Oct. 15, 1957 S. K. NETHERY, JR., ET AL 2,809,680

CHAIN SAW APPARATUS FOR PRODUCING SEMI-TUBULAR SHAPES

Filed Jan. 4, 1955 4 Sheets-Sheet 1

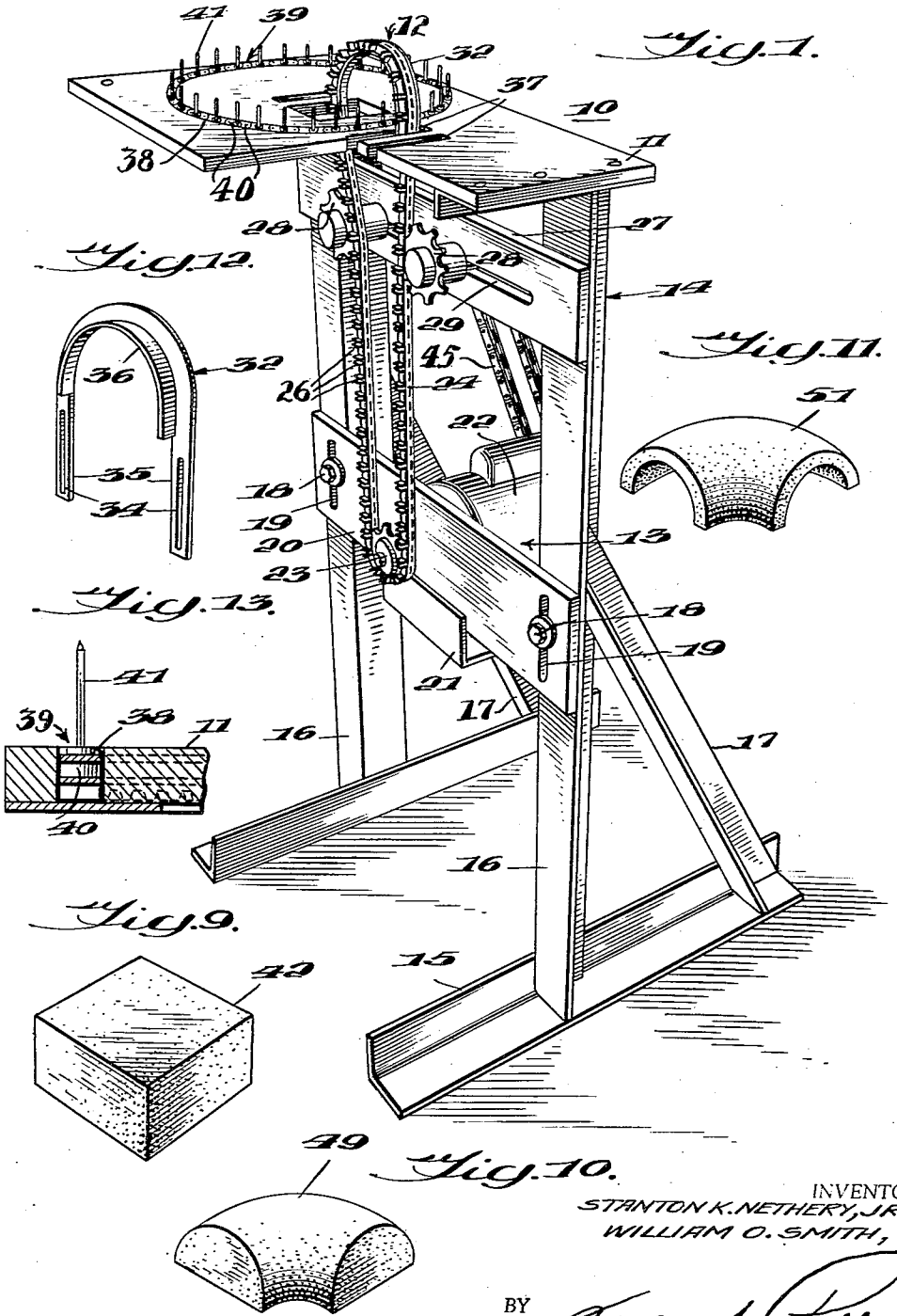


Fig. 1.

Fig. 12.

Fig. 11.

Fig. 13.

Fig. 9.

Fig. 10.

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Fig. 2.

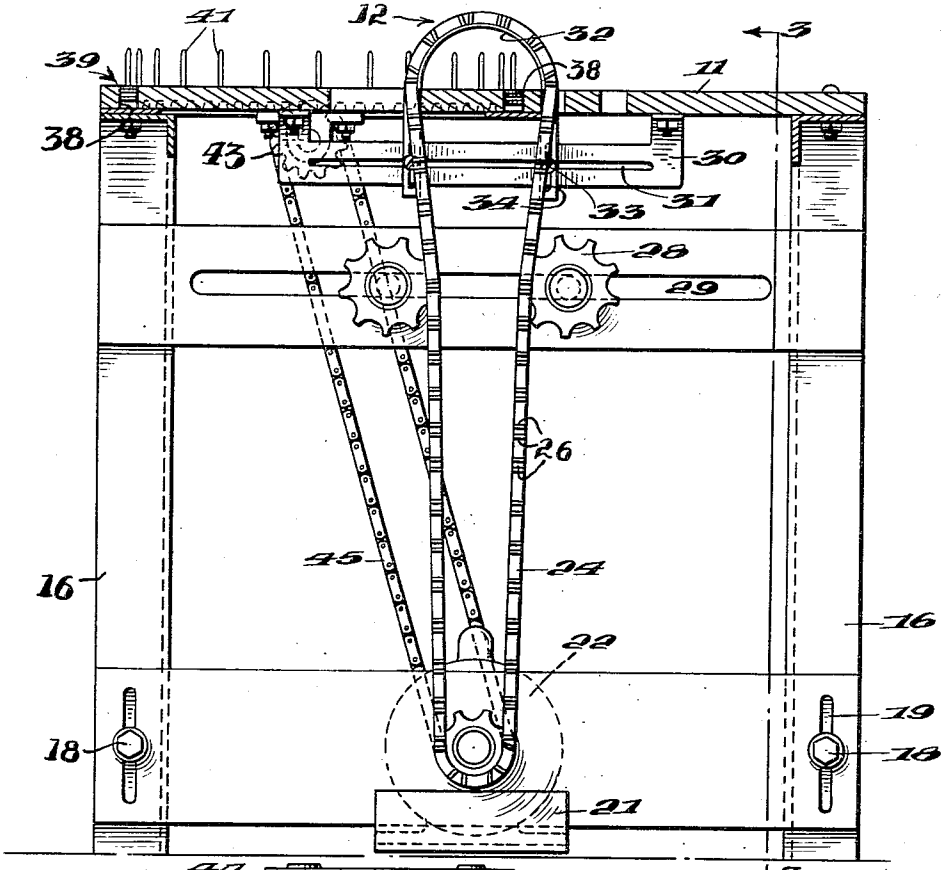
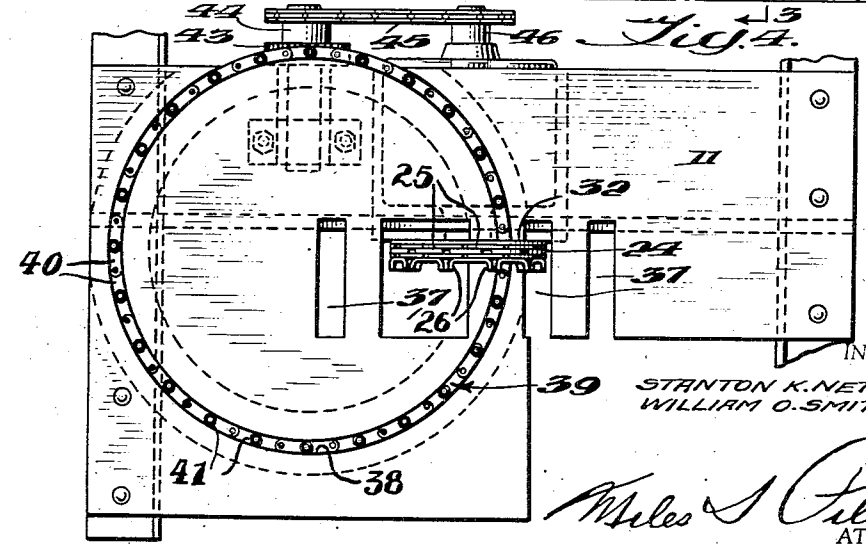


Fig. 4.



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CHAIN SAW APPARATUS FOR PRODUCING SEMI-TUBULAR SHAPES

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Fig. 3.

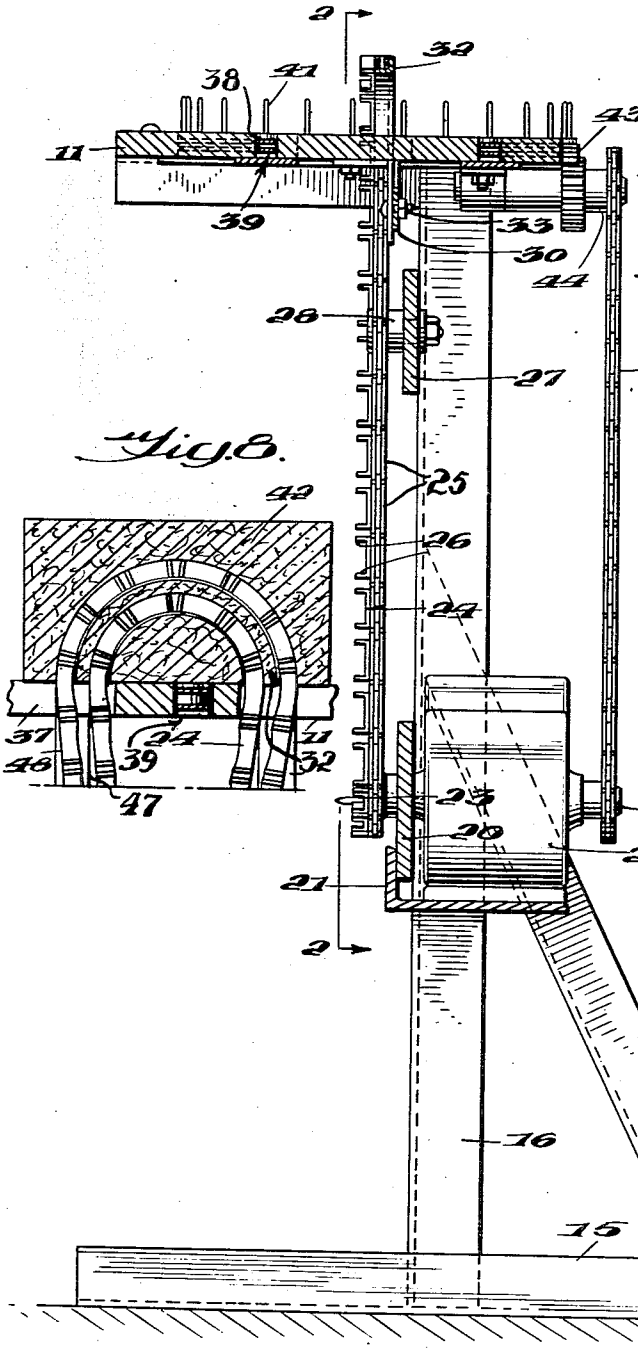


Fig. 6.

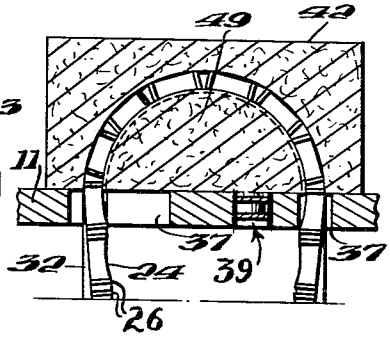
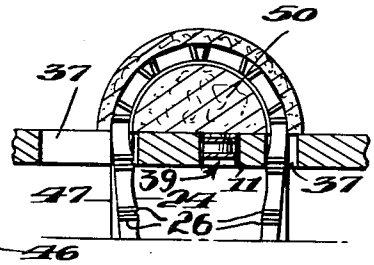


Fig. 8.

Fig. 7.



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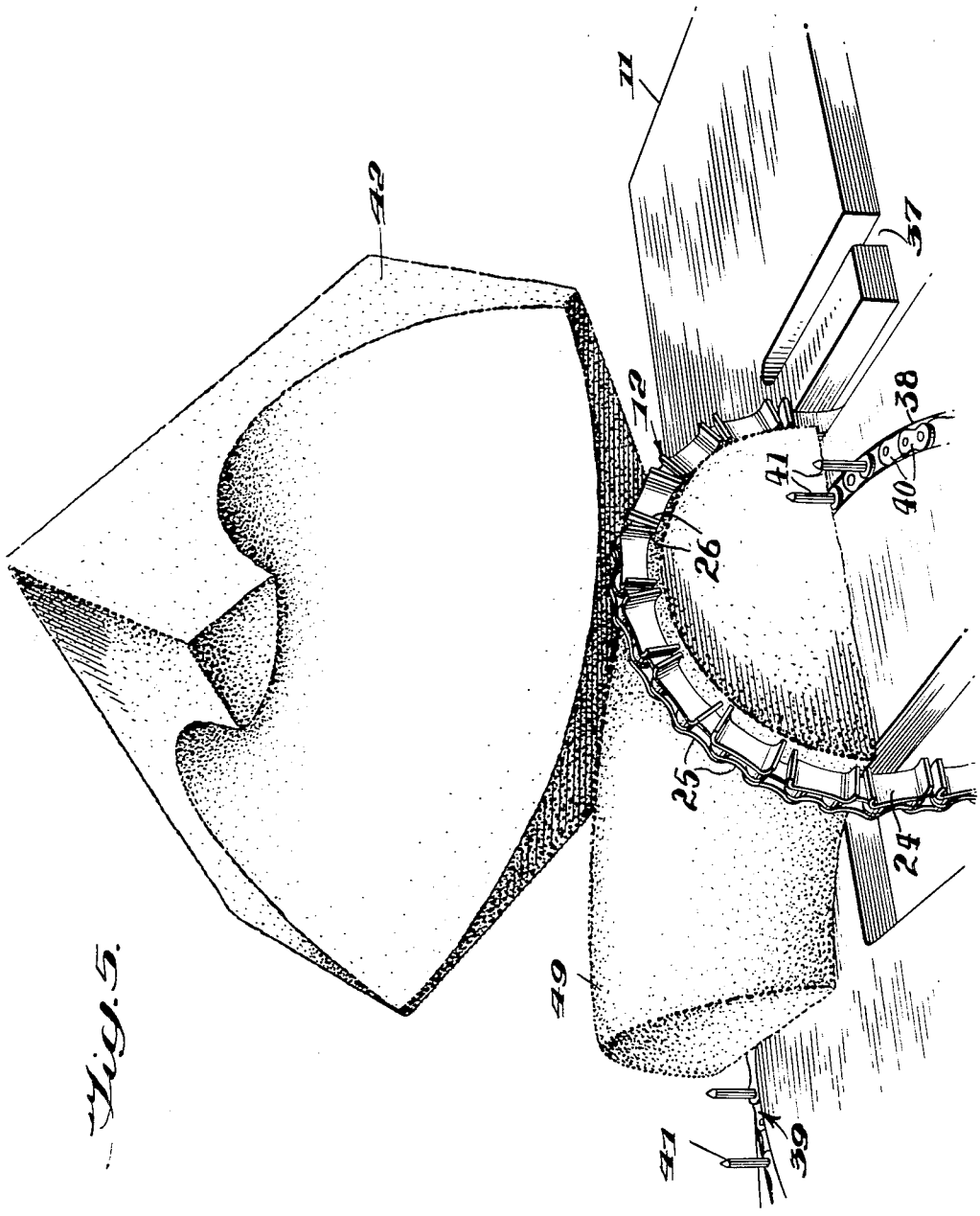


Fig. 5.

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CHAIN SAW APPARATUS FOR PRODUCING SEMI-TUBULAR SHAPES

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Application January 4, 1955, Serial No. 479,702

5 Claims. (Cl. 143—32)

This invention relates to a method and apparatus for producing semi-tubular shapes. More particularly, the present invention relates to an improved method and apparatus for producing semi-tubular shapes from insulative material, said semi-tubular shapes having substantial axial curvatures.

For many years it has been common practice to position insulative covering material over tubes or other conduits which conduct fluids having temperatures substantially different from ambient temperature, the covering serving to insulate the tube or pipe and its contents from the surrounding atmosphere in order to prevent radiant heat loss or absorption.

In order to provide such insulative covering in a readily installable form, it has been almost universal practice to provide the insulative material in semi-tubular complementary sections. These semi-tubular complementary sections are fitted together over the previously installed piping and are held in place by means of clamps, bands, adhesives or the like.

It will be understood that the term "semi-tubular" as used in this specification and the appended claims is intended to define and include an axial section of tubing designed to provide a close covering fit over a portion of any of the standard forms of commercial tubing, regardless of the cross sectional configuration thereof. Such cross sectional configuration may take the shape of an oval, a circle, a polygon or the like. It will also be understood that the semi-tubular section need not be exactly one-half of the overall assembled structure, since in many instances it is desirable to produce complementary sections wherein one of the sections covers over 180° of the perimeter of the pipe and the mating section covers the remaining portion thereof.

In recent years the rapid expansion of chemical refining industries, particularly those relating to the hydrofining and catalytic cracking of petroleum and those relating to the production of synthetic plastic materials, has brought about an ever increasing need for a ready, inexpensive means to manufacture such insulative covering. A single modern petroleum refinery plant may include many miles of tubes or pipes carrrying highly heated fluids. Due to the particular configuration of the tanks and reactors utilized in such a plant and to the series flow problems involved therein, such tubes and pipes of necessity have incorporated therein a number of elbow and reverse bends, as well as S-sections and similarly curved shapes.

While a number of processes and apparatus have been successfully utilized for the production of straight sections of insulative material to cover these pipes, it has heretofore been exceedingly difficult and expensive to produce insulative covering having axial curvature to fit over the elbow or other bends of the pipes. Since a very substantial portion of the pipes in modern chemical refineries and chemical production plants is taken up by such axially curved piping, the cost of the overall insulation for this piping has in the past been very substantial, in some

instances running to a cost approximately equal to that of the piping itself.

It is, therefore, an object of this invention to provide a simple and inexpensive method and apparatus for producing axially curved, semi-tubular sections of insulative material.

Another object of this invention is to provide a method and apparatus for readily producing on a single machine axially curved, semi-tubular sections of different cross sections and of different degrees of curvature.

Another object of this invention is to provide an improved chain saw machine and feed therefor having extreme simplicity in its construction and method of operation, which machine will accurately reproduce the desired semi-tubular insulative shapes.

It is a further object of this invention to provide such a chain sawing machine having interchangeable, adjustable arbors and incorporating therewith a synchronously driven conveyor feed.

A still further object of the invention is to provide such a method and apparatus particularly suitable for the sawing of insulative semi-tubular shapes from blocks of light weight cellular material.

Further objects and advantages of the present invention will be apparent to those skilled in the art from the following detailed description and by the disclosure of the construction shown by way of illustration in the accompanying drawings, in which:

Fig. 1 is a view in perspective of the overall structure of one embodiment of the apparatus of the present invention;

Fig. 2 is a front sectional elevation taken on the line 2—2 of Fig. 3;

Fig. 3 is a side sectional elevation of the apparatus taken on the line 3—3 of Fig. 2;

Fig. 4 is a partial plan view of the apparatus;

Fig. 5 is a view in perspective of a partially completed semi-tubular section as it is manufactured from a block of insulative material according to the present method and apparatus;

Fig. 6 is an enlarged detailed sectional view of the chain saw having a large arcuate saw guide incorporated therewith for cutting the exterior of the semi-tubular shape;

Fig. 7 is an enlarged detailed sectional view of the chain saw having a smaller arcuate saw guide incorporated therewith for cutting the interior of the semi-tubular shape;

Fig. 8 is an enlarged detailed sectional view of the chain saw having incorporated therewith two concentric guides;

Fig. 9 is a view in perspective of a typical insulative material block prior to the sawing operation;

Fig. 10 is a view of the partially completed semi-tubular structure formed by a single guide machine;

Fig. 11 is a perspective view of the completed semi-tubular structure:

Fig. 12 is a perspective view of one form of one of the interchangeable guides of the machine; and

Fig. 13 is a cross sectional detailed view of one form of the conveyor feed chain and pins.

While the invention is susceptible of various modifications or alternative constructions, there is shown in the drawings and described hereinafter in detail the preferred embodiments, and it is to be understood that the invention is not thereby intended to be limited to the specific forms disclosed, but that it is intended to cover all modifications and all alternative constructions falling within the scope of the invention as expressed in the appended claims.

Referring to Fig. 1, numeral 10 indicates one form of

the apparatus of the present invention. This apparatus comprises basically a work supporting table, indicated at 11, a chain saw, indicated in its entirety at 12, a source of power 13, and a supporting means 14 for the apparatus.

The supporting means includes any suitable base, such as indicated at 15, having connected thereto vertical members 16, 16 and, if desired, additional bracing members 17, 17. Supported in vertically adjustable relation upon vertical members 16, 16 by means of bolts or the like 18, 18, coacting with slots 19, 19 is a horizontal cross plate or similar member 20. This member has connected thereto a horizontally extending shelf 21 which supports drive motor 22. Drive motor 22 is the source of power for operation of the chain saw and feed conveyor described hereinafter. Extending forwardly from the shaft of this motor is a driving sprocket 23 operably connected to the shaft of the motor and supported in the adjustable horizontal plate 20.

This driving sprocket 23 coacts in driving relation with a roller chain saw 24 which is composed of a plurality of pivotally connected links 25 each carrying forwardly directed teeth 26 and having spaces therein to engage the teeth of the sprocket.

Carried on a transverse vertically extending plate 27, attached to vertical members 16, 16, are two transversely adjustable sprocket idlers 28, 28 which coact with chain saw 24. These idler sprockets are horizontally adjustable in slot 29 formed in the vertical plate 27 and may be clamped in adjusted position by means of bolts or the like. These idler sprockets serve to adjustably tension the chain saw in order to keep the saw taut and take up any slack caused by the substitution of different size guides, as described hereinafter.

Removably mounted on the underside of table 11 is another horizontally extending transverse plate 30, Fig. 2, having a transverse longitudinally extending slot 31 formed therein. Any particular selected chain saw arcuate shaped guide 32, best illustrated in Fig. 12, is mounted on this latter plate 30 by means of bolts or the like 33 projecting through vertically extending slots 34, 34 formed in guide legs 35, 35. The arcuate shaped guide 32 has formed thereon an arcuate chain saw supporting guide ledge 36 and may, if desired, have an additional upstanding guide flange (not shown) formed on the front of the ledge 36 in order to better guide the chain saw on the guide.

It will be seen from the various figures of the drawings that the guide 32 has its legs 35, 35 projecting through horizontally extending slots 37, 37 formed through the work table 11. Work table 11 is removably attached to supporting means 14 by bolts or the like, for a purpose described hereinafter.

Also formed in the surface of work table 11 is a slot 38 having any desired configuration, shown in the drawings as circular. This slot has positioned therein a conveyor chain 39, preferably formed of a plurality of individual pivotally connected links 40, 40. Each of these links 40, or any desired number thereof, carry upwardly extending pins or the like 41, 41. Pins 41 serve to hold the work piece 42 which is impaled thereon, as described hereinafter. The conveyor chain 39 is driven by means of a suitable gearing mechanism 43, which may include a speed reduction transmission if so desired, which gearing system is driven by sprocket shaft 44, which coacts with a drive chain 45 driven by motor 22 through sprocket 46.

As is best shown in Figures 6 and 7, the mechanism described herein is adaptable to a variety of different shaped and sized adjustable arcuate shaped guides. The portion of these guides extending above the work table may have any desired configuration, depending upon the particular semi-tubular shape which is to be fabricated.

An alternative form of the device is shown in Fig. 8, wherein two concentric arcuate shaped guides 32 and 47 are utilized. It will be understood that the additional guide 47 has coacting therewith an additional chain saw

48, which saw is positively driven from motor 22 by an additional sprocket mounted on the drive shaft thereof. To tension the additional chain saw 48 additional idler sprockets similar to those shown at 28, 28 are positioned in horizontal slot 29 and adjusted to coacting relation with the additional chain saw to tighten the saw. The purpose of this alternative form of the structure will be described hereinafter.

In the embodiment of the invention illustrated in the accompanying drawings, it is desired that a semi-tubular elbow bend of insulative material, such as styrofoam, cork, or the like, shown in Fig. 11, be formed from a starting block of this materials, indicated at 42 in Fig. 9.

The method by which the machine of the present invention accomplishes this fabrication is as follows: motor 22 is started and is adjusted to the desired speed by means of standard controls, not shown. Since this motor drives both the feeding conveyor chains 39 and the band saw 12, it will be apparent that the work feed of the machine will always be synchronously related to the speed of the saw in the desired ratio, which ratio can be adjusted by means of gearing mechanism 43.

In order to form a cover unit of insulating material by the saw and feed conveyor, a block of insulative material 42, such as is shown in Fig. 9, is placed on the conveyor feed chain and impaled upon upstanding pins 41. If desired, gauge lines may be marked on the table in order to indicate the exact correct positioning of the block 42 relative to feed conveyor chain 39.

If the tolerances of the operation are such as to require extremely fine positioning, then it may be desirable to position the block on the conveyor feed chain 39 prior to starting motor 22. For this purpose it may be desirable to incorporate in the gearing mechanism 43 a clutch member, not shown, to initiate operation of the feeding chain once the work piece is positioned thereon.

Conveyor chain 39, carrying the block of insulative material 42, is rotated by the driving mechanism therefor in a counter-clockwise direction, as viewed in the drawings, to present the block to the cutter teeth 26 of the portion of the chain saw 24 supported on arcuate shaped guide ledge 36 above the surface of the work table 11. Continued rotation of the conveyor chain causes the block to move in a curved path past the saw station, resulting in the separation of a curved solid semi-cylindrical portion 49 as illustrated in Figures 5 and 10. The exterior surface of this portion forms the exterior surface of the final semi-tubular shape.

Where such a single arcuate shaped guide form of the invention is utilized as shown in Fig. 6, the drive mechanism is stopped and a second guide 47 having a smaller portion thereof extending above the plane of the work table and being narrower across the leg portions thereof, but generally similar in curvature to guide 32, is substituted for the guide originally on the machine. It will be obvious that where a plurality of similar semi-tubular shapes are to be fabricated, it is desirable to fabricate a plurality of the semi-completed blanks 49 illustrated in Figs. 5 and 10 before changing the guides. The manner in which the guides may be changed will be readily apparent from the above description and from the drawings. Idler sprockets 28 are unclamped and moved away from tensioning position, following which the chain saw 24 is removed from the arcuate shaped guide 32. The arcuate shaped guide 32 may then be readily removed from the horizontal mounting plate and the second guide 47 substituted therefor. The second guide is clamped in the desired position, and the chain saw is positioned thereon. Following this, the idler sprockets are moved into engagement with the chain saw to tighten the saw and these sprockets are then clamped in their adjusted position.

With the second arcuate shaped guide in place the operation of the device described above is repeated. It is to be emphasized that even if the work pieces are removed

from the conveyor after the first cut in order to manufacture a plurality of semi-completed blanks, they may be readily repositioned on the conveyor chain by re-registering the holes formed in the blank by pins 41 in the first operation. The drive mechanism is again started and the semi-completed blank is fed by the conveyor chain past the chain saw in the manner illustrated in Fig. 7, cutting an inside portion 50 out of the semi-completed blank. This results in the fabrication of the semi-tubular shape 51 shown in Fig. 11.

Where it is desirable to produce the semi-tubular shape in one operation rather than in two, the form of apparatus illustrated in Fig. 8 is utilized. In this embodiment of the invention, the two chain saws 24 and 48 are mounted respectively on concentric guides 47 and 32. In consequence, when the work piece is fed in a counter-clockwise fashion past the saw station, the completed semi-tubular shape 51 will be formed in one operation. It is to be noted that the registering holes are formed by pins 41 in the discarded portion 50 of the starting block, so that there is no marring of the finished product.

The height of the selected arcuate shaped guide above the surface of the work table, the width of this guide, and its configuration as to curvature will determine the cross sectional dimensions of the fabricated semi-tubular shape. By appropriate selection of the configuration of this arcuate shaped guide any desired cross sectional shape may be obtained. In like fashion, the thickness of the fabricated semi-tubular shape is determined by the dimensional differences between the larger and smaller guides. In some instances it is desirable that such insulation have non-uniform thickness, which may be readily accomplished by appropriate selection of the configuration of the guides. It will be obvious that it is possible with the method and apparatus of the present invention to fabricate a semi-tubular shape covering less than 180° or more than 180°, if this is desirable.

It is within the scope of the present invention to supply a flexible guide so that this guide can be adjusted, at least over a limited range, without being completely removed from the machine.

The axial curvature of the semi-tubular shape will be determined by the dimension and curvature of the conveyor chain. The form of the device illustrated in the accompanying drawings has been shown for the formation of elbows with the axes of the saw guide curved portions perpendicular to the axis of the cooperating conveyor curved portion. The axial curvature of the semi-tubular shape may be changed by removing the work table from the remaining portion of the machine and substituting other work tables having differently shaped slots 38 and conveyor chains 39. Accordingly, various degrees of curvature may be fabricated in the semi-tubular shapes. As an alternative to this substitutional method, the conveyor chain may be positioned by means of a plurality of adjustable sprockets formed in the surface of the work table, so that adjustment of the sprockets will adjust the curvature of that portion of the chain which traverses past the saw station. One suitable embodiment of mechanism for this alternative structure is a system of idler sprockets and substitutable guides for the conveyor chain, this adjustable conveyor system being substantially identical with that described above and illustrated in the drawings for use with the chain saw. Any similar structure known in the art may be utilized for this purpose.

While the machine and method of the present invention are best suited for use with light weight cellular material, such as styrofoam or cork, it will be apparent that other similar materials which are capable of being positioned upon pins 41 may be fabricated.

We claim:

1. An apparatus for producing axially curved semi-tubular shapes comprising a supporting member having a substantially plane work support surface, an endless saw having horizontally directed teeth, a vertically extending U-shaped saw guide structure having legs adjustably and removably supported on said support and having a substantially semicircular curved base portion connecting juxtaposed ends of said legs and extending above said support, said guide carrying said saw in supporting and guiding relation on said substantially semicircular curved guide portion whereby to saw a substantially semi-circular section from a block of material, and a work-feeding conveyor positioned on said support in the plane of said work support surface and having means for conveying material on said work support surface, said conveyor extending through said curved saw supporting guide portion and having a work-carrying portion with a substantial curvature passing between said legs of said guide and around an axis of curvature extending in a direction perpendicular to the direction of the axis of curvature of said curved guide portion.

2. An apparatus for producing axially curved semi-tubular shapes comprising a supporting member having a substantially plane work support surface, an endless flexible saw, a saw guide including leg portions mounted on said support and having a substantially semicircular curved portion extending thereabove, said guide carrying said saw in supporting and guiding relation on said curved guide portion whereby to saw a substantially semi-circular section through a block of material, an endless work-feeding conveyor traveling in the plane of said work support surface and positioned on said supporting member and having means for carrying a block of working material with a face thereof on said substantially plane work support surface, said conveyor having a curved portion with substantial curvature passing between the legs of said guide with the axis of curvature of said curved conveyor portion extending in a direction perpendicular to the direction of the axis of curvature of said curved guide portion whereby said block of material is carried into sawing engagement with said saw in a curved path around the axis of the curved conveyor portion through the saw, and power means connected in driving relation to both said conveyor and said saw in a manner to drive both simultaneously in a predetermined speed relationship.

3. An apparatus for producing axially curved semi-tubular shapes comprising a supporting member having a substantially plane work support surface, an endless saw having horizontally directed teeth, a saw guide mounted on said supporting member and having a substantially semicircular curved portion extending thereabove, said guide carrying said saw in supporting and guiding relation on said substantially semicircular curved guide portion above said support whereby to saw a substantially semicircular section from a block of material, a work-feeding conveyor traveling in the plane of said work support surface and positioned on said support and having means for conveying material with a face thereof on said work support surface, said conveyor extending through said curved saw supporting guide portion and having a work carrying portion with a substantial curvature around an axis of curvature extending in a direction perpendicular to the direction of the axis of curvature of said curved guide portion whereby said block of material is carried into sawing engagement with said saw in a curved path around the axis of the curved conveyor portion, and an adjustable tensioning means on said supporting member in coacting relation with said saw for tensioning said saw.

4. An apparatus for producing axially curved semi-tubular shapes comprising a supporting member having a substantially plane support surface, an endless saw, a saw guide mounted on said supporting member and having a substantially semicircular curved portion extending thereabove, said guide carrying said saw in supporting and guiding relation on said substantially semicircular curved guide portion above said support whereby

to saw a substantially semicircular section from a block of material, and a work-feeding conveyor traveling in the plane of said support surface and positioned on said support and having upwardly extending pin means for conveying material with a face thereof on said support surface, said conveyor extending through said curved saw supporting guide portion and having a work carrying portion with a substantial curvature around an axis of curvature extending in a direction perpendicular to the direction of the axis of curvature of said curved guide portion whereby said block of material is carried into sawing engagement with said saw in a curved path around the axis of the curved conveyor portion.

5. An apparatus for producing axially curved semitubular shapes comprising a supporting member having a substantially plane support surface, a first endless flexible saw, a first saw guide including legs mounted on said supporting member and having a substantially semicircular curved portion extending thereabove, said first guide carrying said first saw in supporting and guiding relation on said first guide curved portion, a second endless flexible saw, a second saw guide including legs mounted on said supporting member and having a substantially semicircular curved portion of a different diameter from said first guide curved portion arranged within said first guide curved portion and extending above said support surface, said second guide carrying said second saw in supporting and guiding relation on said second guide curved portion, work-feeding conveyor positioned on said support and having means for carrying a block of working material, said conveyor having a portion thereof passing in a curved path between said legs of said guides whereby said block of material is carried into sawing engagement with said saws in a curved path and an axially curved semitubular shape is formed from the block of material.

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