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(54) Method for manufacture of articles in foraminous sheet materials

(57) A method of producing cylindrical expanded metal sections is disclosed wherein a sheet of metal is continuously punched between interlocking discs to create staggered rows of slits. The sheet is only punched between its edges at which unpunched margins are defined. The sheet is expanded laterally and provided with oppositely formed interlocking formations in the unpunched margins, and then the sheet is helically wound over a former with the interlocking formations on opposite margins of the sheet being interlocked on the former as the said two opposite margins are brought together as a result of the helical winding. A compression means is provided immediately behind the interlocking region on the former to create a helical seam. The cylindrical expanded metal section is moved along the former and eventually cut into lengths by a cylindrical cutter. The formation of expanded metal sections in this manner prevents the creation of swarf when the section is cut to length, as previously only the expanded metal strands were provided with interlocking formations, and cutting through these often produced unwanted loose swarf or metal cuttings.

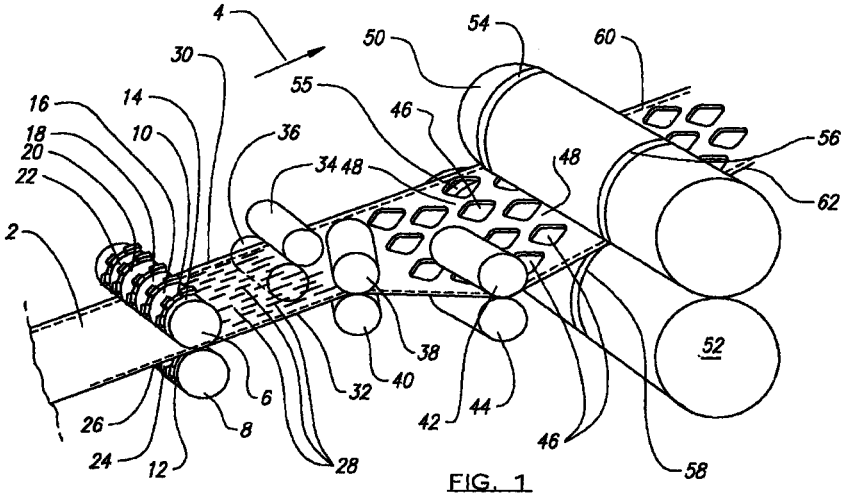

FIG. 1

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Description

[0001] This invention relates to a method for the manufacture of articles in foraminous sheet materials, which term is used to cover those sheet materials whose surface area is comprised to a large extent of holes or perforations defined by strips or strands of material which also provide the integrity of the sheet. A particular example of such sheet material is known as expanded metal.

[0002] Although the following description hereinafter relates exclusively to the manufacture of articles in expanded metal, the invention is not to be considered as limited thereto, and indeed other foraminous materials may be considered to produce articles.

[0003] The manufacture of flat expanded metal sections is a well established art, and accordingly only brief description is provided herein. In general, expanded metal can be produced by passing a continuous web of sheet steel or other metal between a pair of interengaging cylinders, one of which is comprised of a plurality of toothed discs which correspond with a number of plane discs from which the other is comprised, which may be driven, and which punch a number of rows of parallel slits in the web. The rows are parallel to the direction of travel of the web between the cylinders, and each of the slits is offset with regard to those in adjacent rows such that a staggered arrangement of slits results.

[0004] Thereafter, respective edges of the web are urged apart and thus the web is "expanded" in a direction transverse to its direction of travel through the punching cylinders. The degree of the stagger between the slits of adjacent rows, the length of the slits and the distance between respective ends of adjacent slits in the same row can be adjusted depending on the extent and configuration of expansion desired. As respective edges of the web are transversely urged apart, the slits open into holes in the web and the strips of material remaining which define said holes become inclined and angled to the plane of the web. Such inclination of said strips is generally undesirable because the sharp edges which result from the punching operation are presented on both the upper and lower surfaces of the web. The web of expanded material or articles formed therefrom is likely to be manually handled at some stage, and therefore it is desirable to remove any propensity the said material may have for injuring persons handling same. This is commonly effected by rolling the expanded web.

[0005] There are a number of patents for expanded metal webs, notably including perforated cylindrical filters for use in motor vehicles (see for example US4664684 to Dann et al.), and accumulator grids for use in batteries. It will be appreciated that both these uses involve particularly high volumes, and in the latter case there is a requirement to form the expanded metal sheet into cylindrical sections.

[0006] Although the production of webs of expanded metal is relatively straightforward, and the guillotining thereof to form expanded sheet sections presents no significant problems, the formation of articles constructed from expanded metal is rendered difficult by the flimsy nature of the material and the lack of purchase which can be obtained on the sheet material.

[0007] For example, the production of cylindrical filters from expanded metal has conventionally been effected either by rolling opposite parallel edges of a single sheet section towards one another, or helically winding a web of expanded metal about a mandrel. In either case respective edges of the sheets or webs are provided with interlocking formations, for example by bending the edges of expanded metal in opposite directions to form flanges on the sheets or webs which interengage after the respective edges are rolled or wound towards one another. A seaming operation creates the join between the edges and, in the case of sheet sections, completes the article.

[0008] The formation of articles as described above is difficult, firstly because the formation of a seam between respective expanded metal sheet section or web edges is hampered by the lack of purchase obtainable by tooling on such edges, which tend to be corrugated and/or jagged as a result of the expansion process. Secondly, the production of expanded metal cylindrical sections as a continuous process is limited by the width of the strips from which the expanded metal web is comprised and which define the holes therein. It will be immediately appreciated by the skilled person that an expanded metal web comprised of strips of a width (after rolling of the web) less than approx. 5mm is extremely difficult to handle because of the flimsy nature of such strips and thus the web as a whole, and the likelihood of fracturing or tearing such strips during bending thereof in the formation of the flange at the edge of the web.

[0009] Although these disadvantages are in general tolerated, one more important disadvantage arises during the formation of cylindrical filters by helical winding. In the current process, a web of expanded metal is helically wound around a mandrel orientated at a predetermined angle to the direction of travel of the web, and a helical seam is formed around the cylinder formed around said mandrel. The expanded metal cylinder translates along the mandrel and off one end thereof until the uppermost edges thereof contact a switch which temporarily ceases translation of the web and winding thereof during which period a circular cutter rotates about the axis of the cylinder and cuts that portion of the expanded metal cylinder already translated off the mandrel from that in contact with the said mandrel. The fact that the helical seam of the cylinder is formed from the corrugated and/or jagged edges of the expanded metal web which are folded back over one another to form said seam, and the fact that the plane of cutting as described is perpendicular to the axis of the cylinder and therefore intercepts the helical seam at an

angle can give rise to detrital metal swarf from the cutting action.

[0010] In the circumstance where the expanded metal cylindrical constructions are used in the filters of vehicles through which air pass before passing into the carburettor of said vehicle and ultimately into the cylinders of the engine thereof, the presence of such swarf could have catastrophic consequences.

[0011] It is an object of this invention to provide a method for substantially continuous production of cylindrical expanded metal sections which does not suffer from the abovementioned disadvantages.

[0012] According to the invention there is provided a method of forming cylindrical expanded metal sections, the method comprising the steps of constraining a web of sheet material to move in a direction parallel to its free edges, punching a plurality of rows of slits in said sheet material but leaving unpunched margins at said free edges, providing said margins with complementary formations capable of interlocking, expanding the sheet material in a direction generally transverse to the direction of the slits, winding said expanded sheet material over a former disposed at a predetermined angle to the overall direction of travel of the web such that web portions already wound thereon translate along said former, and interlocking said corresponding formations on adjacent edges on said former and compressing to form a helical seam.

[0013] Preferably the rows of slits are substantially parallel to the free edges of the web.

[0014] In a modified embodiment of the invention, only one of said margins may be provided with a formation which is capable of receiving the opposite edge during the formation of the helical seam.

[0015] Preferably the cylindrical expanded metal section translates along the formed until free edges of said section contact switch means which temporarily halt the motion of the web of sheet material and thus the said translation of the formed cylindrical section over the former, during which time cutting means cuts the formed cylindrical section in a plane perpendicular to the axis of the former and thus the formed cylindrical section.

[0016] Preferably the cutting means is a rotary cutter provided internally of the formed cylindrical section.

[0017] A specific embodiment of the invention is now given by way of example with reference to the accompanying drawings wherein:

Figure 1 shows a perspective view of the expansion portion of the process according to the invention,

Figure2 shows a perspective view of a mandrel around which the expanded metal produced in Figure 1 is helically wound, and

Figure 3 shows a section of the louvre-type seam between respective edges formed during the helical winding operation.

[0018] It is to be pointed out that Figures 1 and 2 merely show different portions of a continuous process, and the apparatus shown in these figures are intended to be juxtaposed.

[0019] Referring firstly to Figure 1 there is shown a web of sheet material 2 which is suitably driven in the direction shown by arrow 4. The web 2 passes between a pair of rollers 6, 8 which may optionally impart the drive to the said web and which are provided with corresponding formations 10, 12 which interengage as the said rollers are rotated. The formations 10 are in the form of a plurality of teeth provided on a number of adjacent discs 14, 16, 18, 20, 22 mounted on and securely attached to the roller 6. The roller 8 is provided with a plurality of grooves 24, 26 defined by untoothed discs separated by spacers both of which are mounted on and secured to said roller 8. The thickness of the untoothed discs and the spacers is chose to correspond with the thickness of the teeth 10 and the separation between said teeth on the roller 6.

[0020] As the web 2 passes between the said rollers 6, 8, the interengagement of the respective formations provided on said rollers results in a punching of the web and a plurality of slits 28 are formed in the web. These slits are provided in rows as a result of the rotary motion of the teeth which produced them as the web travels between rollers 6, 8, and furthermore these rows are offset by a predetermined distance from one another which staggers the slits of one row with respect to the next.

[0021] It will be seen from the figure that slits are not provided in margins 30, 32 of the web proximate the edges thereof and shown hatched in the figure. This is important when said edges are joined together in the forming of a seam.

[0022] The punched web is subsequently urged towards two further pairs of rollers 34, 36, 38, 40, the first pair 34, 36 orientated with their axes substantially perpendicular to the direction of travel of the web 2 and the second pair 38, 40 orientated with their axes disposed at a predetermined angle to the direction of travel of the web.

[0023] Said latter pair of rollers urge the particular edge of the web passing therebetween away from the opposite edge and thus effect a transverse expansion of the web. It will be appreciated that a number of different roller configurations may be adopted to perform this particular expansion step, but their ultimate aim is to expand the web in a generally transverse direction and ensure that the web remains substantially planar after the expansion step. Expansion may be effected out of the plane of the web passing through the rollers 6, 8, or in the same plane as shown in the figure, but in either case a set of correcting rollers 42, 44 is required to constrain at least one edge to resume a substantially parallel direction of travel to that of the alternate edge.

[0024] It is immediately evident from figure 1 that the stagger of slits in respective rows is important because such slits are expanded during the expansion of the web and form holes 46 in the web defined by strips 48 of material. The arrangement and disposition of these holes is entirely dependent on the stagger of the slits 28 and furthermore is of importance in providing the resulting expanded web with physical characteristics such as rigidity and strength.

[0025] As a result of the expansion process which is effectively a planar shearing operation on the web, the strips 48 which define the holes 46 and from which the resulting web is structurally constituted are often angled and inclined out of the plane of the web. To ensure that the edges of said strips 48, which may be sharp from the action of the cutting teeth 10, do not cause harm to persons handling the web, it is passed through compression rollers 50, 52 which remove any sharp edges.

[0026] Said compression rollers 50, 52 are also provided with complementary formations 54, 55 (seen through the holes 46 of the web 2), which provide the marginal portion 30 with a downwardly depending curved flange portion 60, and 56, 58 which provide the marginal portion 32 with an upwardly extending curved flange portion 62. The reason for such portions is shown more clearly in Figure 2.

[0027] It is to be mentioned that the forming of said flange portions 60, 62 may be effected by an alternate set of rollers either downstream or upstream of the said compression rollers 50, 52, and further that the formation of said flange portions may even be effected before the punching operation of rollers 6, 8.

[0028] Referring to Figure 2 there is shown the web 2 (without holes 46 for clarity) which emerges from the compression rollers 50, 52 shown in Figure 1. The said web is suitably driven towards a rotatable mandrel 64 whose axis intersects the line of direction of travel of the web at a predetermined angle which is dependent on the width of web 2, and the diameter of the cylindrical article which is to be produced by the process according to the invention.

[0029] Beneath the mandrel 64 is provided a selectively removable seaming roller 66 provided with a formation 68 which both ensures that the downwardly depending and upwardly extending curved flange portions 60, 62 interlock as the planar web comes into contact with the mandrel 64, and also that the interlock thus formed is compressed to form a seam between the edge 70 coming into contact with the mandrel and the edge 72 of the web already helically wound onto the mandrel 64. The resulting louvre-type formation is shown in Figure 3.

[0030] Henceforth, a cylindrical article of expanded metal is formed substantially continuously on said mandrel 64.

[0031] The cylinders so formed are cut into discreet lengths by a selectively operable cutter 74 provided at one end of the mandrel. It will be appreciated that the cutter 74 may be provided entirely separately of the mandrel but its purpose in any event is to ensure that the plane of incision of the cylindrical sections form on the mandrel is perpendicular to its axis.

[0032] Although the cutter is shown in Figure 2 as being mounted on the end of mandrel 64, in practice this cutter is more likely to be mounted above or to one side of the mandrel and outside the helically wound expanded metal cylinder on said mandrel. When the section has moved a predetermined distance from off the mandrel, the cutter moves inwardly over the tool steel end of the mandrel incising the cylinder as it does so to slice off a predetermined cylindrical length.

[0033] The operation of the cutter is automatically effected when a predetermined length of cylindrical section has been translated off the mandrel 64 in the direction shown by arrow 76. At this stage, the motion of all the components, with the exception of the cutter, is temporarily halted while the cutter 74 makes its rotary incision of the cylindrical section.

[0034] It has heretofore been difficult impossible to produce such cylindrical expanded metal components from expanded metal having particularly large holes 46 or strips 48 below a certain dimension because the seaming operation is then necessarily intricate and cannot be performed in a continuous manner as shown in the figures.

[0035] Furthermore, the production of expanded metal cylindrical sections has previously been hampered by the fact that the rotary cutter 74 always cuts across the helical seam 78 at the end of the mandrel, and where the seam is formed between folded expanded metal edges, this incision can result in detrital swarf as the cutter incises through one of the folded strips from which the seam is formed.

Claims

1. A method of forming cylindrical expanded metal sections, the method comprising the steps of constraining a web of sheet material to move in a direction parallel to its free edges, punching a plurality of rows of slits in said sheet material but leaving unpunched margins at said free edges, providing at least one of said margins with a formation capable of receiving an opposite free edge, expanding the sheet material in a direction generally transverse to the direction of the slits, winding said expanded sheet material over a former disposed at a predetermined angle to the overall direction of travel of the web such that web portions already wound thereon translate along said former, and interlocking said corresponding formation and said opposite edge on said former and compressing said interlock to form a helical seam.

2. A method according to claim 1 characterised in that the helical seam is continuous.

3. A method according to either claim 1 or 2 characterised in that the rows of slits are substantially parallel to the free edges of the web.

4. A method according to any of the preceding claim characterised in that interlocking formations are provided on both unpunched margins, and that said said formations are interlocked on the former and compressed to form said helical seam.

5. A method according to any preceding claim characterised in that the cylindrical expanded metal section translates along the former until free edges of said section contact switch means which temporarily halt the motion of the web of sheet material and thus the said translation of the formed cylindrical section over the former, during which time cutting means cuts the formed cylindrical section in a plane perpendicular to the axis of the former and thus the formed cylindrical section.

6. A method according to claim 5 characterised in that the cutting means is a rotary cutter provided internally of the formed cylindrical section.

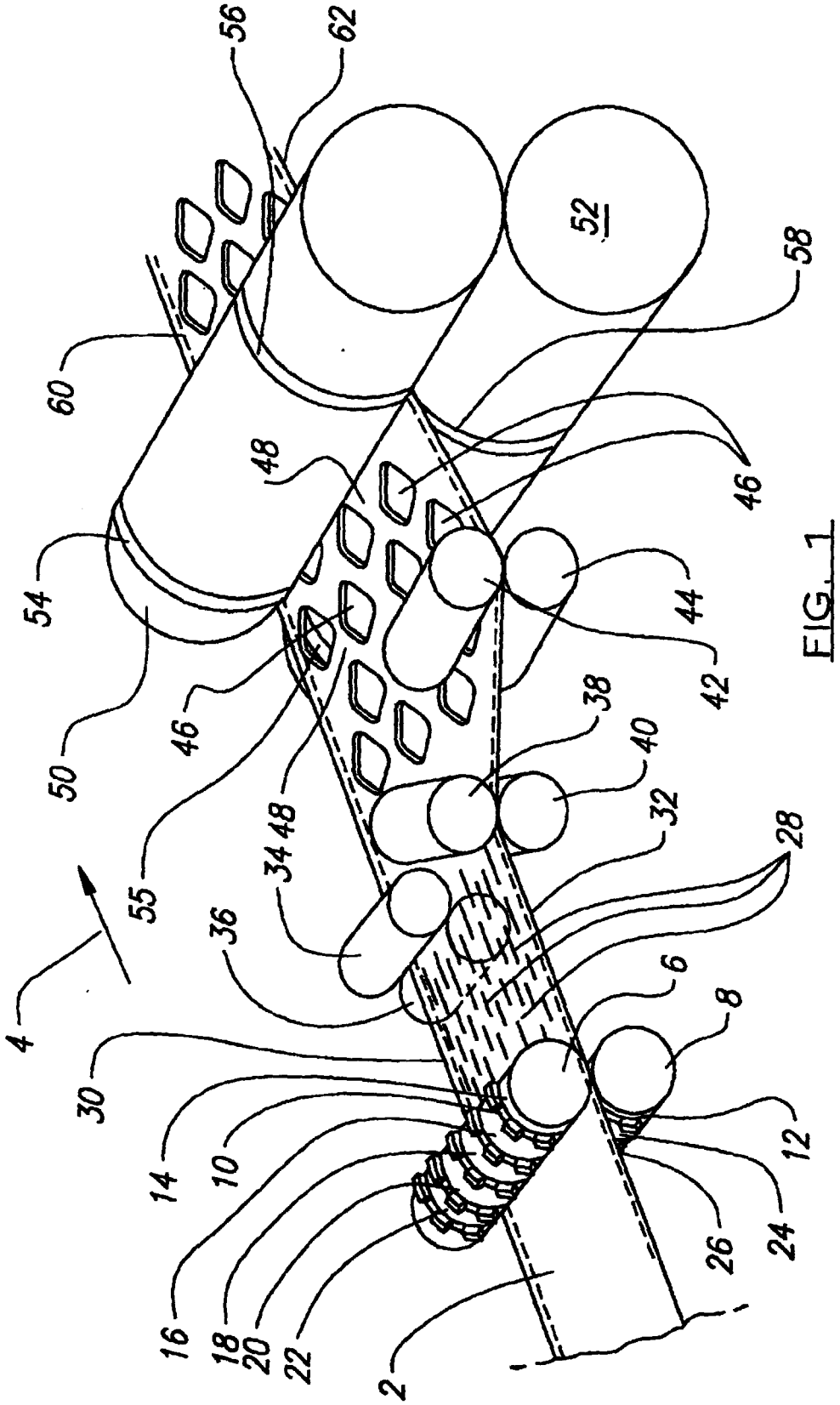
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FIG. 1

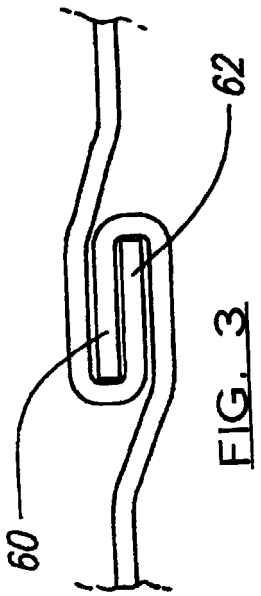

FIG. 3

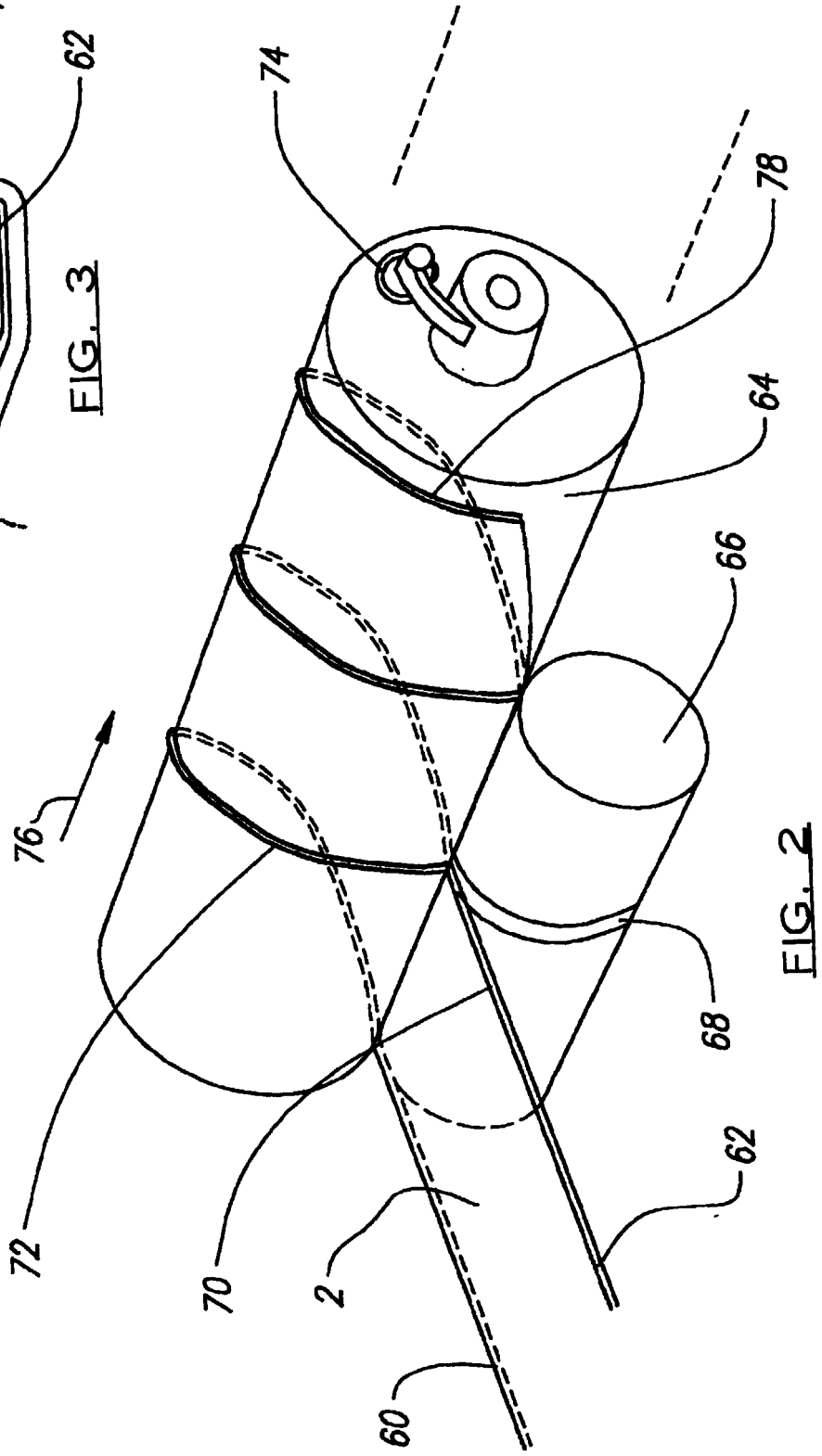

FIG. 2