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(54) OBTURATOR RING WITH INTERLOCKING SEGMENTS

FÜHRUNGSRING MIT INEINANDERGREIFENDEN SEGMENTEN

BAGUE D'OBTURATEUR AVEC DES SEGMENTS ACCOUPlés

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Description

Field of the Invention

[0001] This invention relates to an apparatus and method for sealing gas between a projectile and a launch tube during the launch of the projectile from the launch tube.

Background

[0002] An obturator seals high pressure gas between a projectile and a wall of a launch tube. Providing a good gas seal increases the gas pressure in the launch tube, which increases the projectile's velocity at launch.

[0003] The obturator preferably falls off the projectile after the obturator exits the launch tube. Sometimes the obturator fails to release from the projectile, thereby increasing drag and weight of the projectile, and possibly unbalancing the projectile, thereby reducing its range and accuracy.

[0004] GB 2132321 A discloses a rotating band for projectiles which is formed of a sliding bearing material. The composite sliding bearing material consists of a support material, e.g. of steel, brass, aluminium or corresponding alloys, and an anti-friction layer, e.g. of bronze, or tin bronze optionally containing lead and/or lead oxide, filled with a polytetrafluoroethylene mixture. The outer surface of the anti-friction layer is coated with a synthetic covering layer consisting of polytetrafluoroethylene mixture. Mounting of the rotating band in the groove takes place by a catch connection.

[0005] US 6419235 B1 discloses an obturator ring comprising two or more pieces each being a little larger than semicircle of the projectile obturator ring groove circumference. Each piece at natural position has equal or smaller radius than the radius of the obturator ring groove of a projectile; therefore, each piece expands to be in the projectile groove. Thickness and height of each piece is dependent on projectile's obturator ring groove geometry. The overlap and the radius ensures each piece performs its own grip function independent to the completion of the Segmented Obturator Ring (SOR). SOR seals the expanding propellant gases in the tube optimizing the effectiveness of the propellant while the projectile moves along the gun tube with SOR. After launch, the SOR is totally separated from the projectile minimizing drag effects on and maximizing stability of projectile to enhance dispersion impacts of the warhead.

Summary

[0006] The present invention provides an obturator ring according to claim 1 that is formed of self-locking interlocking segments that create an effective gas seal when constrained in a launch tube and separate from one another and the projectile in a predictable manner and of a uniform size when they exit the launch tube

behind the projectile.

[0007] In one aspect, the present disclosure provides, an obturator that can be secured to a projectile to be launched from within a launch tube, the obturator cooperating with the projectile to seal a pressurized gas within the launch tube during launch, the obturator comprising: two or more segments that combine to define a ring; where each segment includes means for connecting to an adjacent segment to restrict relative circumferential movement separating adjacent segments without restricting radially outward movement of individual segments.

[0008] The connecting means can include connecting features on each segment that cooperate with corresponding connecting features of an adjacent segment to connect adjacent segments together.

[0009] In an exemplary embodiment, at least two of the segments, and potentially all of the segments, are identical. The identical segments can be symmetric about a line of symmetry.

[0010] The connecting features can include interlocking arms, or a tab and a corresponding slot.

[0011] The connecting features restrict circumferential movement of the connected segments.

[0012] An exemplary obturator ring is cylindrical. Accordingly, the segments have an arcuate shape.

[0013] The obturator can be combined with a projectile, where the obturator is mounted on the projectile. The obturator further can be combined with a launch tube, where the projectile and the obturator are installed in the launch tube.

[0014] In another aspect, the present disclosure provides a method of making an obturator, comprising the steps of moving a plurality of segments radially inwardly to connect adjacent segments until the segments combine to form a substantially continuous ring, where the segments include connecting features that cooperate with corresponding connecting features of an adjacent segment to restrict relative circumferential movement separating adjacent segments without restricting radially outward movement of individual segments.

Brief Description of the Drawings

[0015]

FIG. 1 is a perspective view of an exemplary obturator provided by the present invention.

FIG. 2 is a plan view of the obturator of FIG. 1.

FIG. 3 is a plan view of another exemplary obturator provided by the invention.

FIG. 4 is a top view of the obturator of FIG. 1.

FIG. 5 is a schematic top view of the obturator of FIG. 4 illustrating the separation of individual segments.

FIG. 6 is a schematic illustration of the obturator of FIG. 3 mounted on a projectile in a launch tube, the launch tube constraining the obturator to provide a

gas seal between the projectile and the launch tube. FIG. 7 is a schematic illustration of the obturator of FIG. 6 showing the well-ordered separation of the obturator segments as the projectile exits the launch tube.

Detailed Description

[0016] The present invention provides an obturator ring that is formed of interlocking segments that create an effective gas seal when constrained in a launch tube and separate from one another and the projectile in a predictable manner when they exit the launch tube. The term "launch tube" includes any tubular structure from which a projectile is launched, including a rocket launch tube, a missile launch tube, a gun barrel, a mortar launch tube, etc. The present invention also is applicable to other devices that move through a tubular space where it is desirable to have a seal between the device and the walls of the tube, such as a "pig" in a pipeline.

[0017] An exemplary obturator 10 is shown in FIG. 1. The obturator 10 includes a two or more segments 12 joined together to form a substantially continuous ring 14. The segments 12 fit together, each segment 12 connecting with an adjacent segment 12, like the pieces of a puzzle. Each segment 12 is identical and can be connected to an adjacent segment 12, which means that the segments 12 are easier to assemble into a ring.

[0018] The material used to make the obturator segments 12 can vary from polymeric to metallic depending on use, such as the anticipated high temperature of the launch tube, the anticipated pressures, etc.

[0019] Each segment 12 has a longitudinal dimension, or length, aligned with a circumferential direction 16. The circumferential direction 16 is parallel to the circumference of the assembled ring 14. Each segment 12 also has a width dimension 18 transverse the length dimension 16, and a thickness dimension 20 generally perpendicular to the length dimension 16 and the width dimension 18. The illustrated ring 14 is cylindrical, but could also be formed by a hollow conical section. The interlocking segments 12 need to maintain a close corresponding shape relative to the inner surface of the launch tube. Accordingly, the segments 12 generally have an arcuate, nonplanar shape on at least an outer surface.

[0020] The segments 12 have respective connecting features for connecting adjacent segments. Two variations are shown in FIGS. 2 and 3. These connecting features interlock and interfere with the connecting features of an adjacent segment to prevent the segments 12 from separating in the circumferential direction. The segments 12 are connected in a direction that is transverse the circumferential direction, generally parallel to the thickness dimension 20, a direction that corresponds to a radial direction when the ring 14 is assembled. As a result, the ring 14 is strong circumferentially, but the segments 12 readily separate when moved radially outwardly, as shown in FIGS. 4 and 5. The interlocking nature of the

segments 12 also prevents the segments 12 from distorting in shape under the influence of the hot launch gases, thereby ensuring a high quality seal.

[0021] In FIG. 2, the connecting features of the obturator 10 include a bulbous tab 24 that is received in a correspondingly-shaped slot 26 in an adjacent segment. The slot 26 is a negative image of the tab 24. Similar shapes can be found in puzzle pieces. A line 30 can be drawn parallel to the circumferential direction 16, toward an edge of the tab 24, that extends through the tab 24 and a portion of the adjacent segment 12 before returning to the tabbed segment 12. The portion of the adjacent segment and the tab 24 thus interfere with each other in the circumferential direction 16 and prevent the adjacent segments 12 from separating along the circumferential direction 16. The segments 12 are symmetric about a centrally-located circumferential line of symmetry 32.

[0022] An alternative embodiment of and obturator 40 provided by the invention has a plurality of identical segments 42 with different connection features. In FIG. 3, the connecting features include interlocking arms 44 and 46 extending from respective segments 42. Unlike the segments 12 shown in FIG. 2, the segments 42 shown in FIG. 3 do not have symmetric shapes. The arms 44 and 46 on each end of each segment 42 extend in opposite directions. An upwardly-extending arm 46 of each segment 42 defines a cavity 54 between the arm and 46 the body of the segment 42. And a downwardly-extending arm 44 on an opposite side of each segment 42 defines a cavity 56 between the arm 44 and the body of the segment 42. The arm of one segment is a negative image of the cavity formed by the arm of the adjacent segment. Consequently, the arms 44 and 46 of the adjacent segments 42 can be received in respective cavities 54 and 56, tying the segments 42 together. In this example, the segments 42 move laterally (parallel to the width dimension 18 (FIG. 1)), in such a manner as to disengage their arms 44 and 46, if only two segments 42 were connected together in this manner. Once the segments 42 are connected in series to form a ring, the oppositely-extending arms 44 and 46 on the other side of the segment 42 prevent such lateral disengagement.

[0023] To permit some radial expansion of the obturator 10 or 40, the connecting features can allow a limited, restricted amount of movement between adjacent segments 12 or 42 in the circumferential direction 16. This movement can be permitted through limited flexing of the connecting features or a predetermined amount of looseness in the connection. In either case, however, the connecting features prevent the segments 12 or 42 from separating as they attempt to move away from each other in the circumferential direction 16.

[0024] At the joint between adjacent segments 12 or 42, a joint line 50 follows a convoluted path to enhance the obturator ring's gas sealing properties. As a result, even if a gap opens along a portion of the joint line 50 or 52 as the obturator ring 20 or 40 expands and the segments 12 or 42 move radially outward to fill the gap be-

tween the outer surface of the projectile and the inner surface of the launch tube, the convoluted path defined by the joint line 50 or 52 will resist gas flow therethrough.

[0025] As shown in FIG. 4, when the segments 12 are connected together, end-to-end in series, the obturator 10 forms a ring 14. The obturator 14 is assembled by moving a plurality of segments 12 radially inwardly to connect adjacent segments 12 serially, one segment 12 to an adjacent segment, until the last segment is connected to the first segment to form a substantially continuous ring 14. A plurality of segments 12 also can be connected together to form a belt, which then can be wrapped around a projectile and secured in place by connecting the segments from opposite ends of the series of segments 12 that make up the belt. The segments 12 or 42 lock together sufficiently tightly to withstand handling of the projectile without significant risk that the obturator 10 or 40 would separate from the projectile prior to launch. The assembled segmented ring 14 (FIG. 1) also can be heated during assembly or before assembly on the projectile to further ensure that the segments 12 stay connected together. As shown in FIG. 5, the segments 12 readily separate as they each move radially outward.

[0026] FIG. 6 shows an obturator 40 provided by the invention assembled on a schematic projectile 60 within a launch tube 62. Upon launch, hot gases generated by the launch or centrifugal force generated during the launch cause the obturator ring 40 to radially expand and the segments 42 move radially outward to seal a gap between the projectile 60 and an inner wall of the launch tube 62, trapping the hot gases generated at launch within the launch tube 62. A projectile can be made to spin by a launch tube with a rifled bore or features of the projectile designed to induce spin about a longitudinal axis. A spinning projectile generally will move along a straighter path. The expansion of the obturator 40 is restricted by the inner surface of the launch tube 62, which ensures that the obturator 40 maintains an effective seal between the inner surface of the launch tube 62 and the outer surface of the projectile 60. In fact, the obturator 40 engraves into the inside surface of the launch tube 62 during launch, ensuring a tight seal.

[0027] The hot gases remain trapped behind the obturator 40 until the obturator 40 escapes the launch tube 62, thereby maximizing the transfer of energy from the hot gases to the projectile 60. Once the obturator 40 exits the launch tube 62, the inside surface of the launch tube 62 no longer restricts the outward movement of the obturator segments 42. So as the obturator 40 exits the launch tube 62 the captive launch gases or centripetal force will cause the segments 42 to move radially outward and separate from one another and the projectile 60, as illustrated in FIGS. 5 and 7.

[0028] The controlled failure of the obturator in this manner generally causes the obturator to separate from the projectile into a plurality of relatively small segments of uniform size. The small, uniformly-sized segments

minimize the chance of a mass imbalance as the segments separate from the projectile.

[0029] The obturator thus shown and described can be installed and replaced in the field, thereby simplifying the projectile manufacturing process and allowing projectiles to be outfitted with obturators in the field, including retrofitting projectiles to accommodate the obturator provided by the present invention.

[0030] In summary, an obturator 10, 40 can be secured to a projectile 60 to be launched from within a launch tube 62. The obturator 10, 40 cooperates with the projectile 60 to seal a pressurized gas within the launch tube during launch. The obturator 40 has a plurality of segments 12, 42 that combine to form a ring 14. Each segment 12, 42 has connecting features that cooperate with corresponding connecting features of an adjacent segment 12, 42 to hold the segments 12, 42 together by restricting relative circumferential movement, without restricting radially outward movement of individual segments 12, 42. Preferably, each segment 12, 42 is identical, making it easier to repair and assemble the obturator 10, 40. Upon launch, the obturator segments 12, 42 can move radially outwardly to separate into relatively small, uniformly-sized pieces.

Claims

1. An obturator that can be secured to a projectile (60) to be launched from within a launch tube (62), the obturator (10, 40) cooperating with the projectile (60) to seal a pressurized gas within the launch tube (62) during launch, the obturator (10, 40) comprising:
 - two or more segments (12, 42) that cooperate to define a ring (14);
 - where each segment (12, 42) includes means (24, 26, 44, 46) for connecting to an adjacent segment (12, 42) to restrict relative circumferential movement separating adjacent segments (12, 42) without restricting radially outward movement of individual segments (12, 42).
2. An obturator as set forth in claim 1, where the connecting means includes connecting features on each segment that cooperate with corresponding connecting features of an adjacent segment to connect adjacent segments together.
3. An obturator as set forth in claim 2, where at least two of the segments (12, 42) are identical.
4. An obturator as set forth in claim 3, where the identical segments (12) are symmetric about a line of symmetry.
5. An obturator as set forth in claim 2, where the connecting features include interlocking arms (44, 46).

6. An obturator as set forth in claim 2, where the connecting features include a tab (24) and a corresponding slot (26).
7. An obturator as set forth in claim 2, where the connecting features restrict circumferential movement of the connected segments (12, 42).
8. An obturator as set forth in claim 2, where the ring (14) is cylindrical.
9. An obturator as set forth in claim 2, where the segments (12, 42) have an arcuate shape.
10. An obturator as set forth in claim 2, in combination with a projectile (60), where the obturator (10, 40) is mounted on the projectile (60).
11. A combination as set forth in claim 10, in combination with a launch tube (62), where the projectile (60) and the obturator (10, 40) are installed in the launch tube (62).
12. A method of making an obturator (10, 40), comprising the steps of moving a plurality of segments (12, 42) radially inwardly to connect adjacent segments (12, 42) until the segments (12, 42) combine to form a substantially continuous ring (14), where the segments (12, 42) include connecting features (22, 26, 44, 46) that cooperate with corresponding connecting features (22, 26, 44, 46) of an adjacent segment (12, 42) to restrict relative circumferential movement separating adjacent segments (12, 42) without restricting radially outward movement of individual segments (12, 42).

Patentansprüche

1. Obturator, der an einem aus innerhalb eines Abschussrohres (62) abzuschießendem Geschoss (60) befestigt werden kann, wobei der Obturator (10, 40) mit dem Geschoss (60) zusammenwirkt, um während des Abschusses ein Druckgas innerhalb des Abschussrohres (62) abzudichten, wobei der Obturator (10, 40) umfasst:

zwei oder mehr Segmente (12, 42), die zusammenwirken, um einen Ring (14) zu definieren; wobei jedes Segment (12, 42) Mittel (24, 26, 44, 46) zum Verbinden mit einem benachbarten Segment (12, 42) einschließt, um relative Umfangsbewegung, die zwei benachbarte Segmente (12, 42) trennt, zu beschränken, ohne radiale Auswärtsbewegung von einzelnen Segmenten (12, 42) zu beschränken.
2. Obturator nach Anspruch 1, wobei das Verbindungs-

mittel Verbindungsmerkmale an jedem Segment einschließt, die mit entsprechenden Verbindungsmerkmalen eines benachbarten Segments zusammenwirken, um benachbarte Segmente miteinander zu verbinden.

3. Obturator nach Anspruch 2, wobei wenigstens zwei der Segmente (12, 42) identisch sind.
4. Obturator nach Anspruch 3, wobei die identischen Segmente (12) um eine Symmetrielinie symmetrisch sind.
5. Obturator nach Anspruch 2, wobei die Verbindungsmerkmale ineinandergreifende Arme (44, 46) einschließen.
6. Obturator nach Anspruch 2, wobei die Verbindungsmerkmale eine Lasche (24) und einen entsprechenden Schlitz (26) einschließen.
7. Obturator nach Anspruch 2, wobei die Verbindungsmerkmale Umfangsbewegung der verbundenen Segmente (12, 42) beschränken.
8. Obturator nach Anspruch 2, wobei der Ring (14) zylindrisch ist.
9. Obturator nach Anspruch 2, wobei die Segmente (12, 42) eine bogenförmige Form besitzen.
10. Obturator nach Anspruch 2 in Kombination mit einem Geschoss (60), wobei der Obturator (10, 40) an das Projektil (60) montiert ist.
11. Kombination nach Anspruch 10 in Kombination mit einem Abschussrohr (62), wobei das Geschoss (60) und der Obturator (10, 40) in dem Abschussrohr (62) installiert sind.
12. Verfahren zum Herstellen eines Obturators (10, 40), umfassend die Schritte des Bewegens einer Vielzahl von Segmenten (12, 42) radial einwärts, um benachbarte Segmente (12, 42) zu verbinden, bis sich die Segmente (12, 42) kombinieren, um einen im Wesentlichen durchgehenden Ring (14) zu bilden, wobei die Segmente (12, 42) Verbindungsmerkmale (22, 26, 44, 46) einschließen, die mit entsprechenden Verbindungsmerkmalen (22, 26, 44, 46) eines benachbarten Segments (12, 42) zusammenwirken, um relative Umfangsbewegung, die benachbarte Segmente (12, 42) trennt, zu beschränken, ohne radiale Auswärtsbewegung von einzelnen Segmenten (12, 42) zu beschränken.

Revendications

1. Obturateur qui peut être fixé à un projectile (60) à lancer de l'intérieur d'un tube de lancement (62), l'obturateur (10, 40) coopérant avec le projectile (60) pour étancher un gaz sous pression dans le tube de lancement (62) au cours du lancement, l'obturateur (10, 40) comprenant :

deux ou plusieurs segments (12, 42) qui coopèrent pour définir une bague (14) ;
où chaque segment (12, 42) comprend des moyens (24, 26, 44, 46) pour raccorder à un segment adjacent (12, 42) afin de limiter le mouvement circonférentiel relatif séparant des segments adjacents (12, 42) sans limiter le mouvement radial vers l'extérieur de segments individuels (12, 42).
2. Obturateur selon la revendication 1, dans lequel les moyens de raccordement comprennent des caractéristiques de raccordement sur chaque segment qui coopèrent avec des caractéristiques de raccordement correspondantes d'un segment adjacent pour raccorder conjointement des segments adjacents.
3. Obturateur selon la revendication 2, dans lequel au moins deux des segments (12, 42) sont identiques.
4. Obturateur selon la revendication 3, dans lequel les segments identiques (12) sont symétriques autour d'une ligne de symétrie.
5. Obturateur selon la revendication 2, dans lequel les caractéristiques de raccordement comprennent des bras de verrouillage (44, 46).
6. Obturateur selon la revendication 2, dans lequel les caractéristiques de raccordement comprennent une patte (24) et une fente correspondante (26).
7. Obturateur selon la revendication 2, dans lequel les caractéristiques de raccordement limitent le mouvement circonférentiel des segments raccordés (12, 42).
8. Obturateur selon la revendication 2, dans lequel la bague (14) est cylindrique.
9. Obturateur selon la revendication 2, dans lequel les segments (12, 42) ont une forme arquée.
10. Obturateur selon la revendication 2, en combinaison avec un projectile (60), dans lequel l'obturateur (10, 40) est monté sur le projectile (60).
11. Combinaison selon la revendication 10, en combinaison avec un tube de lancement (62), dans lequel

le le projectile (60) et l'obturateur (10, 40) sont installés dans le tube de lancement (62).

12. Procédé de fabrication d'un obturateur (10, 40) comprenant les étapes de déplacement d'une pluralité de segments (12, 42) radialement vers l'intérieur pour raccorder des segments adjacents (12, 42) jusqu'à ce que les segments (12, 42) se combinent pour former une bague sensiblement continue (14), dans lequel les segments (12, 42) comprennent des caractéristiques de raccordement (22, 26, 44, 46) qui coopèrent avec des caractéristiques de raccordement correspondantes (22, 26, 44, 46) d'un segment adjacent (12, 42) pour limiter le mouvement circonférentiel relatif séparant des segments adjacents (12, 42) sans limiter le mouvement radial vers l'extérieur de segments individuels (12, 42).

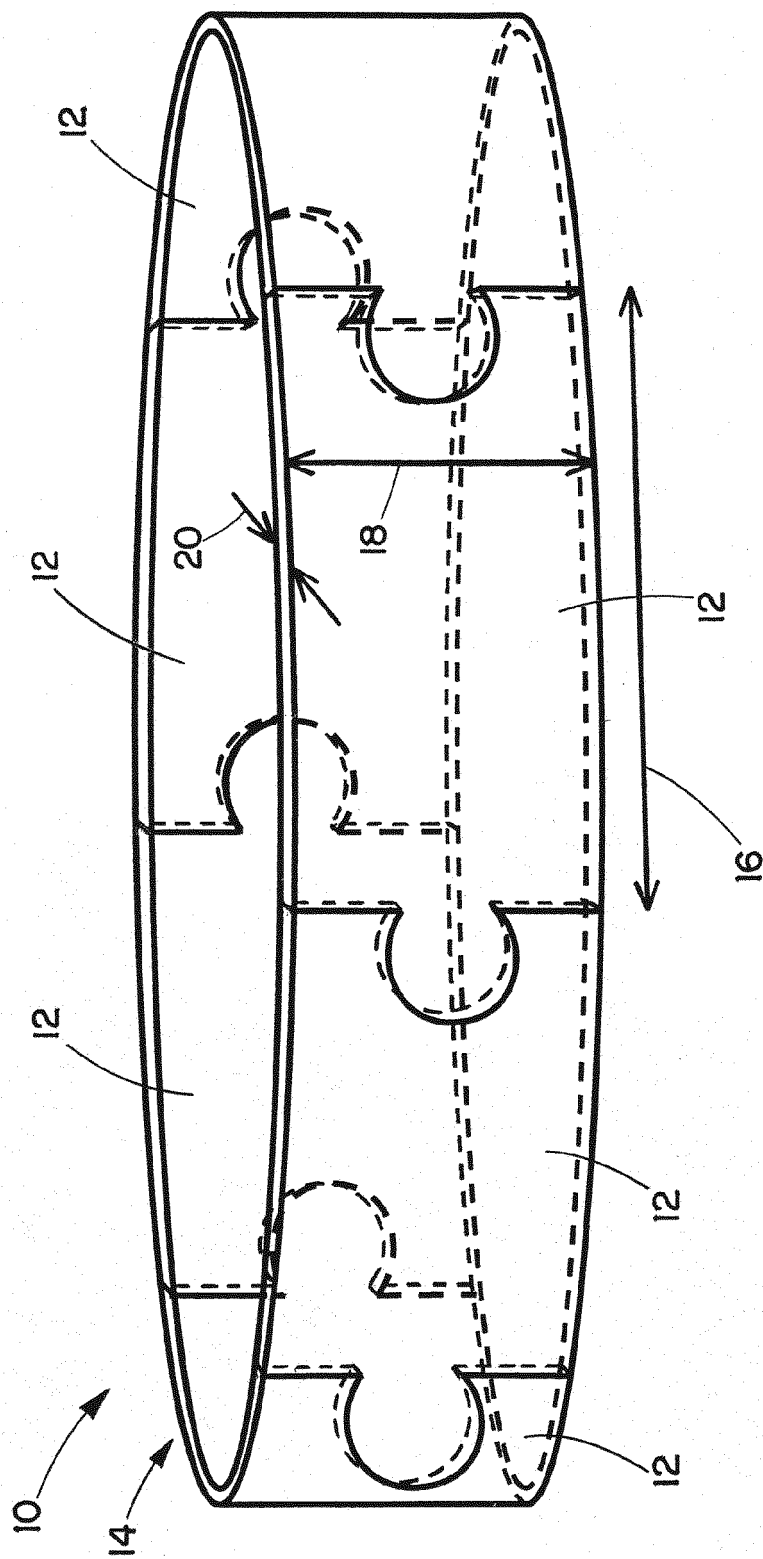
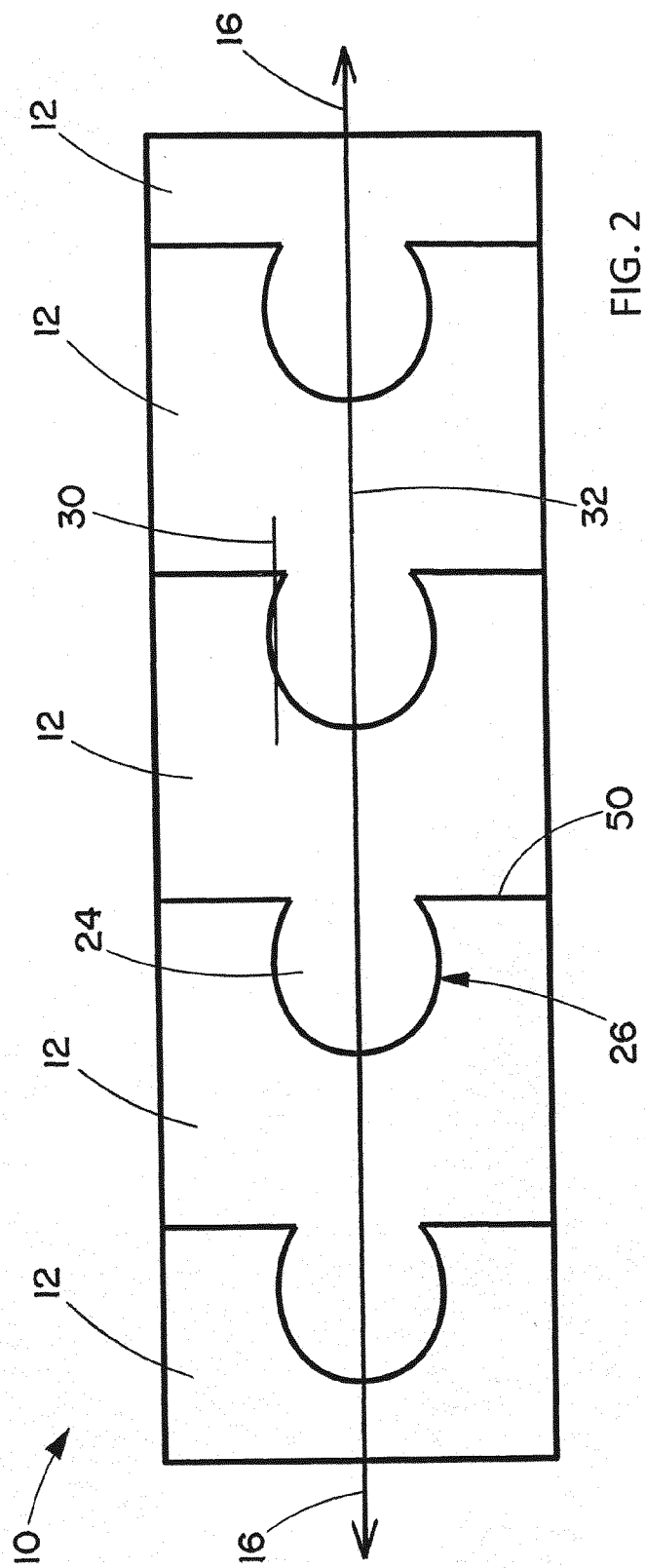
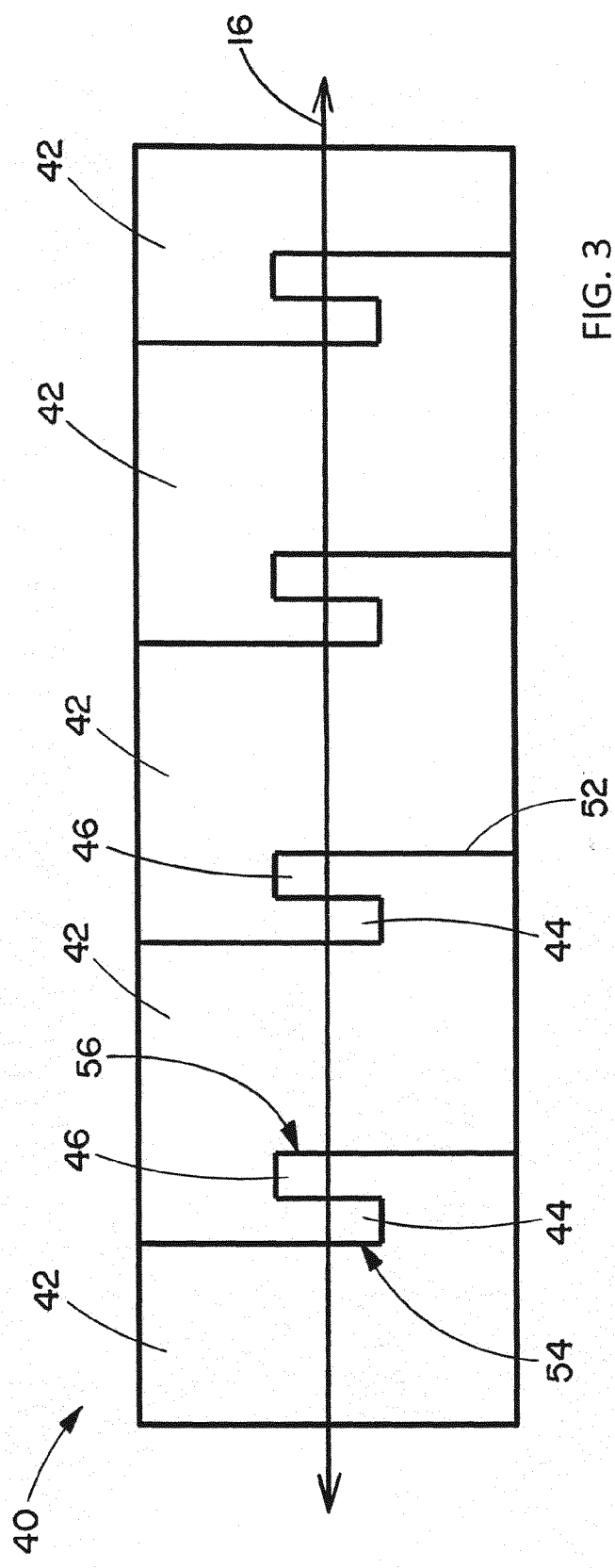


FIG. 1





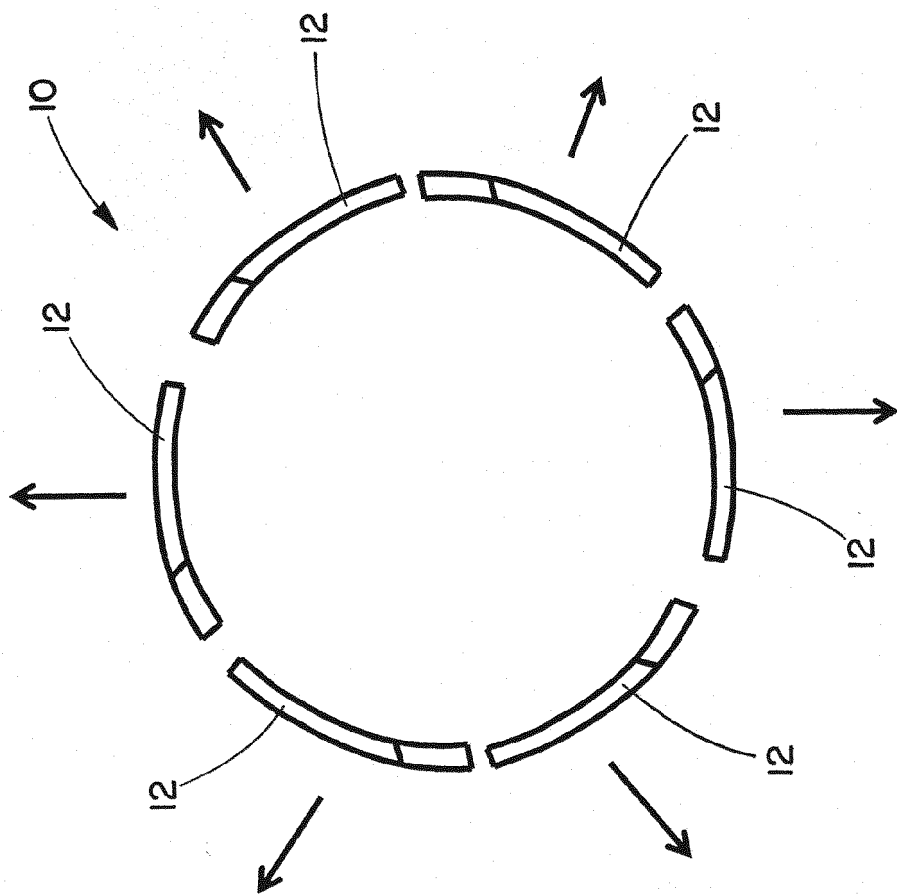


FIG. 5

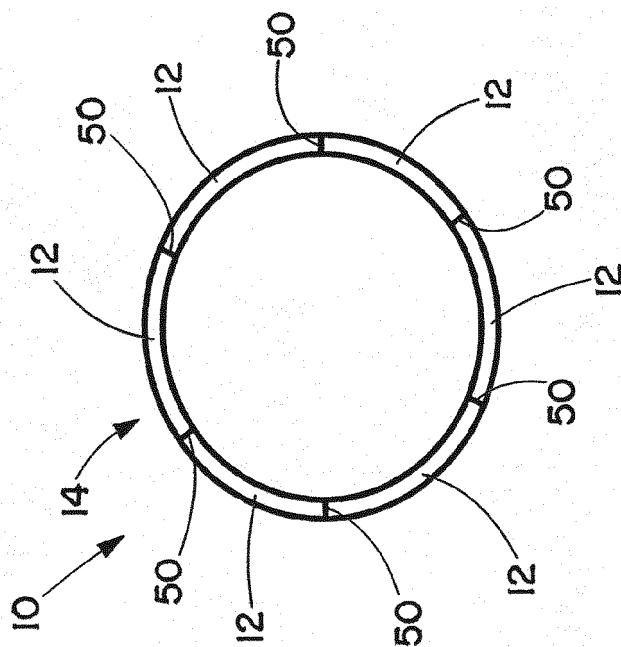


FIG. 4

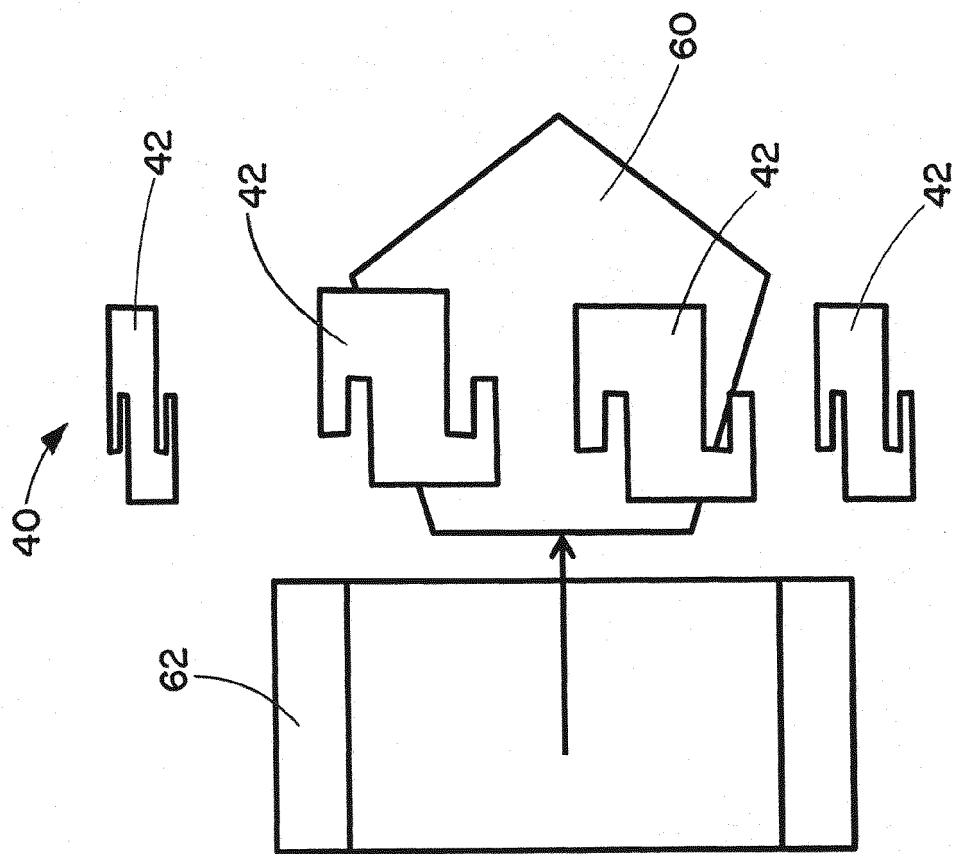


FIG. 6

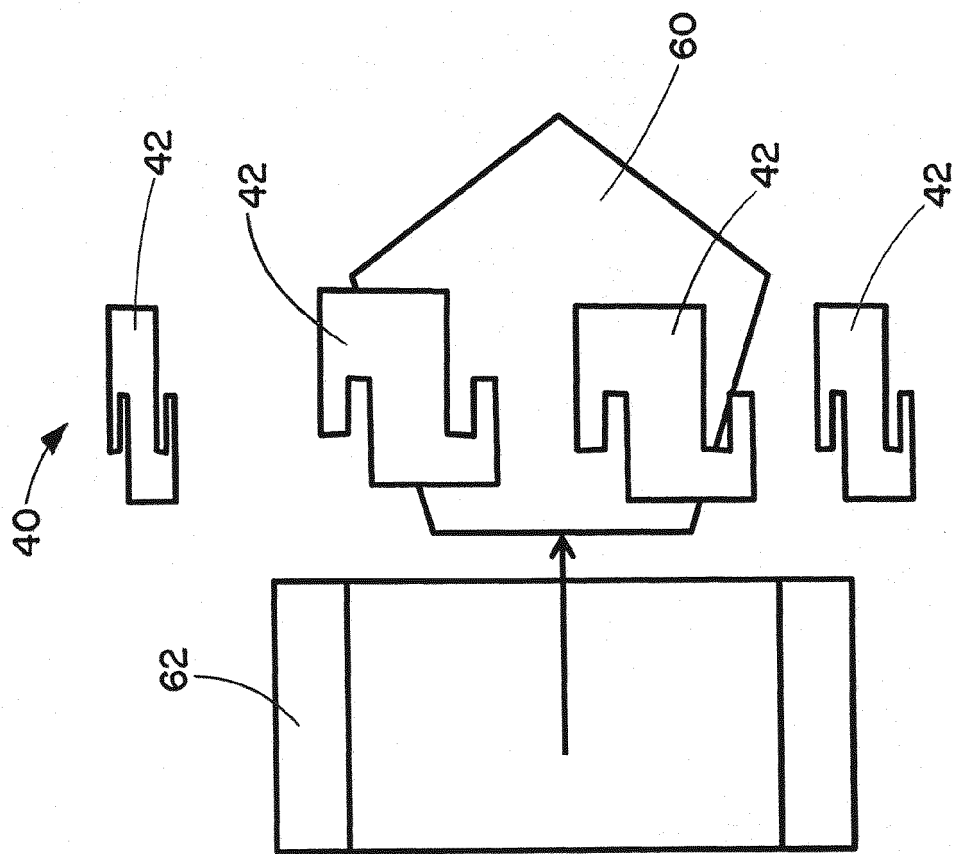


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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