July 23, 1968 J. E. FAY 3,393,546

CONTROL DEVICE FOR SPIRAL PIPE FORMING MACHINE

Filed Feb. 24, 1966 3 Sheets-Sheet 1

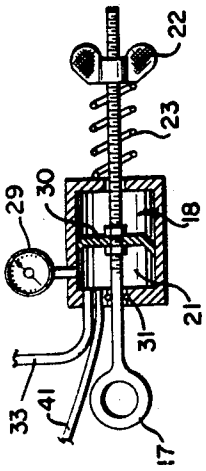


FIG. 1a

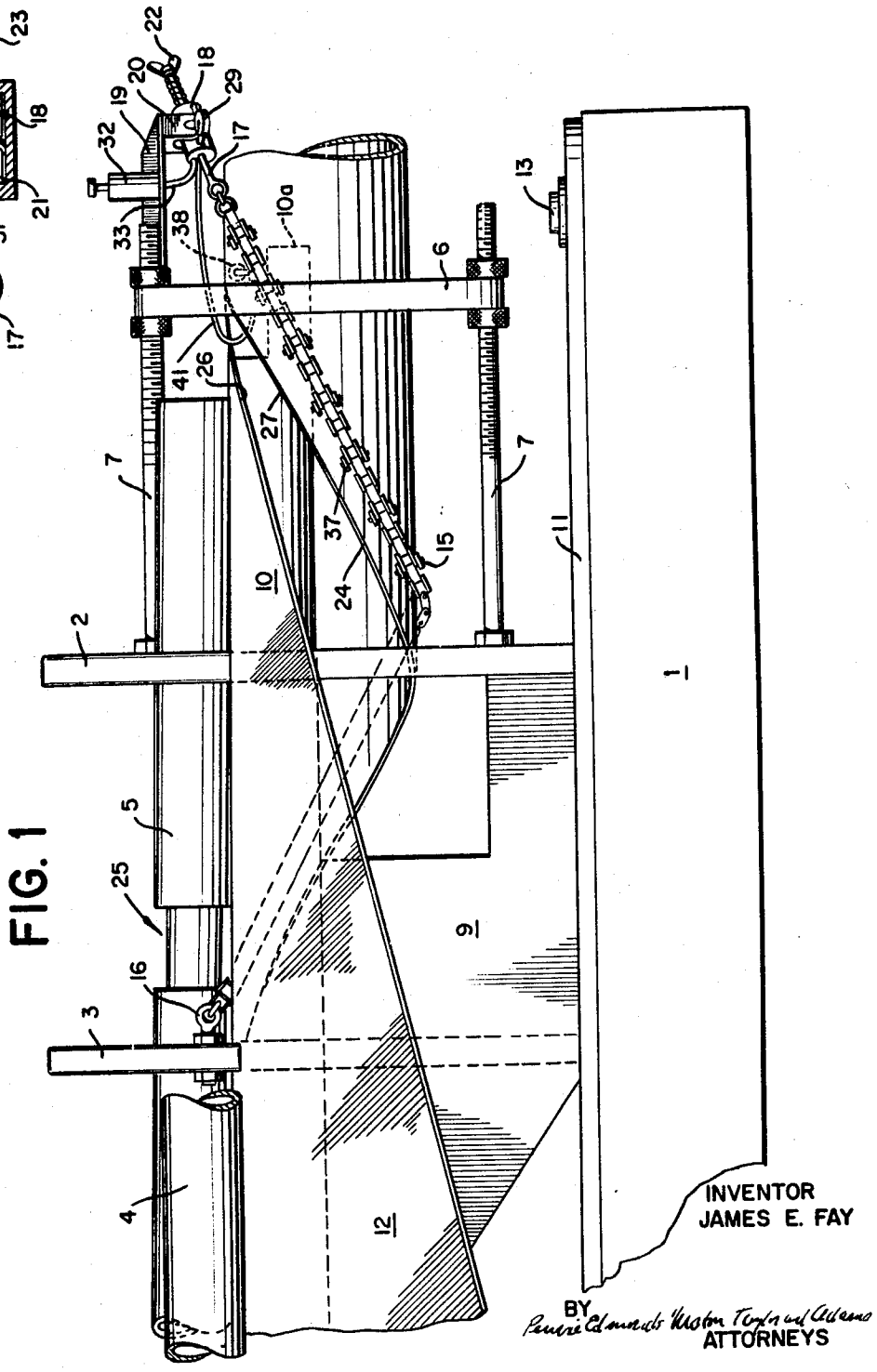


FIG. 1

INVENTOR
JAMES E. FAY

BY Pennie Edmonds Morton Taylor and Adams
ATTORNEYS

July 23, 1968 J. E. FAY 3,393,546

CONTROL DEVICE FOR SPIRAL PIPE FORMING MACHINE

Filed Feb. 24, 1966 3 Sheets-Sheet 2

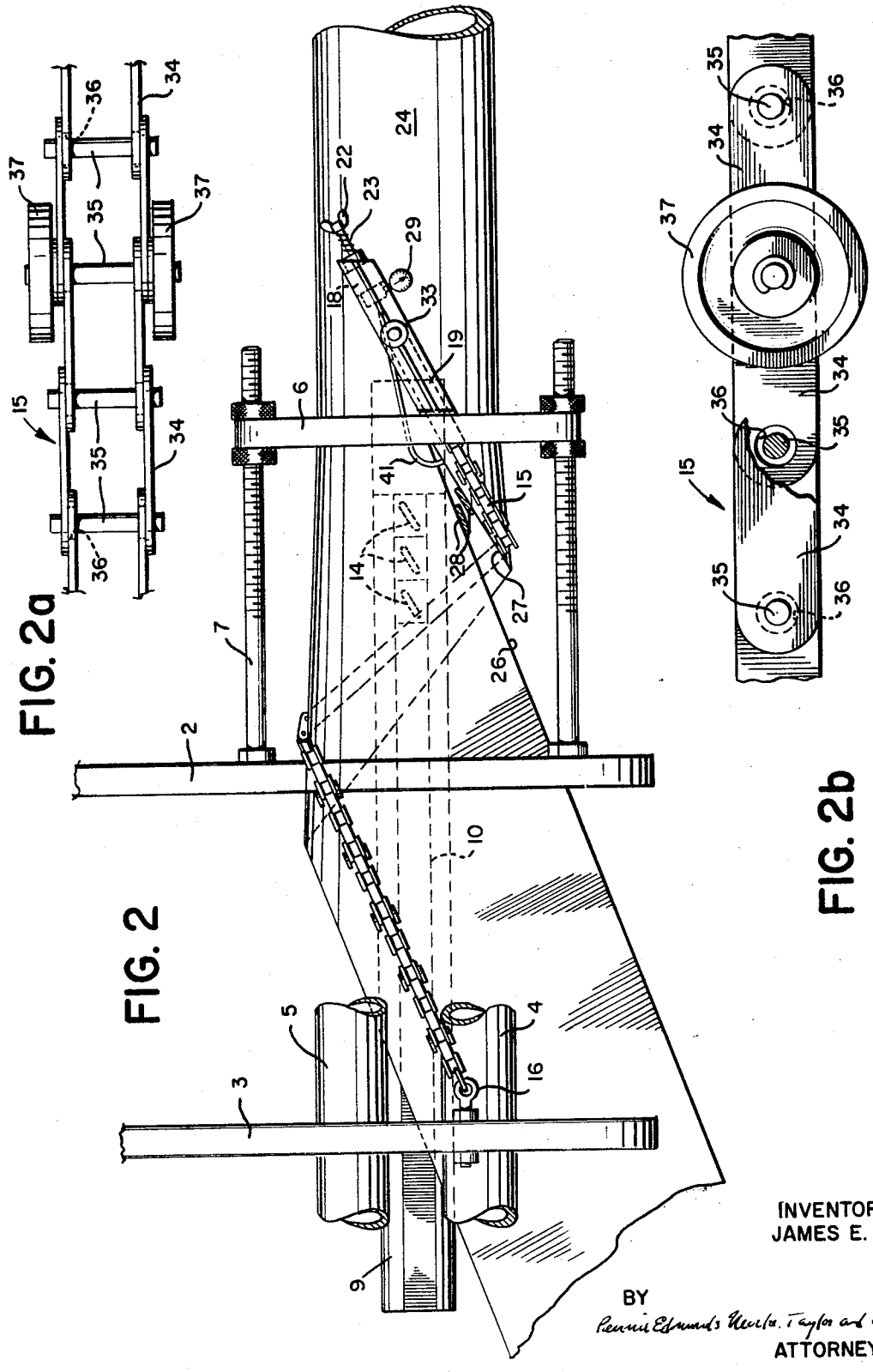


FIG. 2a

FIG. 2

FIG. 2b

INVENTOR
JAMES E. FAY

BY
Pennie Edmonds Morton Taylor and Adams
ATTORNEYS

July 23, 1968 J. E. FAY 3,393,546

CONTROL DEVICE FOR SPIRAL PIPE FORMING MACHINE

Filed Feb. 24, 1966 3 Sheets-Sheet 3

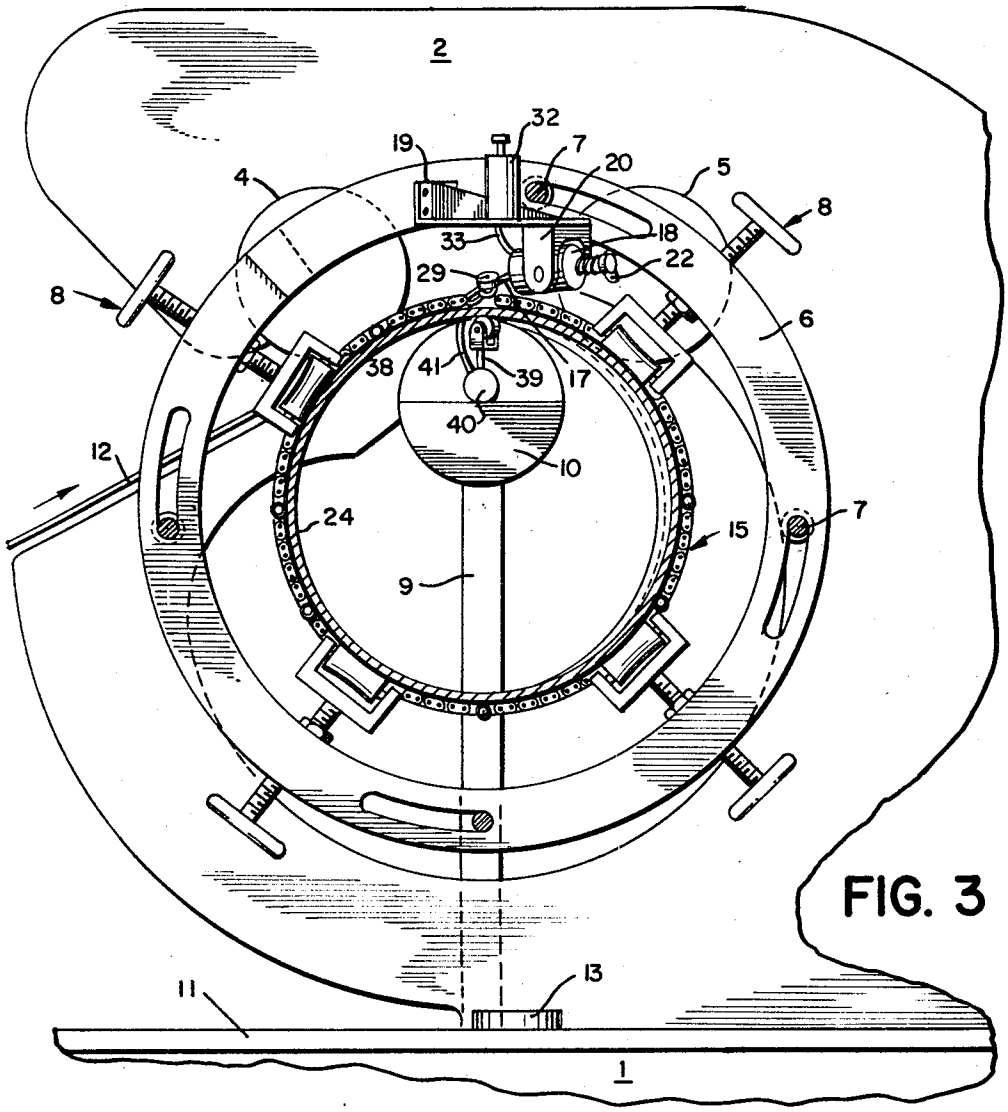


FIG. 3

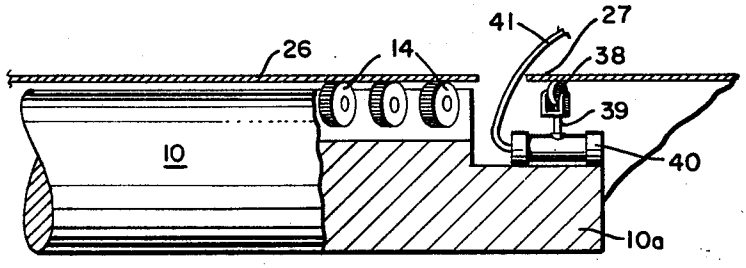


FIG. 4

INVENTOR.
JAMES E. FAY

BY
Pennie Edmonds Morton Taylor & Adams

ATTORNEYS

United States Patent Office 3,393,546 Patented July 23, 1968

3,393,546

CONTROL DEVICE FOR SPIRAL PIPE FORMING MACHINE

James E. Fay, Middletown, Ohio, assignor to Fay Pipe & Pile Co., Inc., Pittsburgh, Pa., a corporation of Pennsylvania

Filed Feb. 24, 1966, Ser. No. 529,800
9 Claims. (Cl. 72—49)

This invention relates to an apparatus for sensing and controlling a spiral loop of sheet material and, more particularly, to a device which functions to measure, restrain and control the amount of sheet material in the spiral loop as it is formed during the manufacture of spiral pipe.

It is known that in the manufacture of spiral pipe from flat or corrugated material variations in sheet width, angle of feed of the material into the forming unit, alignment of sheet edges at the first tangent or juncture point, and other factors cause variations in the circumference, length and shape of the formed spiral loop. The adjustment of the apparatus to compensate for and control these variations to produce commercially acceptable spiral pipe requires that a skilled operator continuously check the operation of the apparatus. For example, when the apparatus adjustment, together with the usual variations in sheet width including the camber of the material is such that the amount of material being fed into the spiral loop is greater than that required to form the desired circumference pipe, oversize pipe is produced until the machine operator detects this condition and makes a corrective adjustment at the juncture of the edges of the sheet to reduce the amount of material being fed into the loop. If an over-correction is made, the apparatus will start making undersized pipe and when this condition is detected the operator is required to make further adjustments until the desired pipe diameter is reached. Since variations in sheet width, including the camber, and movement of the apparatus settings due to internal stresses result in the frequent appearance of variations, continuous attention and adjustment by a skilled operator is required throughout the production of spiral pipe.

The conventional method of detecting variations in circumference of the forming spiral loop has been for the machine operator to watch the sheet edges as they move into the juncture position. The spiral loop length is controlled by the behavior of the matching of sheet edges at or near the juncture position where the edges are welded together. The presence of too little material or too much material will cause pinching or opening of edges. When the operator detects that the spiral loop circumference is above or below the desired setting, he adjusts the machine accordingly.

There are many disadvantages to this conventional method of detecting and correcting variations in loop circumference. The machine operator is required to keep a close watch on the juncture position so that he will detect any variations, such as opening or pinching of the seam, as soon as it develops. The operator must be experienced in observing the movement of the sheet edges and he must continuously check the movement so that he can adjust the machine as soon as a variation occurs. Another disadvantage of making adjustments based on the movement of the sheet edges at the juncture position is that the variations cannot be detected until it has already developed to a point that it is too late to effect a correction that will prevent oversized or undersized pipe from being formed. Where an unattentive or unskilled operator fails to adjust the machine soon after a variation develops the pipe formed is often unsuitable for commercial use and must therefore be scrapped.

The present invention overcomes these disadvantages by providing means for continuously measuring variations in the amount of material in the loop and thereby detecting variations in loop circumference and configurations as soon as they first develop. The detection and correction of loop formation before the seams pinch or open up permit the production of prime pipe at all times. The invention further provides means for restraining or resisting the expansion of the spiral loop beyond a selected size and means for automatically controlling and guiding the loop formation.

Broadly, the present invention is an improvement in spiral pipe forming apparatus comprising an elongated measuring and restraining member positioned around a portion of the forming spiral loop and mounted on the frame of the apparatus. Indicating means connected to the member indicate the tension therein as the configuration and size of the loop varies so that the operator can readily detect the necessity for adjustments of the apparatus. The restraining member may include resilient means and may be arranged to operate a device for guiding the loop edge whereby variations in material feed and loop size are automatically corrected.

It is a feature of the present invention that small variations in the amount of material in the spiral loop are immediately indicated by movement and tensioning of the measuring and restraining member.

It is also a feature that the measuring and restraining member functions to restrain and resist the loop from growing larger than the selected size. The larger the loop grows the greater are the forces exerted on it tending to reduce its size to the desired setting. It also may function to limit the size of the loop to a selected maximum. When more or less than the required amount of material is being fed into the loop, the measuring and restraining member is placed under tension or slackens. This movement and tensioning which is measured by any suitable means provides the operator with an immediate indication that too much or too little material is being fed into the loop.

Measurements of the movement and tensioning of the member may be made by any suitable means such as by observing relative movement between the member and the loop. Preferably, the member is connected to a suitable resilient tension means to permit the member to move out in a radial direction while at the same time urging the loop to return to the selected size. The member thus functions together with the other forming elements to form the material into a loop of desired configuration.

It is another feature of the invention that it may be practiced by using a loop edge guiding device to automatically guide the loop edge in response to movement of the measuring and restraining member.

Reference is made to the following drawings which illustrate a preferred embodiment of my invention, in which:

FIG. 1 is a side elevation view of the spiral pipe forming apparatus including the measuring and restraining member and resilient tension means;

FIG. 1*a* is a sectional view of the resilient tension means and associated indicating means;

FIG. 2 is a plan view of the apparatus with the forming elements partially cut away;

FIGS. 2*a* and 2*b* are enlarged views of a section of the measuring and restraining member;

FIG. 3 is an end elevation view including the control ring, the measuring and restraining member and the resilient tension means;

FIG. 4 is an enlarged elevation view of the hydraulic loop edge guide device positioned on the arbor.

Referring to the drawings in detail, base **1** has vertically mounted thereon stanchions **2** and **3** which in turn support through adjustable means (not shown) front forming element **4** and back forming element **5**. Adjustable control ring **6** which also functions as a forming element is mounted on partially threaded support bars **7**. Ring **6** carries adjustable holding units **8** (FIG. 3) for holding and controlling the spiral loop **24**. Also vertically positioned on base **1** is vertical support **9** which has secured to it arbor **10**. Arbor **10** has rotatable bearing members **14** which function to reduce friction between the forming loop and the arbor. Carriage **11** which carries sheet material **12** and associated feeding drive equipment (not shown) is pivotable about pivot bearing **13**.

Measuring and restraining roller chain **15** is secured at one end to chain mount **16** and to partially-threaded rod **17** at the other end. Roller chain **15** is constructed from a plurality of links **34** (see FIGS. 2*a* and 2*b*) connected together with pins **35** which are mounted in oversize bearing holes **36** to permit the chain to twist around the spiral loop. Rollers **37** are positioned on the end portions of pins **35** for rolling engagement with the outside surface of the spiral loop **24**. While it is contemplated that the measuring and restraining member, such as the roller chain, may be positioned at various distances from the edge of the loop, it is preferred that the element be placed close to that portion of the loop close to its edge for the reason that the element can better sense and, where necessary, retrain the movement of the edge portion if it is so positioned.

Rod **17** is slidably positioned in cylinder **18** which is in turn secured to horizontal arm **19** through depending brackets **20**. Rod **17** has a piston **30** mounted on its (see FIG. 1*a*) and together with cylinder **18** forms a chamber **21**. The chamber is filled with any suitable fluid such as hydraulic oil. An O-ring seal **31** may be used to seal the cylinder to prevent the escape of the contained fluid. Restraining coil spring **23** is positioned between **18** and adjustable wing nut **22** so that as spiral loop **24** expands restraining spring **23** is compressed against cylinder **18**. The pressure of the fluid in chamber **21** is indicated by indicator **29**. The fluid may be initially placed under pressure by using hand pump **32** which includes a supply of fluid and is connected to the cylinder through hose **33**.

The range of movement of chain **15** is limited by length of movement of coil spring **23** before it is fully compressed. By adjusting the wing nut the chain around the the spiral loop may be placed under a selected tension desirable for a given gauge and diameter of pipe. The hand pump **32** can then be used to place on indicator **29** an initial reading so that thereafter a slight movement of the chain can be detected on the indicator.

Any suitable elongated member such as wire cable, band of metal, or the like, may be used as the measuring and restraining member in place of roller chain **15**. The nature of the material used in the member determines the amount of strain that will be introduced in the member by the expansion of the spiral loop by movement of its edge position. While the use of a resilient tension means, such as the spring arrangement described herein, is preferable, it is contemplated that the present invention may be carried out without such means wherein the member itself functions to expand and contract in response to the movement of the loop. Since the movement of chain (strain), where a spring or similar arrangement is not used, will be relatively small, this movement (strain) is best measured using a conventional strain gauge.

Also shown in the drawings is recession **25** in back forming element **5** to permit roller chain **15** to pass between the element and loop **24** without excessive friction. A similar recession may be formed in front forming element **4**. It is preferred that the roller chain make a complete 360° pass around the loop.

Back forming element **5** is shown adjusted to permit the spirial loop to funnel (see FIG. 2) for the purpose of spreading spiral loop edges **26** and **27**, respectively, as they come together in the area adjacent control ring **6**. Electrical contacts **28** are shown in FIG. 2 for heating the edges which are secured together by a forging unit (not shown).

Turning now to FIG. 4, sheet edge **27**, which is sometimes known as the outside edge is moved and supported by guide roller **38** which is mounted on rod **39** which is in turn vertically positioned in a hydraulically-operated jacking unit **40**. Unit **40** is mounted on end portion **10***a* of arbor **10** and has conduit **41** interconnecting it with cylinder **21**.

In the operation of the present invention, the spiral pipe apparatus is started up and all necessary adjustments of the forming elements including the control ring are made to produce pipe of the desired diameter. The roller chain is then preferably adjusted to place it under tension by adjusting wing nut **22**. Hand pump **32** is operated to place the fluid under initial pressure which is indicated by indicator **29**. As the apparatus continues to run the operator uses the indicator, or, in installations of the invention where no indicator is included, he observes the relative movement between the loop and the chain to guide him in adjusting the apparatus. An increase in tension indicates that too much material is being fed into the loop and a decrease in tension indicates that not enough material is in the loop. As the loop increases in circumference above the desired setting, the tension in the measuring and restraining member, including the roller chain and the spring, automatically exerts a radical restraining pressure on the loop to resist further build up. If the loop continues to increase in size the member will reach its limit thus preventing further increase in loop size.

In addition to adjustments made by the operator, the hydraulic loop edge guide device (FIG. 4) automatically guides the outside loop edge through the movement of the rod **39** in response to changes in pressure in chamber **21**. When pressure in chamber **21** increases due to tension in roller chain **15** the pressure is communicated through conduit **41** to hydraulically-operated unit **40**. Outside edge **27** is raised causing it to run faster than edge **26** since it makes a greater radius thus reducing the radial forces applied to the roller chain as the excess material in the loop is reduced. As the tension in roller chain **15** is reduced the pressure reduces and edge **27** is guided downward. It is thus seen that operation of the hydraulic edge guide device serves to provide automatic control of the loop formation.

The present invention may be used in the manufacture of flat wall pipe, corrugated pipe and other types of conduits, such as tubing or other similarly shaped objects. Where corrugated pipe is being formed, the measuring and restraining member will be most suitably positioned in the valleys of the corrugated material.

While the present invention may be adopted for use on any type of spiral pipe making apparatus, the invention is most effectively employed on forming apparatus herein disclosed where the forming elements are adjusted to produce a flair or funneled effect of the spiral loop and where the spiral loop is fed into a control ring to produce a spiral pipe of selected diameter. It is pointed out that in the forming apparatus disclosed in this application the forming elements are adjusted to permit the spiral loop to assume a funnel shape, as shown in FIG. 2. The purpose of permitting the spiral loop to assume this shape is to open up the loop edges in advance of the juncture position, thus providing space for electrical heating contacts used in the forging of loop edges.

The use of the tension element of the present invention is particularly useful in measuring and restraining spiral loops of the configuration formed during operation of the apparatus herein disclosed. Since the movement of the spiral loop edge position is pronounced to permit opening up of the loop edges, the use of measuring pro-

vides great assistance to the operator of the apparatus in making the required adjustments.

I claim:

1. In an apparatus for manufacturing spiral pipe having a frame and forming elements mounted on said frame for continuously forming a sheet material into a spiral loop, the improvement comprising an elongated measuring and restraining element positioned around and in contacting engagement with a portion of said loop, mounting means for mounting said element on the frame to prevent transverse movement of said element as the spiral loop moves through the forming apparatus and measuring means for measuring the variations in tension in said element caused by variations in the loop circumference and configuration during its movement.

2. The apparatus of claim 1 wherein the elongated measuring and restraining element is positioned around the spiral loop in contact with the edge portion thereof.

3. The apparatus of claim 1 wherein the sheet material is corrugated.

4. The apparatus of claim 1 having in addition loop edge guiding means capable of moving a sheet edge, connecting means connecting said guiding means with said elongated measuring and restraining element in such a manner that movement of said element causes movement of said guiding means whereby variations in loop formation are sensed by the element and are automatically corrected by sheet edge movement.

5. The apparatus of claim 1 having in addition resilient tension means connected to said element for tensioning said element as said loop increases in directions perpendicular to its axis whereby said measuring and restraining member is resiliently urged against said loop as said loop expands.

6. The apparatus of claim 5 wherein said resilient means includes limit means for limiting the radial movement of said element whereby the expansion of said spiral loop is limited.

7. In an apparatus for manufacturing spiral pipe having a frame and forming elements mounted thereon for continuously forming a sheet material into a spiral pipe,

a device comprising a measuring and restraining element spiralled around and in contacting engagement with said loop, one end of said element connected to said frame and the other end mounted on a spring to permit said element to be urged in directions perpendicular to the axis of the spiral loop as the loop expands, measuring means for measuring the tension in said element and limiting means for limiting the movement of said element whereby variations in the circumference and configuration of the loop are measured and the loop is prevented from exceeding a selected size.

8. The apparatus of claim 7 having in addition an indicating means for indicating to the apparatus operator said tension measurements.

9. In an apparatus for manufacturing spiral pipe having a frame and forming elements mounted on said frame for continuously forming a sheet material into a spiral loop, the improvement comprising a flexible element positioned around and in contact with the outer surface of said loop for measuring and restraining said loop, one end of said element connected to the frame, the other end connected to a member, mounting means for mounting said member on the frame at selected positions along the length of said member, resilient means positioned between said mounting means and said member, tension measuring means which in turn comprise a piston mounted on said member, a cylinder positioned around said member and mounted on the frame, a pressure chamber formed by the piston and cylinder and means for measuring pressure in said chamber whereby the tension in the flexible element is continuously measured as the element responds to movement of said spiral loop.

References Cited

UNITED STATES PATENTS

1,939,581	12/1933	Tesmer	72—145
3,256,724	6/1966	Wiley	72—136

RICHARD J. HERBST, *Primary Examiner.*

R. D. GREFE, *Assistant Examiner.*