

March 26, 1957

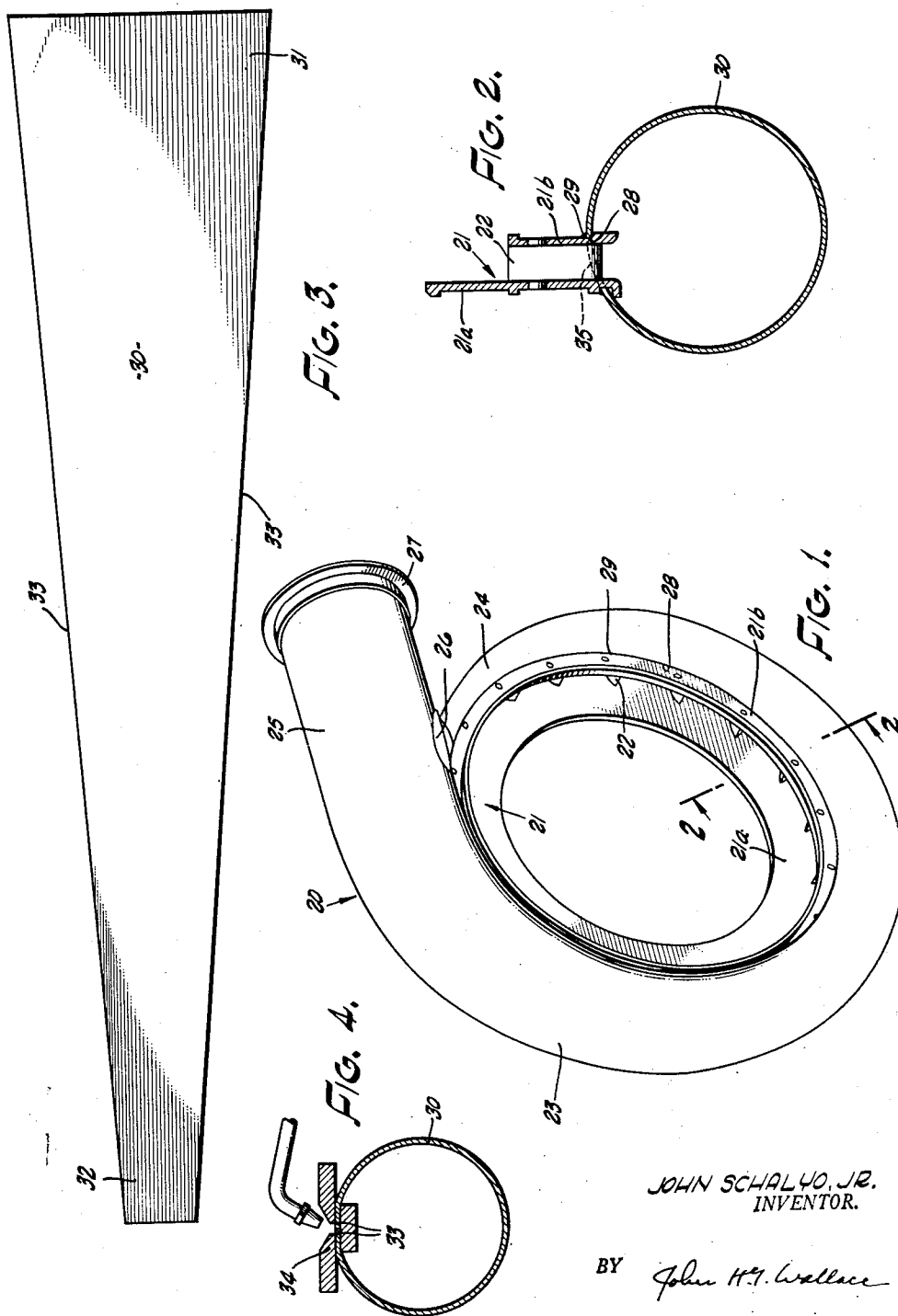
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2,786,261

METHOD OF FORMING PASSAGE STRUCTURE

Filed Oct. 28, 1952

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

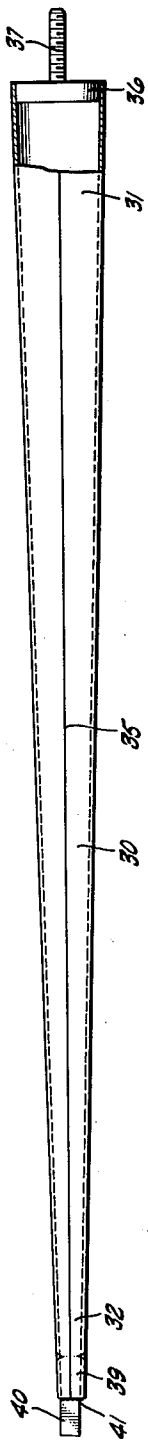


FIG. 5.

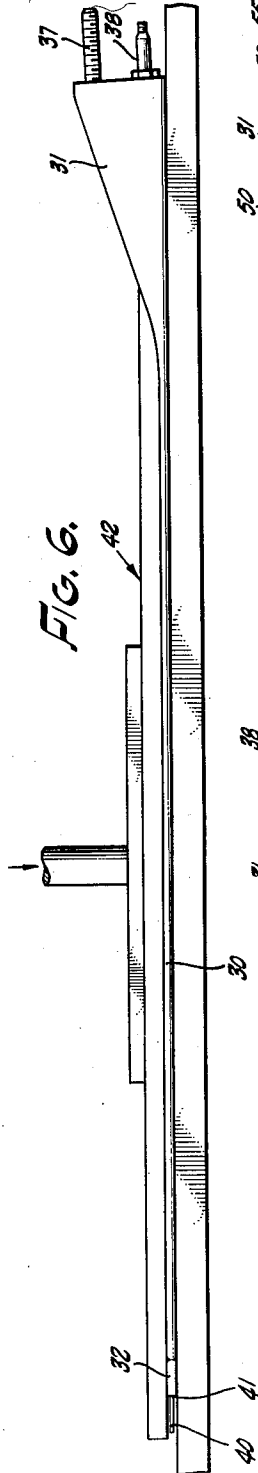


FIG. 6.

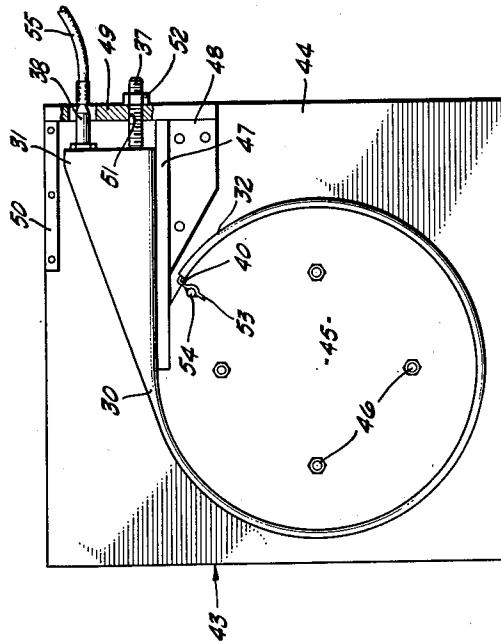


FIG. 8.

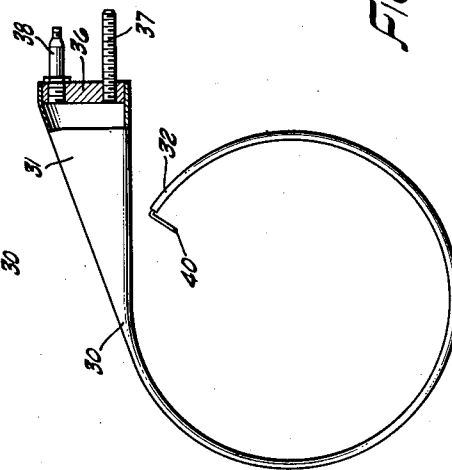


FIG. 7.

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3 Sheets-Sheet 3

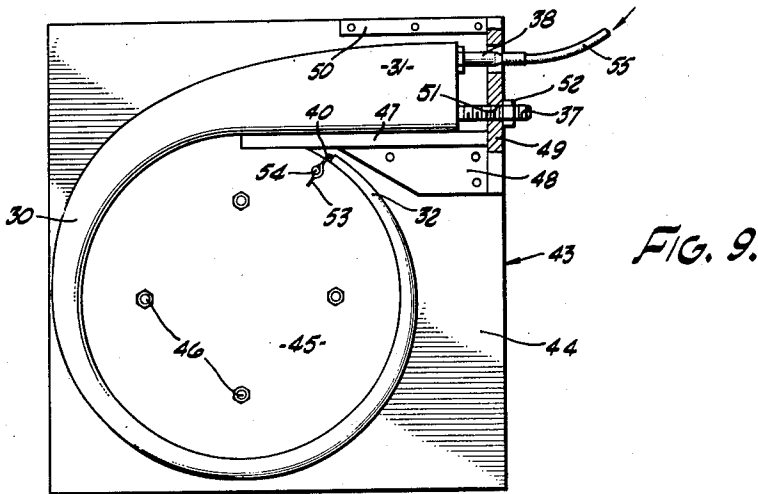
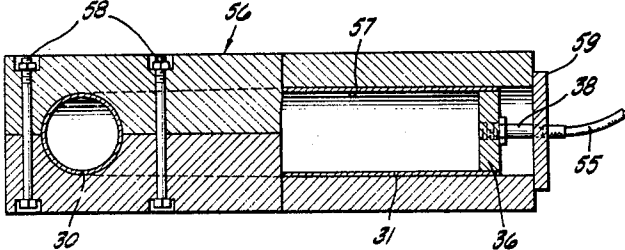
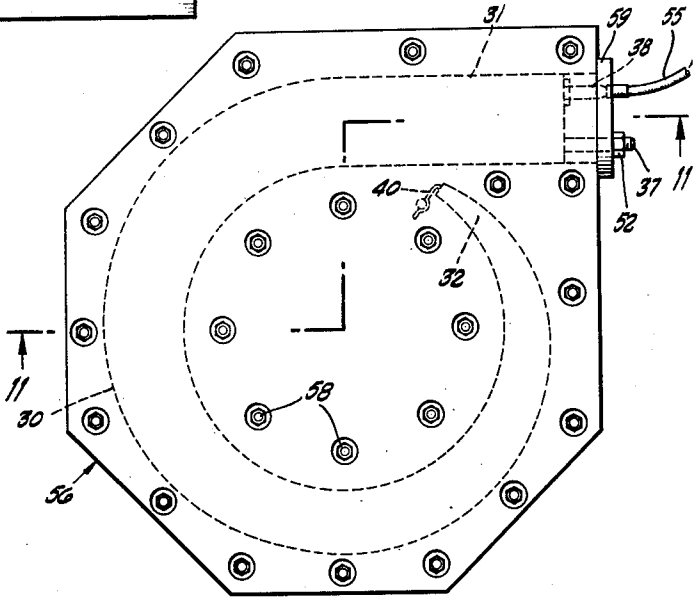


FIG. 10.



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METHOD OF FORMING PASSAGE STRUCTURE

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7 Claims. (Cl. 29—156.4)

This invention relates to centrifugal passage structures and to a method of forming seamless scrolls comprising said passages, and more particularly to such passage structures and a method of forming the same in which there are produced precision, lightweight, efficient and attractive seamless scrolls, for use primarily in the conduction of hot or cold gases from one point to another as in radial flow compressors, expansion turbines and like devices.

For the efficient flow of gases through turbine or compressor passages, it is desirable to construct such passages with uninterrupted, smooth interiors, and often, when one passage is adjacent or within another, the exteriors of the passages must also be similarly constructed. This is particularly important in high speed turbines and compressors, as the efficiency of such units is dependent upon the efficiency of their components, an inefficient structure necessarily being larger and having increased weight in order to accomplish like work. These weight and size factors must be carefully considered in modern applications, particularly in aircraft, as installation and usage of such devices may depend largely thereupon.

The ease of manufacture together with the appearance of the device must also be considered. By the elimination of such components, the complexity of assembly is decreased, the simplified device having a more desirable and marketable appearance.

Heretofore it has been the practice to form scrolls of this type in halves, and to weld, bolt or otherwise secure the halves together. Regardless of the care in manufacture or design, in using this type of construction a seam was always present and exposed to the interior passageway of the scroll. When hot gases were conducted through the scroll, the probability of centrifugal erosion of the material adjacent the seam was increased. The joining of the two halves of the scroll necessitated an exterior ridge, seam or flange, thus adding undesirable roughness and some excess weight to the structure.

The problems of scroll formation are further complicated by the necessity for constructing such devices from stainless steel or other high temperature alloys. These materials are extremely difficult to work, this being especially true where precision is a critical factor, as in gas turbine or compressor construction. The exact configuration of such scrolls must be maintained in successive structures to insure uniform operational characteristics in mass produced devices, a problem not so critical in other fields of tubular or conical metal forming.

It is therefore an object of this invention to provide a novel method for the construction of seamless centrifugal passage structures for use in radial flow compressors, turbines or the like.

Another object of the invention is to provide a novel method for forming seamless centrifugal passage structures in which construction tolerances may be closely maintained.

A further object of the invention is to provide a novel

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method for forming inexpensive, efficient and attractive seamless centrifugal passage structures in a minimum time, using a minimum amount of equipment and material.

Another object of the invention is to provide a novel seamless scroll forming method.

A still further object of the invention is to provide a novel centrifugal passage structure.

Other and further important objects of the invention will become apparent from the disclosures in the following description, appended claims and accompanying drawings, wherein:

Fig. 1 is a perspective view of the scroll structure embodying the scroll produced by the process of the invention;

Fig. 2 is a fragmentary sectional view taken substantially as indicated by line 2—2, Fig. 1;

Fig. 3 is a plan view illustrating the initial shape of the material to be utilized in forming the scroll;

Fig. 4 is a transverse sectional view showing one of the early steps in the process;

Fig. 5 is a longitudinal view, partially in section, showing the material as it appears in another step of the process;

Fig. 6 is a side elevational view showing the step in the process wherein the assembly of Fig. 5 is partially flattened;

Fig. 7 illustrates the assembly of Figs. 5 and 6 after having been laterally rolled;

Fig. 8 is a top plan view of a forming fixture with the assembly of Fig. 7 secured thereto;

Fig. 9 is a view similar to Fig. 8 showing the scroll partially expanded;

Fig. 10 is a top plan view of a restricting die and showing the scroll completely expanded therein; and

Fig. 11 is a sectional view taken as indicated by line 11—11, Fig. 10.

Referring primarily to Figs. 1 and 2 of the drawings, the passage structure of the present invention is shown as indicated generally at 20. While it is not intended to limit the invention to the particular use shown, for purposes of description and illustration, the passage structure has been applied to a portion of a radial flow compressor or expansion turbine having a suitable nozzle ring 21 comprising a pair of spaced rings 21a and 21b and directional vanes 22 secured to said rings. As shown, the structure has a scroll body 23 which is provided with a reduced diameter end 24 and a relatively straight neck portion 25. The end 24 is secured to the neck 25 as by welding or other suitable means as, for example, a securing saddle or plate 26 to thus form a continuous annular passage. The end 25 is also provided with an attaching flange 27. The nozzle ring 21 is shown as secured in an annular, inwardly directed cutout 28 in the scroll body 23 by means of welding 29 or other suitable means. The configuration of the scroll body 23 is such as to provide a smooth, efficient and attractive passage structure for the delivery of gases to the nozzle ring 21.

In the present process for forming the scroll body 23, a sheet of material 30 such as stainless steel, aluminum etc., is cut substantially as illustrated in Fig. 3, i. e., tapered and cut to form an elongated trapezoidal blank having a wide end 31 and a narrow end 32. The material 30 is next rolled about an axis extending parallel to the length of the blank so that it assumes the conical configuration shown in Figs. 4 and 5, the longitudinal edges 33 being clamped in a suitable jig 34 and butt welded therein, as by any known welding process, in order to provide a strong, fluid tight joint as indicated at 35, Fig. 5.

There is thus produced an elongated conical frustum having a longitudinally welded seam, the sheet 30 losing

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its identity as such to become this new structure. The enlarged end 31 is next provided with a plug-like closure 36, this closure being welded or otherwise secured within the open end of the cone and further provided with a rigid stud 37 and a tubular fluid connection 38, the purposes of which will be later described. The narrow end 32 of the cone is flattened as at 39 and a tab 40, co-extensive therewith, is secured thereto as by welding 41. The assembly thus far produced is illustrated in Fig. 5.

The major length of the frustum of Fig. 5 is next flattened by application of external pressure thereto in a suitable jig 42, as indicated in Fig. 6 in which the frustum is shown, seam-down, under the press. During this and subsequent steps in the process, care must be taken to prevent scratching or marring of the surface of the material. Accordingly, to prevent such damage, the jig 42 may be lined with wood, plastic or other suitable material.

The flattened frustum is then rolled into the shape shown in Fig. 7, with the welded seam 35 on the inner periphery thereof. As shown, the tab 40 is then bent radially inwardly. Stresses that have accumulated in the material during the initial longitudinal rolling operation, the subsequent flattening and the lateral rolling, may be eliminated by annealing at this point.

The balance of the forming operations to complete the scroll structure may be accomplished by the application of fluid pressure such as air, oil or the like, to the interior thereof through the fluid connection 38. In order to maintain the partially formed scroll body in approximately the desired final configuration, the rolled assembly of Fig. 7 is next secured to a forming fixture indicated generally at 43, Figs. 8 and 9. The fixture 43 has a base portion 44 and a centrally disposed upstanding cylindrical portion 45 secured thereto by means of bolts and nuts 46. A guide member 47 extends tangentially from the portion 45 and is located and secured to the base 44 by means of a block 48. The outer end of the guide 47 provides a stop for one end of a tension plate 49, the other end being adapted to bear against a stop member 50, the latter also being secured to the base 44. As shown in Fig. 8, the stud 37 is adapted to extend through an opening 51 in the plate 49 and to be retained therein by means of a nut 52. The inner surface of the scroll body is positioned along the guide 47 and around the periphery of the upstanding portion 45, the tab 40 being positioned in a slot 53 and retained therein by means of a drive pin 54. By tightening the nut 52, the scroll body assembly will be placed in tension and thus be securely positioned so as to maintain a predetermined internal diameter, which diameter will approximate that of the finished scroll body. With the scroll body thus in position, the fluid pressure may be applied through a conduit 55, connected to the fluid connection 38, and into the interior of the scroll body, thus radially expanding the outer periphery thereof to an extent substantially as shown in Fig. 9. The flow of the material during expansion is generally radially outwardly with little expansion taking place adjacent the weld seam 35 which is held substantially against the cylindrical portion 45 by the tension applied thereto. To prevent circumferential movement along the outer surface of the upstanding portion 45 and the guide 47, it may be necessary to occasionally adjust the tension applied to the scroll body, through the stud 37, by further tightening the nut 52.

The partially expanded scroll body may next be again annealed to eliminate local stresses incurred in the beforementioned fluid forming operation.

As a final step in the forming operation, the partially expanded scroll body is placed in a split restricting die 56 which has a cavity 57. The cavity 57 is shaped to conform to the final configuration of the scroll body, one-half of the cavity being contained in each of the upper and lower portions of the die 56, these last being retainable in tight coadunation by means of a plurality

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of bolts and nuts 58. The scroll is placed in the cavity and secured against circumferential movement by means of a plate 59, similar to the plate 49, the nut 52 being secured at the stud 37 and engaging the outer portion of the plate. Fluid pressure is again delivered through the conduit 55 to the interior of the scroll body to complete the expansion within the cavity 57.

Upon removal of the scroll body from the die 56, the small end, adjacent the tab 42, is cut off and the closure 36 is removed. The end 32 of the original sheet 30 thus forms the reduced diameter portion indicated at 24 in Fig. 1, to thereafter be secured as previously described to the straight portion 25 to form the scroll 24. The portion adjacent the welded seam 35, along the inner wall of the scroll body, is cut away as shown by the dotted lines in Fig. 2 to provide the annular groove 28 for the reception of the nozzle ring 21.

It will thus be seen that the scroll body and finished scroll are finally formed with no welded seam or other protuberance which would extend either inwardly or outwardly from the walls thereof and that undesirable ridges, flanges, seams and the like, which necessarily add weight to the device and decrease the efficiency thereof are thus eliminated.

Having thus described the invention and the present embodiment thereof, I claim:

1. In a method of forming a passage, the steps of rolling an elongated trapezoidal sheet metal blank and joining the side edges to form a frusto-conical body; flattening the major portion of such body while maintaining the larger end substantially circular in cross-section with the joined side edges on one side between the two side edges of the flattened portion; coiling the flattened portion of such body into substantially circular form; and applying fluid pressure to the interior of said body with the ends thereof closed to expand the flattened portion of said body into substantially circular cross-section while maintaining the internal diameter of said circular form.

2. In a method of forming a passage, the steps of rolling an elongated trapezoidal sheet metal blank and joining the side edges to form a frusto-conical tubular body; flattening a portion of said body extending from a point spaced a limited distance from the large end to the small end with the joined side edges on one side between the two side edges of the flattened portion; coiling the flattened portion of such body into substantially circular form tangent to the unflattened portion; and alternately annealing and applying fluid pressure to the interior of said body with the ends thereof closed to expand such body into tubular shape while maintaining the internal diameter of the circular form.

3. In a method of forming a substantially annular passage, the steps of rolling a trapezoidal blank about an axis extending longitudinally of the blank; joining the side edges of the blank to form a frusto-conical body; pressing a portion of such body into flattened form with the joined side edges on one side between the two side edges of the flattened portion and sealing the ends of the body; coiling the flattened portion of such body into substantially annular form with the joined side edges at the inner side; applying longitudinally tensioning force to such body; and introducing fluid pressure to the interior of such body to effect expansion of the flattened portion while maintaining the internal diameter of said annular form.

4. In a method of forming a substantially annular passage, the steps of rolling a trapezoidal blank about an axis extending longitudinally of the blank; joining the side edges of the blank to form a frusto-conical body; pressing a portion of such body into flattened form with the joined side edges at substantially the longitudinal center of one of the flat sides of the body; sealing the ends of the body; coiling the flattened portion of such body into substantially annular form with the joined side edges on the inner side; and alternately annealing

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said body and introducing fluid pressure to the interior thereof to expand the flattened portion into tubular shape while maintaining the internal diameter of the annular form.

5. In a method of forming a substantially annular passage, the steps of rolling a trapezoidal blank about an axis extending longitudinally of the blank; welding the side edges of the blank together to form a frusto-conical tubular body; pressing the portion of such body extending from the small end to a point spaced from the large end into flattened form with the joined side edges in one side between the two side edges of the flattened portion; sealing the ends of the body; coiling the flattened portion of the body into substantially annular form tangent to the unflattened portion with the joined side edges at the inner side; and introducing fluid pressure to the interior of the body to restore the tubular shape of the flattened portion while maintaining the internal diameter of the annular form.

6. In a method of forming annular fluid receivers for compressors and turbines, the steps of rolling a trapezoidal blank about an axis extending longitudinally of the blank; welding the side edges of the blank together to form a frusto-conical tubular body; pressing the portion of the body extending from the small end to a point spaced from the large end into flattened form with the joined side edges on one side between the two side edges of the flattened portion; sealing the ends of the body; coiling the flattened portion of the body into substantially annular form tangent to the unflattened portion with the joined side edges at the inner side; applying

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longitudinally tensioning force to the body; introducing fluid pressure to the interior of the body to restore the flattened portion to tubular shape while maintaining the internal diameter of the annular form; securing the small end of the body to an intermediate portion thereof to complete the annular form; cutting a slot in said body at the inner side of said annular form; and securing a nozzle ring in said slot.

7. In a method of forming a passage, the steps of rolling an elongated trapezoidal blank and joining the side edges to form a frusto-conical body; flattening the major portion of such body with the joined side edges on one side between the two side edges of the flattened portion; coiling the flattened portion of such body into substantially circular form with the joined side edges at the inner side thereof; and applying fluid pressure to the interior of said body with the ends thereof closed to expand the flattened portion of said body into substantially circular cross-section while maintaining the internal diameter of said circular form.

References Cited in the file of this patent

UNITED STATES PATENTS

25	1,796,325	Flanders	Mar. 17, 1931
	1,821,850	Riemenschneider	Sept. 1, 1931
	2,151,699	Heiner	Mar. 28, 1939
	2,243,464	Kucher	May 27, 1941
	2,294,037	Kucher	Aug. 25, 1942
30	2,673,542	Smith	Mar. 30, 1954