Oct. 26, 1971 E. K. MALKKI ET AL 3,614,882

MACHINE FOR MANUFACTURING HELICALLY SEAMED TUBING FROM A STRIP-LIKE PROFILED BLANK

Filed March 26, 1969 2 Sheets-Sheet 1

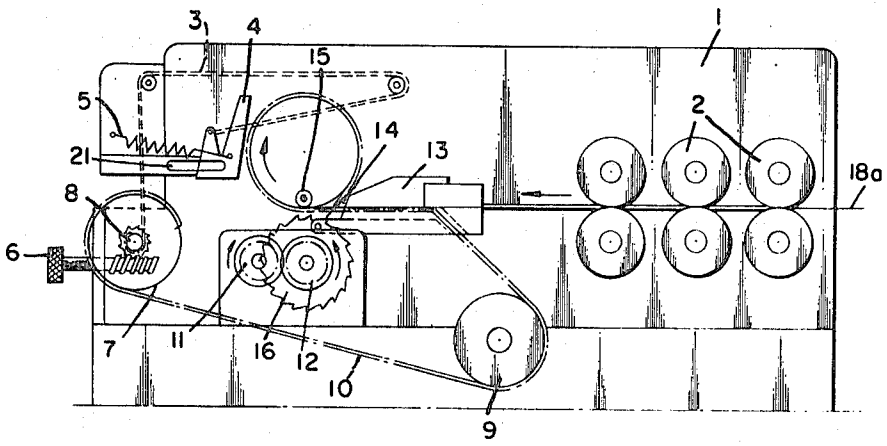

FIG. 1

FIG. 2

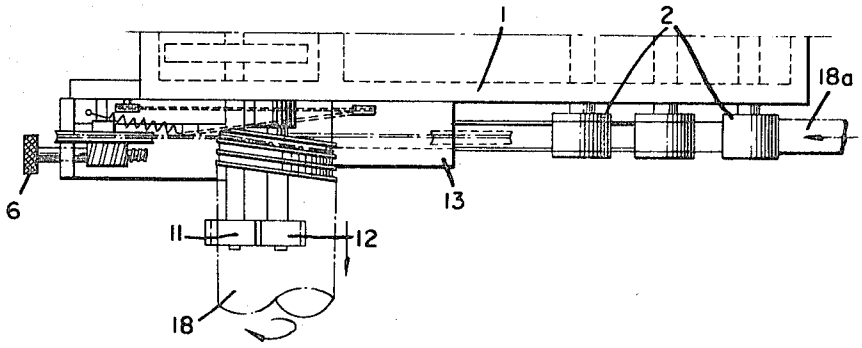

FIG. 3

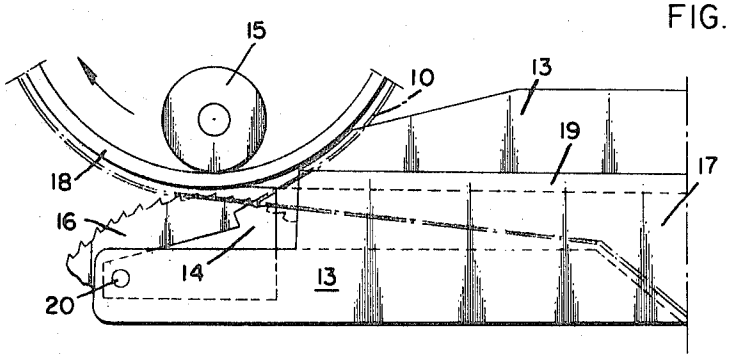

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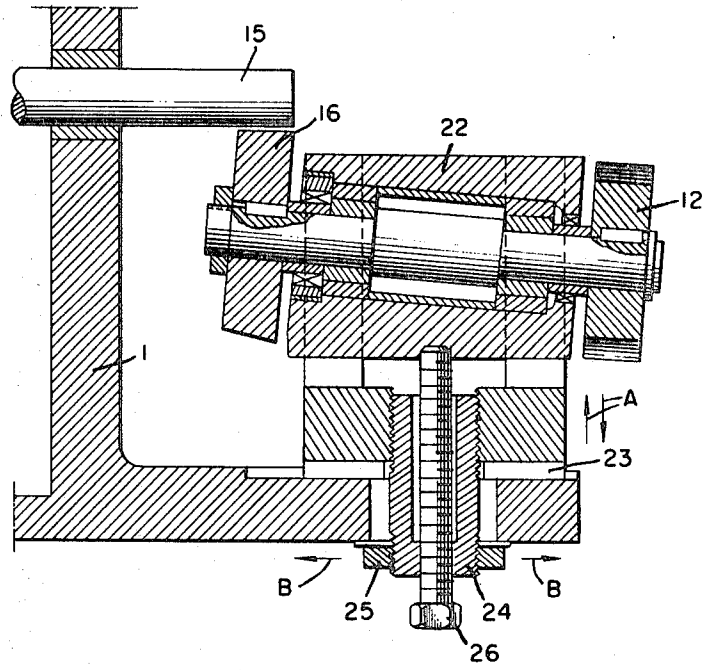
FIG.4



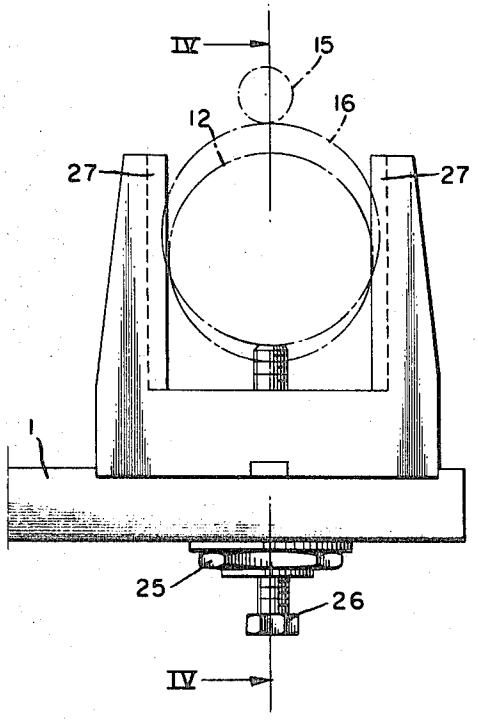


FIG.5

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MACHINE FOR MANUFACTURING HELICALLY SEAMED TUBING FROM A STRIP-LIKE PROFILED BLANK

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Int. Cl. B21c 37/12; B21f 3/10
U.S. Cl. 72—49 6 Claims

ABSTRACT OF THE DISCLOSURE

A machine manufactures helically seamed tubing from a strip-like profiled blank. The machine includes two seaming rolls cooperating with a loop consisting of a flexible traction element. The blank is forcibly fed into the loop and is bent into a tubular shape with guidance by the loop. A support member is used to support the tube while it is being formed from the outside, namely, the side opposite to the direction of feeding of the blank.

The present invention concerns a machine for manufacturing helically seamed tubing from a strip-like profiled blank, in which the strip-like profiled blank is guided under forced guidance into a shape consistent with that of the tubing over a length corresponding to the pitch of the helical seam, whereupon the edges of the profiled blank, which have been conducted into jointing contact, are jointed to form a seam by using at least two seaming rolls, one of them located outside and the other inside the tube which is being formed.

A number of different machines operating according to different principles are previously known with the aid of which helically seamed tubing can be produced. Commonest are machines of the type in which the pre-profiled metal strip is fed upon a cylindrical mandrel piece and finishing of the seam is then accomplished with the aid of various kinds of seaming rolls. In this machine the axis of the mandrel is inclined against the pre-profiled strip at a given angle. The magnitude of this angle is prescribed in the first place as a function of the breadth of the strip employed and of the inner diameter of the tubing to be manufactured.

In another type of machine no mandrel or equivalent is used, instead of which the pre-profiled strip is forcibly fed into a stationary shaped piece consistent with the external shape of the tubing and presenting contact surfaces along which the pre-profiled strip passes and in its passage is forced to bend into the shape of tubing, while the blanks which have come into jointing contact with each other are jointed to form a finished seam with the aid of rotating seaming rolls.

The machine according to the invention belongs in the first place to the latter category. The drawbacks of previously known machines include the fact that their accessories have to contain a great number of different tool units which have to be exchanged at every transition from a given breadth or type of strip to another or when the diameter of the tubing is to be changed. Such tool units are difficult to manufacture and their manufacturing is quite expensive, which implies that considerable capital investments have to be tied down in them in versatile production activity. On the other hand these units are subjected to wear because the tubing which is being formed, when it glides past their guiding surfaces, causes them to wear down at a considerable rate with the consequence, among others, that the calculated, correct tolerances, which are important in view of the quality of the product,

change in an undesirable direction and the quality of the tubing, for instance the tightness of the helical seam, deteriorates.

The object of the invention was to overcome all the detrimental factors mentioned above. A further objective of the invention is to provide a machine by means of which it is possible at any time, within certain maximum and minimum limits, to produce tubing with arbitrary and completely freely selectable diameter. It is still a further objective to provide a machine by means of which helically seamed tubing narrowing or widening in its diameter can be produced, so that it is possible with a given tubing length to change from one tube diameter to another on a comparatively short distance.

The invention is mainly characterized in that the machine comprises a loop formed of a flexible traction element, into which the strip-like profiled blank has been arranged to be fed, whereby this strip is forced to roll up into tube shape under forced guidance by the said loop, and that it further comprises at least one support member firmly connected with the machine body, this member supporting the tubing which is being formed, from its outside and from the side opposite to that from which the profiled blank is forcibly fed.

A machine according to the invention has no such parts highly susceptible to wear which would have to be exchanged ever so often or to be replaced within a short period owing to deterioration of quality. It is also to be noted that no such tool units are used which would require high accuracy in their manufacturing, or any machine tools at all for that matter. It is true that in a machine according to the invention a flexible traction element is used, e.g. a steel strip or wire, which is subject to wear and constitutes a consumption item. But its initial price is entirely negligible and the material is sold by the yard; it follows that the person operating the machine is able very rapidly to replace the worn-out part by merely using a pair of pincers and to continue the operation. One of the consequences of the circumstances outlined above is that a machine according to the invention is eminently suitable for use as a so-called working-site machine, in other words, it is taken directly to the site where tubing is needed and the tubing is manufactured there. In this manner the unreasonably high transport costs are avoided which mostly encumber the use of sheet metal tubing especially if tubing of rather large diameter is concerned, in which instance the greater part of the transport charges is in fact paid for transporting air.

The invention is described in greater detail in the following with reference to the attached schematic drawing and to one embodiment of the invention, which has been presented in the drawing.

FIG. 1 shows a machine according to the invention, viewed from the side, in the direction of the tubing which is being formed. FIG. 2 is another view, from above, of the same machine. FIG. 3 shows, in elevational view, an enlarged detail with reference to the attachment to the machine of the traction element which is used in the invention. FIG. 4 shows, viewed from one end of the machine and sectioned along the line IV—IV in FIG. 5, an enlarged detail with reference to the arrangement with respect to each other of the seaming rolls used for accomplishing the helical seam. FIG. 5 shows the same as FIG. 4, but as viewed in the same direction as that in FIGS. 1 and 3.

The reference numerals **1** indicate side plates belonging to the body of the machine and outside which the elements participating in the jointing or seaming operation are located. The flat sheet metal blank **18***a* must pass, first, between the driven profiling rolls **2**, which impart to it the desired profile. At the same time the profiling rolls **2** accomplish positive or forced feed of the strip

forward and in between the guide blocks **13**, where a gorge **19** (FIG. 3) has been provided, which presents various protruding steps or grooves consistent with the profile of the strip so that at this stage, too, the strip **18***a* will be positively guided and cannot be twisted to either side or deflected upwardly or downwardly.

Upon its release from the positive guidance by the guide blocks **13**, the strip encounters a loop formed of the flexible traction element **10**, which may be made e.g. of strip steel. This traction element loop determines the outer diameter of the tubing **18** which is formed. After the profiled strip has completed one turn inside the traction element loop, the preformed seam portions, or joint components, come into jointing contact with each other, and their jointing is accomplished in a way previously known in itself, between two seaming rolls **15** and **16**, which most appropriately both are driven rolls.

In the conditions encountered in actual practice no sufficiently good result is obtained by using a traction element loop alone, and additional guidance at the tub-forming stage is required in order to eliminate the vibration phenomena which tend to occur in particular at higher operating speeds. In the embodiment shown in the drawing, for additional guidance the support **4** has been employed, which at one point rests against the strip blank which is in the process of being bent into tube shape.

In order to afford sufficient space for the elements required in the seaming operation, the drive of the lower seaming roll **16** has been arranged to be by means of a gear train **11**, **12**, which is most appropriately mounted on an adjustable slide, the design of which shall be described later. The drive shaft of the seaming roll **15**, however, passes through the wall **1** of the machine body.

For the purpose of length adjustment of the traction element **10**, a take-up reel **7** turnable and adjustable by means of the screw **6** has been provided in the machine, upon which the traction element may be wound or from which it may be unwound so that a loop size consistent with the desired tube diameter is obtained. The traction element **10** passes over the pulley **9** and into the gorge **17**, which has been provided in the guide blocks **13**. From the terminal point of the gorge **17** the traction element passes helically through the distance corresponding to one turn, or to the pitch, of the helical seam and attaches to the arm **14**, which is turnable about the pin **20** (FIG. 3). The traction element **10** passes in the loop portion most appropriately as closely adjacent to the preformed seam portion of the strip blank as possible, whereby the abrasion marks it causes on the surface of the strip that is being bent into tube shape will be hid from view at the stage when the seam proper is formed.

In order that operation of the machine might be as convenient as possible and that, for instance, conical sections of tubing might be produced, the support **4** has been arranged to be movable along a guide **21**, a spring **5** and a flexible traction element **3** carried over appropriate transmission elements and winding upon a reel **8** mounted on the same shaft as the reel **7** ensuring that in the event of adjustment being made by screw **6** the support **4** will move along the guide **21** in synchronism with the resultant change in loop size.

In practice, the traction element **10** may be made of a number of different materials. The following, for instance, may come into question: strip steel, plastic strip, steel wire, and a chain with roller elements of such size that the latter contact the outer surface of the strip blank **18***a* which is being bent into tubular shape.

FIGS. 4 and 5 present in closer detail the mounting on the machine body of the seaming roll **16**, which participates in the forming process of the helical seam and is located outside the tube that is being formed. The seaming roll **16** has been journalled in a slide **22**, which is movable both in the direction of arrows A and in that of arrows B. The slide **22** moves in the direction of arrows A and B in the guides **23** and can be locked in position with the aid of the sleeve piece **24** and nut **25**. In vertical direction, or in the direction of arrows A, the slide moves in the guides **27** and it is adjustable to a given position in height by means of the screw **26**, for which there is a corresponding thread in the sleeve piece **24**. The axis defined by the seaming roll **16** and its drive wheel **12** is inclined at an angle of a few degrees against the axis of the seaming roll **15**. This has been found to be of great importance in view of the tightness of the seam that is obtained, because for successful accomplishment of the seaming operation the seam has to be compressed slightly past the position it will have in the finished tubing, this fact being due to the elastic characteristics of the material of which the seam is being formed.

The adjustment facilities of the slide **22**, which need not cover a very wide range, are important for initial adjustment of the machine; practical tests have shown that different operating speeds and different material thicknesses as well as qualities require somewhat different adjustments in the interest of most favourable ultimate results.

The arrangement involving transfer of driving power to the seaming roll **16** through the slide **22** is advantageous in two respects. Firstly, the detriments resulting from bending of the drive shafts of the seaming rolls **15** and **16** are hereby eliminated. It is to be noted that these shafts can never be made thick enough in practice to preclude in operation and under high seaming force the occurrence of a given deflection, which has a detrimental effect on the accuracy with which the machine performs the seaming. On the other hand, this arrangement is useful in allowing sufficient space e.g. for the placing of the traction element **10**.

With a prototype machine according to the invention excellent production results have been achieved. For instance, tubing of diameters between 100 and 1500 mm. and in continuous lengths up to 70 m. have been produced with it. Since a machine according to the invention has a weight only one-third, at the most, of that of other competitive types, it follows that a machine according to the invention is easily transportable to various sites of work and such lengths of tubing as are required can be manufactured there, whereby tubing joints made on the site become superfluous. Moreover, the machine is simpler in its design than any competitive type in such degree that its initial cost will be less than one-half of that of conventional machines.

The invention is not narrowly confined to the examples of its design presented in the drawing, and the design of the machine can be modified in various details within the scope of the invention.

We claim:

1. A machine for manufacturing helically seamed tubing from a strip-like profiled blank, comprising two seaming rolls, means feeding said blank between said seaming rolls, a flexible traction element extending between said seaming rolls and forming a loop enclosing and bending said blank into tubular shape, a support member engaging said blank while it is being bent, said rolls being located between said means and said member, a guide supporting said member for adjustable movement, a mechanism connected with said traction element for adjusting the size of said loop, and means operatively connecting said guide with said mechanism to provide a single adjustment control of the diameter of tubing being manufactured.

2. A machine for manufacturing helically seamed tubing from a strip-like profiled blank, comprising a machine body, driven profiling rolls carried by said body for feeding said blank, a flexible traction element forming a loop enclosing and bending said blank into tubular shape and bringing edges of the profiled blank into joint contact with each other, at least two seaming rolls located close to one end of said traction element for seaming together the edges of the profiled blank, a pulley guiding said traction element outside of the loop, a take-up reel holding

one end of said traction element outside of the loop, said reel being rotatable in opposite directions to vary the size of the loop, a support member engaging said blank from the outside while it is being bent, a guide supporting said member for adjustable movement, a spring connected with said support member, elastic means connecting said support member with said take-up reel, whereby when the take-up reel is turned in a direction causing a diminution of the loop the support member is moved closer to said seaming rolls against the action of the spring, thereby providing a single control for varying the loop size.

3. A machine in accordance with claim 2, having means holding the other end of the traction element and causing its loop to run outside the profiled blank and around it beside the preformed seam on the profiled blank.

4. A machine in accordance with claim 3, wherein the last-mentioned means comprise an arm having an end holding said other end of the traction element close to said seaming rolls, and a pivot extending through the other end of said arm for rotatably supporting said arm.

5. A machine in accordance with claim 4, wherein said flexible traction element consists of a steel band.

6. A machine in accordance with claim 4, wherein said flexible traction element consists of a chain having anti-friction elements adapted to engage the outer surface of the tube being manufactured.

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