Sept. 22, 1964 C. R. REES ETAL 3,149,598

METHOD OF PRODUCING CONICAL STRUCTURES

Filed Nov. 7, 1961 2 Sheets-Sheet 1

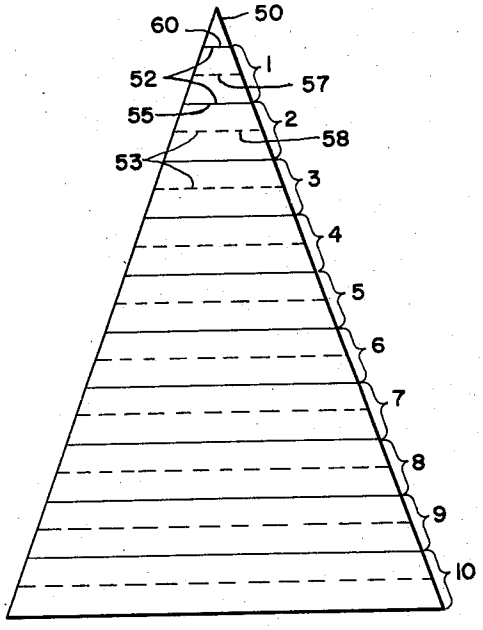


FIG. 1.

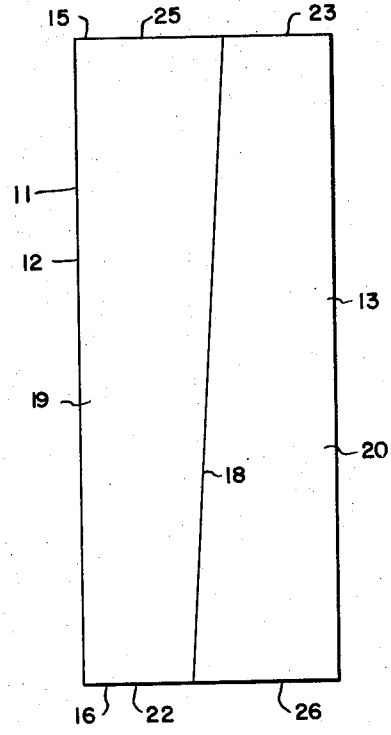


FIG. 2.

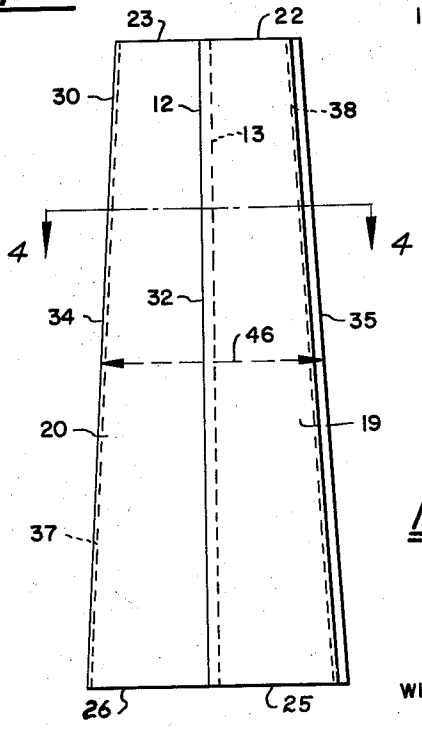


FIG. 3.

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METHOD OF PRODUCING CONICAL STRUCTURES

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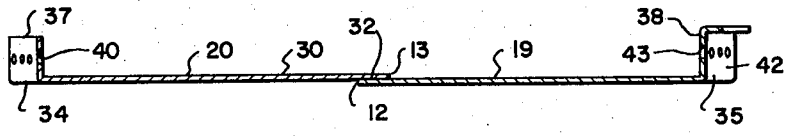


FIG. 4.

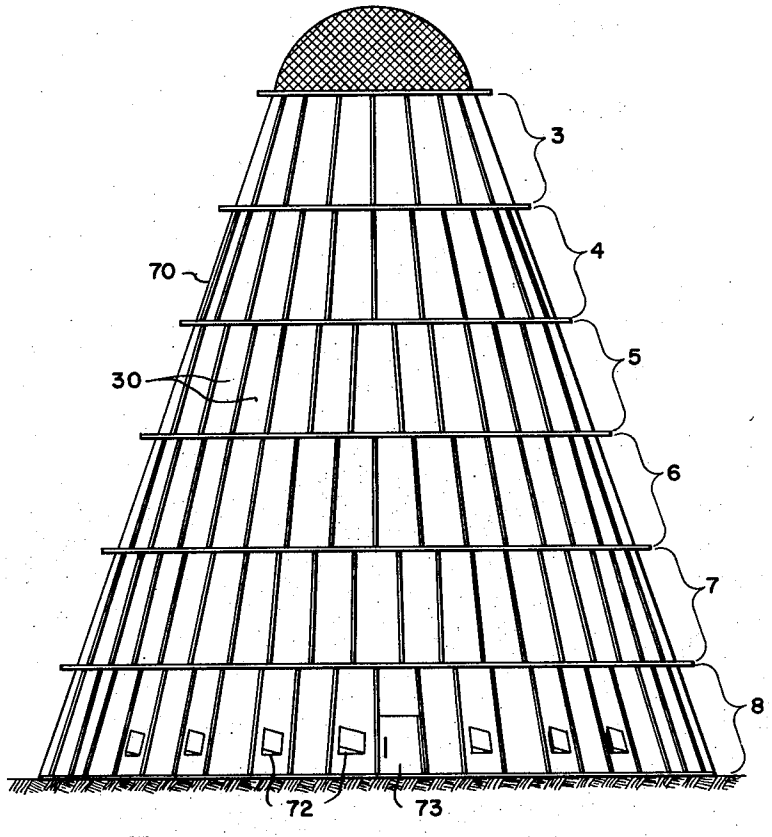


FIG. 5.

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3,149,598

METHOD OF PRODUCING CONICAL STRUCTURES

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This invention relates to a method of producing conical structures which include a plurality of horizontal courses of trapezoidal panels.

This method is particularly for use in the construction of waste wood burners constructed of metal panels, but it is to be understood that the method may be applied to the construction of other conical structures made of panels of any material.

An object of the present invention is the provision of conical structures in courses made up of shaped panels without waste of material.

Another object is the provision of a process for producing conical structures of different sizes using commercially available standard rectangular sheets with a minimum of waste.

A further object is the provision of a method which makes it possible to design a large conical structure and to make jigs for producing trapezoidal panels for the entire structure, whereby any desired number of consecutive courses of the basic structure may be constructed to produce a conical structure of desired dimensions.

For the sake of convenience, the invention will be described in connection with waste wood burners. Such burners are in the form of well proportioned frustums. The burner is made up of a plurality of horizontal courses, each of which is in the form of a frustum, and each course is made up of a plurality of trapezoidal panels which are secured to each other along the side edges thereof which converge from the lower to the upper edges of the panels. The lower edge of each course frustum is connected to the upper edge of the course frustum therebelow. The actual connecting of the panels to each other in their respective course and the courses to each other is standard practice and does not require any detailed description herein.

Each course panel is made from a rectangular sheet of metal. The basic or master design from which each burner is constructed is such that standard metal sheets may be used with little or no waste of material, thereby eliminating the trouble and cost of obtaining sheets of odd dimensions, that is, dimensions which are not normally manufactured or stocked. In order to make a course panel, the selected sheet is cut on a predetermined central diagonal from the upper to the bottom edge of the sheet to produce two identical pieces, each having short and long edges at opposite ends thereof. One piece is reversed relative to the other so that the vertical or original side edges of the sheet are brought together and secured to each other in any desired manner to form a trapezoidal panel. The two short edges of the sheet pieces constitute the top edge of the panel, and the two long edges of said pieces constitute the bottom edge thereof.

In actual practice, the vertical edges of the two sheet pieces are usually overlapped and secured together in any desired manner, such as by welding or by bolting. The degree of overlap may be adjusted to fit the circumstances, but this overlap is the same for all the panels for a given burner and constructed in accordance with this invention. Rails are formed along the two side edges of the course panel. One side edge is usually bent to form a rail or

flange extending outwardly substantially at right angles to the main plane of the panel, while the opposite side is bent outwardly on the same side of the panel plane to form a rail which is substantially L-shaped in cross section. When determining the size of the sheet to be used for the burner, allowance has to be made for the seam or overlap down the centre of each course panel and for the rails on the side edges thereof.

The actual formation of each course panel forms part of the present method. The method also includes the steps necessary to arrive at the size of the panels for each course, and particularly the upper and lower edges of said panels.

In carrying out the present method, a master cone is drawn on paper and divided into any desired odd number of horizontal courses of equal slant heights. The theoretical dimensions of the cone should be such as to include the frusto-conical structure for anything from the smallest to the largest burner that it is desired to build. In other words, a desired number of courses from the top down of the cone would make up the smallest burner to be built, while a desired number of courses from the bottom up would make up the largest burner. The dimensions of the burners produced according to this invention depend upon the slant height of the various courses, the degree of slope of the conical structure, and the size of the metal sheets from which the course panels are to be made.

The present process includes three basic factors, namely, (1) all the trapezoidal panels for burners developed from a given master cone have the same mean width, (2) a desired number of panels is selected from the top or No. 1 course of the cone, and the number of panels in each succeeding course is a multiple of the number in the first course, and (3) a mean diameter is selected for No. 1 course, and the mean diameter of each succeeding course is a multiple of the first course diameter.

The mean diameter and the number of panels for the top or No. 1 course has to be worked out by trial and error in order to be able to use standard and readily available metal sheets without waste of material.

For the sake of clarity, a set of figures and dimensions will now be used for constructing desirable wood waste burners, and reference will be made to the accompanying drawings, in which,

FIGURE 1 illustrates a master cone used to work out the dimensions of desired burners of different sizes,

FIGURE 2 illustrates a standard metal sheet ready to be cut on a central diagonal line,

FIGURE 3 shows a finished course panel,

FIGURE 4 is an enlarged cross section taken on the line 4—4 of FIGURE 3, and

FIGURE 5 diagrammatically illustrates a wood waste burner constructed in accordance with the present method.

FIGURE 2 illustrates a sheet metal **11** of standard dimensions, and in this example, the sheet is 4 feet wide between its side edges **12** and **13**, and 10 feet long or high between its end edges **15** and **16**. Sheet **11** is cut along a central vertical diagonal **18** into two identical pieces **19** and **20**. Piece **19** has a narrow edge **22** that is exactly the same length as a corresponding narrow edge **23** of piece **20**. Similarly, piece **19** has at its opposite end a wide edge **25** that is the same length as a corresponding wide edge **26** of piece **20**.

One of the sheet pieces **19** or **20**, in this case, piece **19**, is reversed relative to the other piece to bring the side edges **12** and **13** together to form a trapezoidal panel **30**. The adjacent edges **12** and **13** are overlapped, as clearly shown in FIGURE 4, and joined together in any suitable manner, such as by welding, to form a vertical central seam **32** in the panel. The slanting edges formed by

diagonal cut 18 provide side edges 34 and 35 for panel 30 which converge upwardly from the relatively long lower edges 25–26 to the short upper edge 22–23. The customary side rails are formed along side edges 34 and 35. In this example, piece 20 is bent outwardly along the sloping edge thereof to form flange 37. Similarly, piece 19 is bent along its sloping side to form a flange 38 which is L-shaped in cross section and projects from the same side of the general plane of panel 30 as flange 37, as clearly shwon in FIGURE 4. As the course panels 30 of a burner are usually bolted together, flange 37 is provided with a plurality of holes 40 therethrough and throughout the length thereof. Flange 38 includes a web 42 which is opposed to flange 37 and has a plurality of holes 43 therethrough throughout the length thereof. With this arrangement, the flange 37 of one panel 30 may be bolted to flange web 42 of the next adjacent panel.

Panel 30 has a mean width, indicated by line 46, midway between its upper edge 22–23 and its lower 25–26. It has been found that sheet 11 may be economically used to produce panels 30 having a mean width of 41 inches for use throughout the entire burner to be constructed. The original sheet is 48 inches wide, and when allowance of one inch is made for seam 32 and 6 inches for the side rails formed by flanges 37 and 38, the resulting width is 41 inches. If six panels of a mean width of 41 inches are used for the top or No. 1 course, this results in a course with a mean diameter of 6.5 feet. It should be kept in mind that the calculated dimensions are approximate. The six panels provide a means circumference of 246 inches, and this divided by 3.1416 gives a mean diameter of 6.5 feet. Thus, in the carrying out of this process with the figures used in this illustration, the mean panel width of 41 inches, the six panels of the top course, and the mean diameter of 6.5 feet for the top course are the basic factors.

A master cone 50 is constructed on paper in order to determine the width of the upper and lower edges of the panels 30 for each course.

As each sheet 11 and, consequently, each panel 30 is 10 feet long or high, the slant height of each course is approximately 10 feet. However, as in standard practice, there is a small overlap between adjacent courses, the effective slant height of each course is a little less than 10 feet. The slant height of cone 50 is divided into an odd number of equal spaces, each space representing half the slant height of the course. The slant height of the illustrated cone 50 is divided into 21 equal spaces to provide 10 complete courses, said divisions representing increments of 4.875 feet. The spaced solid lines 52 represent the upper and lower boundaries of the courses, and broken lines 53 represent the mean diameters of the respective courses. Cone 50 is divided into courses Nos. 1 to 10, No. 1 being the upper course and No. 10 the bottom course. There are six panels 30 in course No. 1, and the numbers of panels in the succeeding courses increases by multiples of this number. For example, course No. 2 has 12 panels, course No. 3, 18 panels, and down to course No. 10 having 60 panels. The mean diameter of course No. 1 is 6.5 feet, and the mean diameters of the succeeding courses increase by multiples of this number. For example, the mean diameter of course No. 2 is 13 feet, of No. 3 is 19.5 feet and down to course No. 10 having a mean diameter of 65 feet.

In order to calculate the respective lengths of the upper and lower edges of the panels 30 for each course, you determine the circumferences at the top and bottom of the course and divide the number of panels of that course into said circumferences, and this gives the upper and lower edge widths of each panel for that course. The diagonal 18 for each sheet 11 to be used in producing the panels for said course is now easily located. The narrow edges 22 and 23 of sheet pieces 19 and 20 are each one-half the width of the upper edge of the desired panel, and

the wide edges 25 and 26 are each equal to one-half the width of the bottom edge of said panel.

The upper and lower edge widths of panels 30 for course No. 1 are determined as follows:

The bottom circumference 55 of course No. 1 is the mean circumference between known mean circumferences 57 and 58 of courses No. 1 and No. 2, said circumferences being 246 inches and 491 inches respectively. Thus, the circumference of lower edge 55 of No. 1 course is 369 inches. As there are six panels 30 in No. 1 course, you divide six into 369, and this results in a lower edge 25–26 width of each panel of 61.5 inches. As each of the wide edges 25 and 26 is half this length, each of these wide edges is 20.7 inches. The upper circumference 60 of course No. 1 is determined by taking the mean circumference between mean circumference 57 of course No. 1 and the next course up. As the latter is the apex of the master cone, it has a slant height equal to half the slant height of the other courses. Therefore, circumference 60 is 123 inches. Divide this circumference by 6 and you arrive at a top edge width of 20.5 inches for each panel 30 of course No. 1. This results in each of the narrow edges 22 and 23 being 10.25 inches long. Thus, the combined lengths of narrow and wide edges 22 and 26 equals approximately 41 inches, the mean width 46 of panel 30.

The widths of the upper and lower edges of panels 30 for each succeeding course is determined in the same manner as for course No. 1, the mean diameter and the number of panels for each course being known. For example, the tops and bottoms of the panels for course No. 2 would be 30.7 inches and 51.1 inches respectively; and the tops and bottoms for course No. 3 would be 34.1 inches and 47.7 inches respectively. Thus, master cone 50 is used to determine the dimensions of the panels 30 for each of a desired number of courses.

When it is desired to construct a burner of dimensions coming within those of master cone 50, the desired courses for the burner are selected from the master cone. FIGURE 5 illustrates a burner 70 utilizing courses Nos. 3 to 8 of the above-described master cone 50. The size, shape and number of panels are known for each course. For example, courses Nos. 3 to 8 would have 18, 24, 30, 36, 42 and 48 panels respectively. As the panels for each course are the correct sizes, it is only necessary to put the panels together in courses to form frustums, one on top of the other, starting with course No. 8 as the bottom course for the burner. Ventilating openings 72, and an access opening 73 may be formed in panels of course No. 8.

It will be understood that the dimensions set out above are examples only. For example, if the mean diameter of course No. 1 is 6 feet 3 inches, a mean sheet width of 39.3 inches may be used, and this is produced from a sheet 4 feet by 10 feet by making the panels with an overlap or seam of 2.7 inches. A sheet width of 42 inches provides a diameter increment of 5.58 feet, approximately.

What we claim as our invention is:

1. The method of producing conical structures in courses which comprises selecting rectangular sheets of a desired length and width, cutting the sheets for each course on a vertical diagonal into two pieces, reversing one piece of each sheet and securing it to the other piece of said sheet to form a trapezoidal panel, the angle of cut from the vertical of the sheet of each course being increased over that of the previous course of larger diameter, the number of panels in each course being less than that of the previous course of larger diameter, all of the panels for the courses being of the same mean width, joining the non-parallel edges of the panels of the first course to produce a frustum, joining the non-parallel edges of the panels of each successive course to produce the course, and securing the bottom ends of each course to the top ends of the course immediately below.

2. The method of producing conical structures in

courses which comprises selecting rectangular sheets of a desired length and width, cutting the sheets for each course on a vertical diagonal into two pieces, reversing one piece of each sheet and securing it to the other piece of said sheet to form a trapezoidal panel, the angle of cut from the vertical of the sheet of each course being increased over that of the previous course of larger diameter, the number of panels in each course being less than that of the previous course of larger diameter, all of the panels for the courses being of the same mean width, joining the non-parallel edges of the panels of the first course to produce a frustum, joining the non-parallel edges of each successive course to produce a course of a diameter that is a predetermined amount less than the diameter of the next course below to form a burner wall having a predetermined slope, the number of panels in each course being less by a predetermined amount from the number of panels in the course below, and securing the bottom ends of each course to the top ends of the course immediately below.

3. The method of producing conical structures in courses of trapezoidal panels, which comprises determining the number of courses, increasing the mean diameter of each course from the top course down by the same amount from the diameter of the next course above, determining the number of panels for the top course and progressively increasing the number of panels in the courses from the top course down, selecting rectangular sheets of a desired length and width for the production of the course panels, cutting the sheets for each course on a vertical diagonal to produce two identical pieces each having narrow and wide ends, reversing one piece of each sheet and securing it to the other piece of said sheet to form a trapezoidal panel, the widths of the tops and bottoms of the panels of each course being determined by the number of panels in said course and the diameters of the top and bottom of said course, all the panels for the courses being of the same mean width, joining the non-parallel edges of the panels of the first course to produce a frustum, joining the non-parallel edges of the panels of each successive course to produce the course, and securing the bottom ends of each course to the top ends of the course immediately below.

4. The method of producing conical structures in courses of trapezoidal panels, which comprises determining the number of courses, increasing the mean diameter of each course from the top course down by the same amount from the diameter of the next course above, determining the number of panels for the top course and progressively increasing the number of panels in the courses from the top course down by multiples of the first course, selecting rectangular sheets of a desired length and width for the production of the course panels, cutting the sheets for each course on a vertical diagonal to produce two identical pieces each having narrow and wide ends, reversing one piece of each sheet and securing it to the other piece of said sheet to form a trapezoidal panel, the widths of the tops and bottoms of the panels of each course being determined by the number of panels in said course and the diameter of the top and bottom of said course, all of the panels for the courses being of the same mean width, joining the non-parallel edges of the panels of the first course to produce a frustum, joining the non-parallel edges of the panels of each successive course to produce the course, and securing the bottom ends of each course to the top ends of the course immediately below.

5. The method of producing conical structures in courses of trapezoidal panels, which comprises determining the number of courses, increasing the mean diameter of each course from the top course down by a multiple of the diameter of the top course from the diameter of the next cousre above, determining the number of panels for the top course and progressively increasing the number of panels in the courses from the top course down, selecting rectangular sheets of a desired length and width for the production of the course panels, cutting the sheets for each course on a vertical diagonal to produce two identical pieces each having narrow and wide ends, reversing one piece of each sheet and securing it to the other piece of said sheet to form a trapezoidal panel, the widths of the tops and bottoms of the panels of each course being determined by the number of panels in said course and the diameters of the top and bottom of said course, all the panels for the courses being of the same mean width, joining the non-parallel edges of the panels of the first course to produce a frustum, joining the non-parallel edges of the panels of each successive course to produce the course, and securing the bottom ends of each course to the top ends of the course immediately below.

6. The method of producing conical structures in courses of trapezoidal panels, which comprises determining the number of courses, increasing the mean diameter of each course from the top course down by a multiple of the diameter of the top course from the diameter of the next course above, determining the number of panels for the top course and progressively increasing the number of panels in the courses from the top course down by multiples of the first course, selecting rectangular sheets of a desired length and width for the production of the course panels, cutting the sheets for each course on a vertical diagonal to produce two identical pieces each having narrow and wide ends, reversing one piece of each sheet and securing it to the other piece of said sheet to form a trapezoidal panel, the widths of the tops and bottoms of the panels of each course being determined by the number of panels in said course and the diameters of the top and bottom of said course, all of the panels for the courses being of the same mean width, joining the non-parallel edges of the panels of each successive course to produce the course, and securing the bottom ends of each course to the top ends of the course immediately below.

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