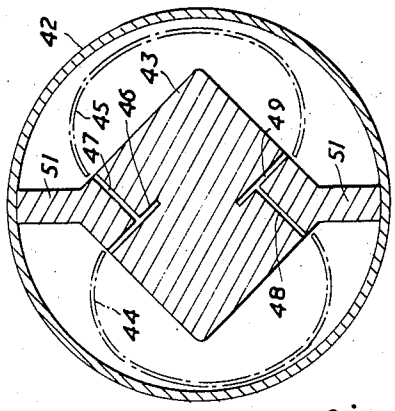

FIG. 8.

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METHOD AND APPARATUS FOR FORMING STRIP MATERIAL INTO TUBE

Filed March 3, 1961 4 Sheets-Sheet 4

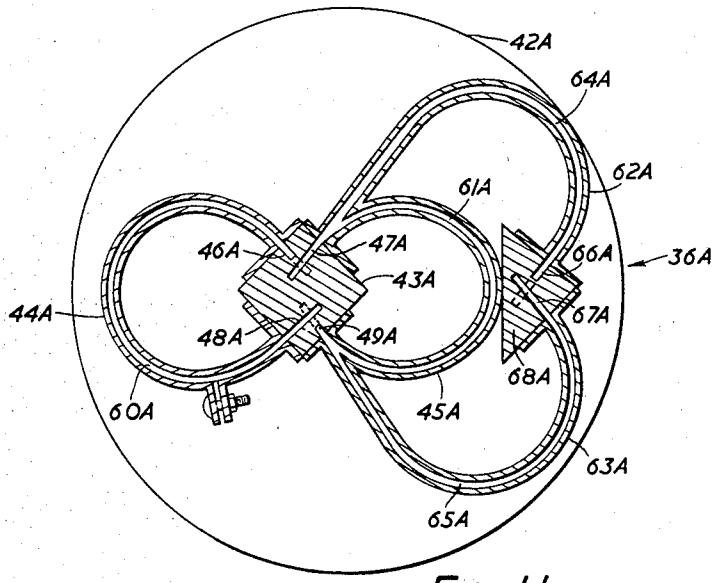

FIG. 11.

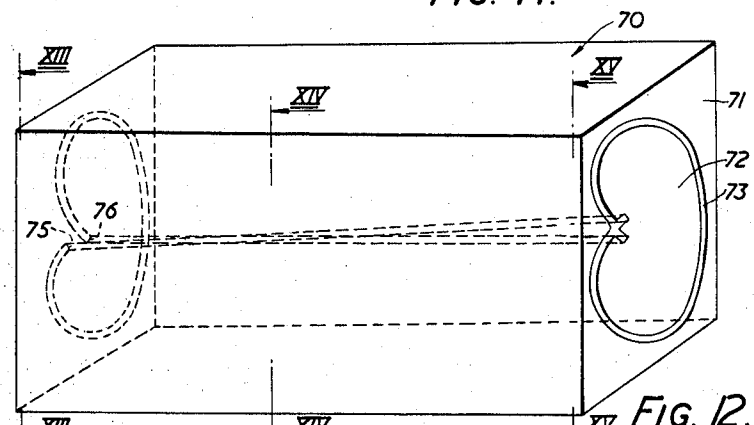

FIG. 12.

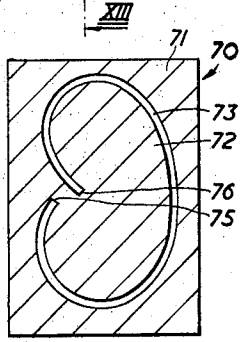

FIG. 13.

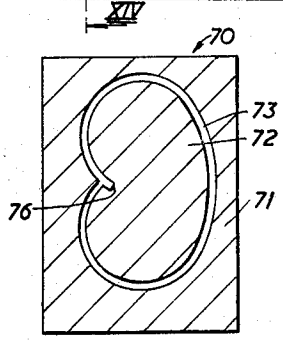

FIG. 14.

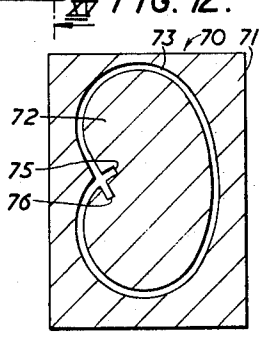

FIG. 15.

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United States Patent Office 3,250,077
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METHOD AND APPARATUS FOR FORMING STRIP MATERIAL INTO TUBE

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Filed Mar. 3, 1961, Ser. No. 93,107
Claims priority, application Great Britain, Mar. 4, 1960, 7,843/60
11 Claims. (Cl. 61—72.6)

This invention relates to the formation of tube from strip material which is formed along its longitudinal edges with tabs and recesses which can be interlocked to knit the opposed edges of the curled strip together.

It is an object of the invention to provide an improved means for curling such strip material about its longitudinal axis and guiding its tabbed and recessed edges into interlocking relationship with one another or with its corresponding edges of another strip of the material, so as to form a tube. A further object of the invention is to provide means for the formation of underground drainage pipe from such strip made of plastics material and curled and knitted into tubular form, although it will be realised that the invention can be usefully employed in other applications as well as in the formation of underground pipe.

According to one aspect of the present invention a method of forming a tube from one or more strips of sheet material formed with interlockable tabs and recesses along its two longitudinal edges, comprises curling the strip or each strip about its longitudinal axis into a troughed form and passing the curled strip through a former constructed and arranged to cause each longitudinal edge of the advancing strip to move laterally towards and into interlocking engagement with the other edge of the strip or with the co-operating edge of an adjacent, similarly curled strip, the tabs of one edge entering the recesses of the co-operating edge in the inward direction with respect to the tube thus formed so that they will lie against the inner surface of the completed tube.

Thus in the case where a tube is formed from a single strip of the sheet material, the former is constructed and arranged to cause the opposed longitudinal edges of the curled strip to move laterally towards and into interlocking engagement with one another whilst it supports the two marginal portions of the strip in positions in which they are curled over through an angle in excess of 360° relatively to one another whilst the tabs enter into and pass through the recesses. Thus as the two longitudinal edges are constrained by the former to approach one another, more or less at right angles, the tabs of one pass through the recesses in the other, until the line of tabs protrudes into the interior of the tube so formed. On discharge from the former the tube is allowed to expand into circular or other shape by means of its internal springiness or by the assistance of a further former, a core or guides leading up to the required section, so that finally the tabs and the recessed edge of the strip both take up positions more or less flat against the inner surface of the tube.

For forming a tube from a single strip of the sheet material, the former may comprise a female part and a male part having co-operating outer and inner surfaces respectively both of generally cardioid section and spaced apart coaxially one within the other to define between their said surfaces a narrow open-ended cardioid-shaped gap adapted to receive and guide the strip through the former, the longitudinal marginal portions of the gap converging one on the other and intersecting at the node of the cardioid at an angle in the region of 90°, so that the total angle through which the strip will be curled will be 450°.

As already mentioned, however, the tube may be formed not from a single curled strip, but from two or more strips of resilient sheet material formed with interlockable protruding tabs and recesses along their longitudinal edges, the strips being curled about their longitudinal axes into troughed form and being joined one to another along their adjacent edges by the introduction of the tabs of one edge of one strip into the co-operating recesses of the adjacent edge of the adjacent strip, the tabs being passed through the recesses in the inward direction with respect to the tube thus formed so that they will lie against the innersurface of the completed tube.

Preferably the recessed edges of the strip or of each strip are formed, not with open undercut notches, but with a row of closed elongated slots extending generally longitudinally of the strip, into which slots the co-operating protruding tabs can be introduced and with which the undercut ends of the tabs will be interlocked. However one or more strips having open-sided notches in place of the closed slots referred to might be employed for making up a tube in accordance with the present invention.

Where the tube is to be made up from two or more curled strips, each of the interlocked seams of the tube is formed by supporting opposed marginal portions of the two curled strips to be joined in attitudes inclined at right angles to one another, with the tabs of one marginal portion pointing inwardly towards the outer surface of the adjacent recessed portion of the other strip, that is, towards the surface of the strip which will ultimately face outwardly of the tube to be formed, and advancing the tabbed portion towards the recessed portion to cause the tabs to enter and pass into interlocking engagement with the recesses, the portions of the tabs which protrude through the recesses lying within the interior of the completed tube.

For this purpose one or more formers generally similar to that referred to above may be employed to support the two or more curled strips and to cause their edges to be advanced into interlocking relationship. However since the edges of each strip in this case are to be joined, not to one another, but to those of one or more co-operating strips, the former or formers will not be of cardioid shape but will be appropriately modified in shape and construction.

The invention may be carried into practice in various ways, but certain specific embodiment will now be described by way of example only with reference to the accompanying drawings, in which—

FIGURE 1 is a side view of a plastic strip drainage tube forming device mounted behind a mole plough towed by a tractor,

FIGURE 2 is a sectional side elevation on a larger scale of the feeder conduit and forming tube of the apparatus of FIGURE 1,

FIGURE 3 is a cross sectional plan view on the line III—III of FIGURE 2,

FIGURE 4 is a cross sectional elevation on the line IV—IV of FIGURE 2,

FIGURE 5 is a view of the profile of a short length of the tabbed and slotted plastic strip for use in the apparatus of FIGURES 1 to 4,

FIGURE 6 is a fragmentary view showing the arrangement of reels for feeding two of the strips of FIGURE 5 into the feeder conduit of FIGURES 1 to 4,

FIGURE 7 is a view on an enlarged scale of the die incorporated in the forming tube of FIGURE 2,

FIGURE 8 is a cross-section of the die taken on the line VIII—VIII of FIGURE 7,

FIGURES 9 and 10 are respectively end views of the die as seen in FIGURE 7,

FIGURE 11 is a view similar to FIGURE 9 of a modified form of die for forming three strips simultaneously into a tube,

FIGURE 12 is a perspective view of another modified form of die for forming a single strip into a tube, and

FIGURES 13, 14 and 15 are respectively cross sections through the die of FIGURE 12, on the lines XIII—XIII, XIV—XIV and XV—XV of the front face of the die.

In the embodiment illustrated in FIGURES 1 to 10, the invention is applied to a method and apparatus for forming in situ continuous underground drainage pipe from continuous resilient plastics strip material, by passing two identical continuous strips of the material down into a tunnel being formed underground by a mole plough, and interlocking the edges of the strips together to form a tube having longitudinal seams.

The general arrangement of the apparatus is shown in FIGURE 1. The mole plough **10** comprises a bullet or mole **11** mounted at the foot of a blade-shaped coulter **12** whose upper end is supported by a linkage **13** from the rear of the tractor **14**, which is driven forwards to cause the mole plough **10** to be dragged through the ground with the mole **11** submerged to form a continuous underground tunnel **14** having a vertical slit **15** produced by the coulter and leading into the upper part of the tunnel. The linkage **13** is of the construction forming the subject of the present applicants co-pending United States patent application No. 787,860, now U.S. Patent 3,032,903, dated May 8, 1962, and comprises a slotted member **16** having a curved track formed by arcuate slots **17** and **18**, and a trolley **19** to which the upper end of the coulter **12** is secured, the trolley having pivoted rollers **20** and **21** which can run in the slots **17** and **18**, so as to permit the whole mole plough to rotate about a centre of curvature in the vicinity of the rear part of the tractor **14**, so that the mole plough as it is dragged through the soil can take up a position of floating equilibrium under the influence of the various towing and soil reaction forces acting on it. The slotted member **16** forms part of a quadrilateral linkage **22** mounted on the rear of the tractor **14**, and a hydraulic ram **23** acting diagonally on the linkage **22** enables the level of the slotted member **16** to be preset to a desired value. The precise form of the supporting linkage **13** with its slotted member **16** and trolley **19** and its quadrilateral linkage **22** and ram **23** forms no part of the present invention and will not be further described.

Mounted behind the mole plough **10** and attached thereto is a tube forming device illustrated in greater detail in FIGURES 2 to 4, and comprising a hollow vertical feeder conduit **25** of flattened section and a former tube **26** extending generally horizontally and rearwardly from the foot of the feeder conduit **25**. The feeder conduit **25** is formed with a hole **27** at its foot and is pivotally secured to the rear of the mole **11** by means of a pin **28** passing through the hole **27**, a second hole **29** at the upper part of its leading edge enabling the conduit **25** to be secured to the top of the coulter **12** by means of a strap **30**. The strap **30** is loose enough to allow the conduit **25** to rock slightly through a few degrees in a vertical plane in the fore-and-aft direction about the pivot afforded by the pin **28**. A pair of flanged reels **32** and **33** are mounted on a Y-shaped frame **34** above the open top of the feeder conduit **25**, each reel carrying a roll of continuous strip material 600 feet long by 4¼ inches in overall width, and means is provided for feeding the two strips from the reels in a side-by-side relationship down to the interior of the hollow feeder conduit **25**, around an inclined guide plate **35** at the foot of the conduit **25**, and rearwardly through the former tube **26** into a former die **36** mounted at the rear of a tube **26**, by means of which die the two strips are curled longitudinally and knitted together at their adjacent edges to form a pair of continuous seams each formed by the interlocking of tabs on one edge of one strip in slots formed in the adjacent edge of the other strip. In this way the two strips are seamed together and emerge in tubular form through a final cylindrical sleeve **37** mounted at the rear of the tube **26**, and emerge from the open rear end of the sleeve **37** into the tunnel **14** as a continuous drainage tube.

The strip material **38** mounted on two reels **32** and **33** is made of a resilient high-impact-strength polyvinyl chloride sheet material, and as shown in FIGURE 5 each strip **38** is formed along one edge with a row of integral longitudinally-spaced protruding tabs **39** whose two pointed ends **40** are undercut as illustrated, and along the other edge with a row of correspondingly spaced elongated closed slots **41** arranged parallel to the extreme edge **42** of the strip and spaced about one tenth of an inch from the edge **42** of the strip. Each slot is one and one sixteenth of an inch in overall length and 0.08 inch wide, and is formed with parallel long sides and inclined ends as illustrated so as to be in the form of a parallelepiped, with the shorter of the parallel long sides nearest to the edge **42** of the strip. The spacing between adjacent ends of adjacent slots is $\frac{15}{16}$ inch. Similarly the two edges of the strip will be guided by and retained wide, so that each tab **39** can be inserted through a slot **41** with substantially no interference between the two. The effective width of each strip **38** is approximately four inches between the points of the ends of the tabs and the shorter longitudinal sides of the slots, and each tab **39** is slightly staggered in relation to the corresponding slot **41** on the opposite side of the strip **38**, the tabs **39** lagging the slots **41** by one sixteenth of an inch in the direction of travel of the strip down the feeder conduit **25**.

The former die **36** mounted in the rear end of the former tube **26** is shown in detail in FIGURES 7 to 10 and comprises a cylindrical open-ended brass sleeve **42** mounted within which is a curved brass guide block **43** of rectangular section and a pair of elongated concave sheet metal guide troughs **44** and **45**. Formed in diagonally-opposite corners of the guide block **43** are two pairs of deep longitudinal slots, **46**, **47** and **48**, **49**. The two slots **47** and **48** extend longitudinally parallel to the axis of the block **43**, and extend transversely at right angles to the faces of the block in which they are formed, but the two slots **46** and **49** extend obliquely to the longitudinal axis of the block whilst being at right angles to the faces of the block in which they are formed. Thus the slots **46** and **49** at the end of the die seen in FIGURE 9 (referred to as the lead-in end of the die) are respectively spaced from the bottoms of the slots **47** and **48**, but at the other or lead-out end of the die seen in FIGURE 10 the slots **46** and **47** intersect one another and the slots **48** and **49** intersect one another. The intersection of the slots first occurs at the cross-section on the line VIII—VIII of FIGURE 7, as indicated in FIGURE 8. The guide troughs **44** and **45** are secured by means of screws **50** to diagonal extension wings **51** of the block **43**, the guide trough **44** being omitted from FIGURE 7 in the interest of clarity. The edges of the guide trough **44** extend along the block just outside the open mouths of the two slots **46** and **48**, and the trough is so shaped and dimensioned that when one of the strips **38** is fed into the slots **46** and **48** within the trough **44** at the lead-in end of the die and is forced through the die, the two edges of the strip will be guided by and retained in contact with the bottoms of the two slots **46** and **48**. Similarly the guide trough **45** embraces the mouths of the two slots **47** and **49** and is correspondingly shaped and dimensioned, so that the two troughs **44** and **45** converge slightly in the longitudinal direction.

Thus as the two strips **38** are led around the inclined plate **35** towards the lead-in end of the die **36**, the strips are progressively longitudinally curled from the flat at the plate **35** until they enter the guide plates **44** and **45** and the slots **46**, **48** and **47**, **49** of the die, with the tabbed

edges of the two strips in the slots 47 and 48 of the block, and the slotted edges of the strips in the slots 46 and 49 of the block. Thus as the two strips are simultaneously drawn longitudinally through the die, the oblique slots 46 and 49 will progressively carry the slotted adges of the two strips towards the tabbed edges lying in the other slots 47 and 48 until, at the cross-section VIII—VIII where the slots intersect, the tabs 39 of the strip in the slot 47 will enter the slots 41 of the other strip in the intersecting slot 46, and similarly the tabs 39 in the slot 48 will enter the slots 41 in the intersecting slot 49. Further movement of the two strips 38 simultaneously to the lead-out end of the die will carry the two sets of tabs 39 into full penetration in the co-operating slots 41 to form two longitudinal knitted seams by which the edges of the strips are interlocked with one another to form a continuous tube emerging from the die. It will be observed that due to the inwardly-intersecting disposition of the pairs of slots at right angles to one another, the tabs 39 and the slotted edges 42 of the two strips will emerge from the die pointing inwardly into the interior of the newly formed drainage tube. The tube is now allowed to expand under its own resilience into cylindrical form within the follower sleeve 37 from which it emerges into the earth tunnel 14 formed by the mole 11. The strips are drawn down the feeder duct 25 and through the die 36 by the forward movement of the mole plough 10 towed by the tractor 14, the two ends of the strips after being initially fed manually down the duct 25 and through the die 36 being anchored at the start of the tunnel 15. Thereafter, as the mole is drawn through the soil to form the tunnel 15, the strips 38 are progressively knitted together into tubular form and laid as a drainage pipe directly in the newly formed tunnel.

It will be observed that the two strips are led through the die 36 in slightly strained, asymmetrical disposition, owing to the fact that one edge of each strip is pressed into a slot 47 or 48 which is parallel to the axis of the die 36 whilst the other edge of the same strip is pressed into a slot 46 or 49 which is inclined to the said axis, their dispositions being maintained by the asymmetrical convergence of the two guide troughs 44 and 45. Owing to the staggering of the tabs 39 and slots 41 in each strip 38 already referred to, the tabs 39 of one strip can enter the slots 41 of the other strip without interference despite this lack of symmetry in the die position of the strips, but once the interlocked strips have left the die 36 the strain will partially relieve itself and the strips will progressively tend to assume a spiralled cylindrical shape in the sleeve 37 and in the tunnel 15, which will cause each tab 39 to ride along the slot 41 in which it is engaged until the undercut end 40 of the tab 39 overlies the end of the slot 41 and prevents the withdrawal of the tab from the slot. In this way a tight joint is established at each seam.

A modified embodiment of die 36A is shown in FIGURE 11, designed to enable the tube to be made by interlocking together adjacent edges of either two or three longitudinal plastic strips formed along their edges with cooperating tabs and slits. The die 36 is employed with a mole plough 10, feeder conduit 25 and former tube 26 precisely as described in the preceding embodiment in place of the die 36, save that where a three-strip tube is required it is necessary to support a third reel of strip 34 on the frame 36 and to load all three strips in side-by-side relationship down the conduit 25 and into the die, and it is also necessary to use strips whose width is reduced by one third, both for two-strip and for three-strip tubes.

The die 36A of FIGURE 11 comprises a cylindrical sleeve 42A of the same diameter as the sleeve 42, and a rectangular block 43A formed with slots 46A and 49A of progressively increasing depth, whose bottoms are inclined to the die axis and with slots 47A and 48A whose bottoms are parallel to the die axis, and with convergent guide troughs 44A and 45A which embrace the slots and have their transverse dimensions reduced to suit the reduced strip width. In this case the troughs 44A and 45A are of double-sheet form defining narrow curved gaps 60A and 61A between their inner and outer sheet metal members, the ends of the gaps 60A and 61A respectively merging with the associated slots 46A and 49A. The slots 46A to 49A all extend longitudinally parallel to the axis of the die, but the intersection of the slots is produced by the progressively increasing depth of the slots 46A and 49A.

In addition, the die 36A is provided with two additional double-walled guide troughs 62A and 63A defining narrow gaps 64A and 65A which merge at one end with the gap 61A in the guide trough 45A, and which merge at their other ends respectively in slots 66A and 67A formed in a triangular-sectioned guide block 68A also mounted within the sleeve 42A. The slots 66A and 67A extend at right angles to one another along the length of the block 68A, the slot 67A being of constant depth whilst the slot 66A is of progressively increasing depth and intersects the slot 67A at a point about midway along the length of the block 68A. The two guide troughs 64A and 65A are both curled through about 180° about their longitudinal axis, as shown.

Thus the die 36A enables alternative constructions of tube to be formed, either from two of the reduced-width strips which are passed through the gaps 60A and 61A so that the tabs and slots of their adjacent longitudinal edges will become interlocked in the slots 46A, 47A and 48A, 49A to form two-seam tube, or from three of the reduced-width strips which are passed through the gaps 60A, 64A and 65A so that their adjacent edges become interlocked in the slots 46A, 47A and 66A, 67A and 48A, 49A to form a three-seam tube of greater diameter.

Whilst in the two embodiments described above all the pairs of intersecting slots in the guide blocks 36, 36A and 68A are arranged in side-by-side relationship within a single sleeve 42 or 42A, it will be apparent that a series of longitudinally-spaced formers might be employed, each affording only two inwardly directed slots having a single intersection or node and each being employed to form only one seam of the tube.

With the dies 36 and 36A described in the two preceding embodiments, the width of the strip required for the formation of a drainage tube of a given diameter is reduced by either one half or two thirds, as compared with the strip width required to form a single-seam tube from a single strip, and this facilitates handling. Thus not only is the required breadth of the duct down the feeder conduit 25 reduced, since it only has to accommodate two,or three, narrower strips in side-by-side relationship instead of a single wider strip, but also the mole diameter and the diameter of the resultant tunnel formed in the soil can be reduced on account of the reduced strip width as the strips extend generally horizontally rearwardly in the former tube 26 before and during their individual curling. If only a single strip is used, the earth tunnel and the former tube 26 must be wide enough to accommodate the uncurled strip as it extends rearwardly from the inclined plate 35, and must therefore be approximately three times the diameter of the final single-seam drainage tube formed from the strip; and in addition the former die 36 must be positioned a considerable distance above the floor of the earth tunnel and above the bottom of the former tube 26 in order that the die shall be in alignment with the axis of the strip. The use of two or more strips fed in side-by-side relationship thus enables a correspondingly smaller earth tunnel to be made and a correspondingly smaller former tube to be used, and enables the former die 36 or 36A to be close to the bottom of the former tube 26 without loss of alignment and without difficulty arising through distortion of the plastic strip.

Moreover the use of two or more strips to form a single drainage tube gives the possibility of having strips of different apertures to provide different parts of the peripheral wall of the tube to suit particular requirements thereby giving control of the positions of drainage holes in the finished tube. For example a combination of two unperforated and one perforated strip might be used to make a single drainage tube, the arrangement being that the perforated strip will form the roof of the finished tube.

Two-seam or three-seam drainage tube formed from two or three strips will be substantially symmetrical about its longitudinal axis as regards its seams, thereby increasing its strength against buckling and against collapsing under the applied load of the soil forming the wall of the tunnel in which the tube is laid, or at bends or corners. Moreover since no one of the strips making up the tube has to be curled through an angle in excess of 270° during the tube-forming operation, the risk of cracking of the material in the region of the curved spine of the strip is reduced as compared with a tube made from a single strip.

However for certain applications a drainage tube formed from a single plastic strip tabbed and slotted along its edges may be preferred, for example owing to the greater simplicity of the forming apparatus, and for this purpose a suitable former die **70** is illustrated in FIGURES 12 to 15. The die **70** would be used in combination with a feeder conduit **25** and former tube **26** mounted behind a mole plough **10** in the same manner as described in relation to the preceding embodiments.

In the embodiment of FIGURES 12 to 15, the former die **70** comprises a block of brass of rectangular external shape machined in two parts, namely an external part **71** and an internal part **72** having opposed faces of generally cardioid section and inserted generally coaxially one within the other, their opposed faces being spaced apart one within the other so as to define between them a narrow open-ended gap **73** of generally cardioid section adapted to receive and guide the single strip through the former. At the lead-in end of the former **70**, the longitudinal edges **75** and **76** of the cardioid-shaped gap are spaced from each other, and the marginal portions of the gap are directed inwardly at an angle in the region of 90°, so that the total curvature imposed transversely on the strip when fed into the leadin end of the gap will be about 450°. The longitudinal edges **75** and **76** of the gap converge on one another progressively along the length of the die and intersect at the section line XIV—XIV, as shown in FIGURE 14. Over the part of the die **70** between the section line XIV—XIV and the lead-out end of the die at the line XV—XV, the intersection of the marginal portions of the gap **73** increases progressively, whilst the total peripheral distance measured around the gap **73** between the edges **75** and **76** remains constant over the whole length of the block **70**.

Thus a single plastic strip of appropriate width can be fed through the gap **73** in the block **70**, and the tabbed and slotted edges of the strip which abut against the longitudinal edges **75** and **76** of the gap **73** will initially be spaced apart whilst directed inwardly towards one another at an angle of convergence of approximately 90°. As the strip is fed progressively along the gap **73** the tabbed edge of the strip abutted against the edge **75** will be progressively advanced towards the slotted edge portion of the strip until, at the intersection line XV—XV, the tabs will be introduced into the slots and further feeding along the strip along the die will cause the tabs to penetrate fully into the slots of the strip so as to interlock therewith and protrude into the interior of the tube thus formed.

As the strip emerges from the die **70** with its longitudinal edges thus knitted together into a seam, the tube thus formed will expand under its own resilience into cylindrical form with the tabs lying more or less flat against the internal surface of the tube, in which position the interlocked joint at the seam cannot easily be broken and does not constitute a weakness when the tube is subject to a crushing action. The opening out of the tube from a curvature of 450° to a curvature in the region of 360° enhances its mechanical strength.

As in the preceding embodiments, the leading end of the strip after having been passed manually through the die **70** is anchored to a stop placed across the mouth of the tunnel formed by the mole, so that the strip will be progressively drawn through the advancing die and down the feeder conduit **21** by the forward movement of the mole towed by the tractor, thus avoiding any need for a mechanical feed for the strip.

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

1. A method of forming a tube from at least two narrow elongated strips of resilient sheet material having integral interlockable tabs and recesses formed along the longitudinal edges of the strips, comprising curling at least two separate lengths of the said strips about their longitudinal axes into troughed form and joining the curled strips together in side-by-side relationship along each of their adjacent longitudinal edges by the introduction of the tabs of one edge of one strip into the co-operating recesses of the adjacent edge of the adjacent strip to form a tubular shape having a number of interlocked longitudinal seams, corresponding to the number of strips, in each seam the tabs of one strip are passed through the co-operating recesses of the adjacent strip in the inward direction with respect to the said tube so that they will be against the inside surface of the said tube, the tabs of each strip as introduced into said recesses are directed past the convex surface and inwardly towards the inner concave surface of an adjoining curled strip, and said strips with their tabs interfitted in said recesses are further guided into a continuous tubular shape with the tabs of each strip being moved against the inner surface of a respective adjoining strip to complete said tube.

2. A method as claimed in claim **1** in which the adjacent longitudinal edge portions of adjacent curled strips are supported in attitudes inclined substantially at right angles to one another, with the tabs of one such edge portion protruding inwardly towards the outer convex surface of the longitudinal edge portion of the adjacent strip, and in which each tab on one edge portion while so supported is advanced towards a recess in the adjacent edge portion to cause the tabs to penetrate into the recesses into interlocking engagement therewith.

3. A method as claimed in claim **1**, for forming a tube from two strips of material, in which the longitudinal edges of each strip are curled through an angle exceeding 180° relatively to one another, before the tabs and recesses are interlocked.

4. Apparatus for forming a seamed tube from at least two strips of the sheet material having interlockable tabs and recesses formed along the longitudinal edges of each of the strips, comprising a hollow elongated former having a plurality of longitudinally convergent internal guide means disposed around the central axis thereof, providing separate passages with concave surfaces for shaping the two strips individually, each passage being of arcuate form and each passage surface having incurved margin portions as seen in cross-section, and having an inlet end and an exit end, the margin portions of the respective passage surfaces at the inlet end being spaced apart, while at the exit end the passage surfaces terminate with incurved overlapped margin portions intersecting substantially at right angles to provide intersections of the edge portions of the strips, and between the inlet end and the exit end the passage surfaces merge continuously from one cross sectional shape to the other, and including a hollow cylindrical exit sleeve connected to the former adjacent the exit end thereof, the passages acting to feed

the said strips into said exit sleeve where the tube shape is finally defined.

5. Apparatus as claimed in claim 4 in which the former comprises at least one internal guide block providing, for each seam between two strips, a separate pair of deep slots formed at right angles to one another in the block and constituting a pair of said guide passages, the slots extending longitudinally of the former and intersecting one another over at least a portion of the length of the block adjacent the exit end of the former.

6. Apparatus as claimed in claim 5 in which the guide means comprise convergent troughs each associated respectively with one strip and each embracing the mouths of the slots in which two edges of that strip lie.

7. Apparatus as claimed in claim 6 in which both slots of each co-operating pair are of equal depth, and in which one slot extends longitudinally parallel to the axis of the former whilst the other slot extends longitudinally obliquely to the said axis.

8. Apparatus as claimed in claim 6 in which both slots of each co-operating pair extend longitudinally parallel to the axis of the former, and in which one slot is of constant depth whilst the other slot is of progressively increasing depth along the length of the slot.

9. Apparatus as claimed in claim 4 including a former tube having an open rear end in which the former is mounted, and a hollow feeder conduit of generally flattened cross section extending at a substantial angle to the former tube and joined to the former tube at the leading end of the latter, means for passing said strips of sheet material in flattened form continuously down the feeder conduit to the lower end thereof, into the former tube and through the former, and an inclined guide member at the foot of the interior of the feed conduit around which each strip is passed to change its direction.

10. Apparatus as claimed in claim 9 in combination with a mole plough comprising a mole rigidly secured at

the foot of a flat coulter blade, the feeder conduit being secured to the coulter behind its rear edge and the former tube being secured to the coulter behind and in alignment with the mole.

11. Apparatus as claimed in claim 10 including a towing hitch for attaching the coulter to a towing vehicle.

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