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(54) **An unfurling wing or fin for missiles and other projectiles.**

(57) The present invention relates to an unfurling wing (V, 15) or fin intended for missiles and other projectiles, the wing or fin being, from a first furled (V^1) position bent in towards the projectile body (K) and initially locked, unfurlable, on cessation of the locking function, to a second position where it generates and desired lifting force and/or guiding impetus for the projectile (P). The wing or fin according to the present invention consists of two plates (1, 2, 16, 17) which are cupped away from one another, and are immovably joined together to one another along all edge sides (3, 18) which are not directly or indirectly secured to the projectile body. The wing or fin occurs in two main variants, of which the first, in the unfurled state, extends transversely of the projectile body on either side thereof, while the second variant consists of fins foldably secured to the projectile body which, in the unfurled state, extend more or less radially out therefrom.

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Description

AN UNFURLING WING OR FIN FOR MISSILES AND OTHER PROJECTILES

TECHNICAL FIELD

The present invention relates to a novel type of unfurling wing or fin for missiles and other projectiles which, while being of the so-called wrap-around type may nevertheless be given a tangential or alternatively radial extent in relation to the cross-section of the projectile with optional wing or fin length and - by no means least equally important - an aerodynamic profile with a cross-sectional configuration conditioned by flight and steering considerations.

Guided missiles and projectiles may be steered or guided by means of rudders, impulse motors etc. Wings or fins are often employed to increase their steerability or to stabilize them.

Such missiles or projectiles as are discharged from barrels or launching tubes must, as a rule, be provided with wholly or partly furlable wings or fins (for purposes of simplification, the body of this specification will hereinafter refer solely to "projectiles" and "wings" without entailing any restriction of the scope of the invention whatever in respect of "missiles" and "fins").

BACKGROUND ART

This art abounds in a plurality of designs of furlable wings. One type is folded along a joint parallel to the longitudinal direction of the projectile. These wings may be straight or curved about the projectile. This latter type is normally referred to as a wrap-around wing. Such folded "straight" wings take up considerable volume even in the furled position and/or can they be made as long as is often desirable.

Wrap-around wings may be constructed of considerable length, but because they usually retain, after being actuated and unfurled, a helical extent in relation to the cross-section of the projectile, they create a powerful interaction between the steering about the three spatial axes, which considerably impedes the steering control system if the projectile is to be guided. A further drawback inherent in wrap-around wings is that these have hitherto of necessity usually been manufactured from simple plates, for which reason it has not been possible to impart to them a desirable aerodynamic profile with a wing cross-section conditioned by flight or steering considerations.

Furthermore, it is also previously known in this art to produce open compound or twin-walled wrap-around wings consisting of two plates which support one another along a common outer edge extending in parallel with the projectile. In these wing designs, the air flowing about the projectile thus has free access to the space between the plates. One example of such a design is described in greater detail in German patent specification DE 36 18956. Aerodynamically, this is not a particularly satisfactory design even though the assembled wing will in itself be more stable than the single plate wing.

Yet a further wing design which is employed quite often is that in which the wings lie retracted in a slot in the projectile body proper. However, this wing type makes a serious encroachment on the space available within the projectile and cannot be used in certain cases because it would prevent a desirable design of the warhead of the projectile. Furthermore, this wing type often calls for specific and special designs of projectile which would otherwise not have been selected.

SUMMARY OF THE INVENTION

The present invention relates to a wing which consists of two plates which are cupped away from one another and mutually abut and, for example by welding or glueing, are interconnected along all edge sides along which they are not directly or indirectly anchored in the projectile body. With this design, there will thus be formed a space between the plates and this will result in a rigid wing even though the thickness of the plates as such is relatively slight. The design also makes it possible to impart to the wing an aerodynamically adapted cross-sectional profile. One of the preconditions for such a profiled wing to be adaptable to the wrap-around technique and, in the furled state, to lie closely bent around the projectile body, is that the material of the wing be of sufficient elasticity to permit a compression of the cupped plates into a tightly held together plate package and, secondly, a bending of this plate package around the projectile body. Despite the at least partly appreciable plate flexure which is thus necessitated, the wing must subsequently - as soon as it is released - reassume its original form and be of sufficient inherent rigidity to be able to withstand the lifting and guiding forces necessary for its function. We have now surprisingly found that certain titanium alloys, certain glass-fibre and carbon-fibre reinforced plastic materials and certain high-grade spring steels possess such properties as make possible the production of wings of the type defined in the appended Claims.

Hence, a distinctive feature of the wing according to the present invention - in addition to the above-outlined design of two cupped, mutually joined plates making for a desired aerodynamic design and wing surface even with very long wings - is that the actuating force requisite for unfurling the wing derives in all essentials from those tensions and flexural stresses which are positively imparted in the material as the wing is wrapped into its furled position. The locking function necessary for retaining the wing in its furled position will not be dealt with in greater detail in this context, since it is not included in the present invention; but such function may for instance consist of a locking sleeve which is ejected as the projectile departs from the barrel or launching tube.

As will indirectly be apparent from the foregoing, this wing type is wholly unribbed and, for its inherent rigidity, is completely dependent upon the shape of and material in the included cupped plates.

According to one detailed embodiment of the present invention, there are many advantages to be afforded in designing the cupped plates with at least certain central parts where the plates are substantially completely flat and run parallel to one another. This design affords the particular advantage that these parts of the plates, on furling, are first urged into dead abutment against one another and preferably by means of cooperating bosses and apertures in the opposing plates which, on mutual compression thereof, enter into engagement with one another, are locked against relative lateral displacement before the wing is furled in against the projectile body. This will prevent creasing and twisting in the plates which, even though they are, in the unfurled and operative position, wholly identical because of their different distances from the outer surface of the projectile body will, in the furled position, always be exposed to slightly different flexural stress on being bent in against the abovementioned outer surface.

In its simplest form, the wing according to the present invention is a straight two-sided wing which is tangentially secured to the projectile body. Since such wings may, in the furled state, lie wrapped overlappingly against the projectile body, each respective wing half may be of a length which at most correspond to almost the entire circumference of the projectile, i.e. from one side of anchorage to the other side of the same anchorage.

A second variant of the present invention makes for radially projecting wings but in such a case it is usually most appropriate to provide the wing (or rather the wing half) with a pivotal anchorage which makes it possible to furl the wing to an at least tangential direction in relation to the projectile body before the wing is folded, or rather bent, in along the outer surface of the projectile body.

Two different types of furled-in wings according to the present invention will be described in conjunction with the accompanying Drawings.

In the first alternative, use is made of a reversible journal for the wing in the form of a journalling shaft which is separately locked in the fully unfurled and operative position and is provided with a substantially centred rectangular bottom groove disposed in its longitudinal direction, along whose one longitudinal side one of the cupped plates is secured along its inner edge side, while the second of the cupped plates is provided, along its inner edge side, with a locking bead which may engage in a cooperating groove in the other opposing inner edge side of the bottom groove. Moreover, locking means are provided in the form of a curved leaf spring which may snap in between the plates when the wing is fully unfurled and the cupped plates have reassumed their original form. The purpose of such locking means is to prevent the plates from being pressed together by the wing load during the flight of the projectile.

According to the second variant of furlable radial wing, each cupped plate is provided with a substantially semicircular stub at each outer corner on its free inner edge side facing in towards the projectile. When the cupped plates have been fully compressed, these semicircular stub each pairwise form their complete stub end about which the wing may be furled into a position at least tangentially in relation to the projectile body.

The basic shape of the support for these assembled stubs in the projectile body is oval. Furling of the wing inwardly is then effected along one edge of the oval support, but in the fully open state, the plates splay apart and the semicircular stubs support against opposing edges of the oval supports.

This basic model for reversible wing journalling may then be supplemented with the same type of locking edge along the lower edge of the one plate as is to be found in the previously-discussed wing type. The same also applies to the locking means between the plates.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The present invention has been defined in the appended Claims and will now be described in greater detail with particular reference to the embodiments of the present invention shown on the accompanying Drawings.

In the accompanying Drawings:

Fig. 1 is a oblique projection of a projectile with unfurled superjacent wings;

Fig. 2 is a cross-section through the projectile of Fig. 1;

Fig. 3 is a partial section of the wing anchorage according to Figs. 1 and 2;

Fig. 4 shows a projectile with four radial wings;

Fig. 5 is a cross-section through a projectile with four radial wings;

Fig. 6 shows, on a larger scale, a detail of the wing anchorage according to Fig. 5;

Figs. 7-9 show different projections of a wing;

Figs. 10-11 show details of the wing anchorage; and

Figs. 12-13 are cross-sections and detailed sections of an alternative wing anchorage.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the Drawings, the projectile P shown in Figs. 1-3 is provided with a superjacent furlable wing V and guide fins or rudders F. The guide fins F may be of different design and will not be considered in greater detail in this context.

The wing V is formed of two cupped plates 1 and 2 which have been bent to the common longitudinal and profile cross-section which is apparent from Figs. 2 and 3. The plates 1 and 2 are interconnected along their periphery by joints 3 which may consist of welded, glued or soldered joints but may also be provided by other optional means. The main thing is that the joints offer a non-sliding connection between the plates and are capable of absorbing shear stresses. On furling, the plates 1 and 2 are first urged into dead abutment against one another so that they become flat, whereafter they are wrapped around the projectile body K in the manner intimated by broken lines V^1 in Fig. 2. As intimated in this Figure, the wing tips partially overlap. The strain to which the plates 1 and 2 are exposed when they are wrapped about the projectile body consists of two components; first the strain which the compression and flattening of the cupped configuration of the plates give rise to, and secondly the strain occasioned by the operation of wrapping around the projectile. This latter strain is determined by the double thickness of the plate and the diameter of the projectile, while the former is determined by the thickness of the plate and its radius of curvature in the bent state. The elasticity limit of the plate must be sufficient to accommodate the combination of these strains. This imposes very high demands on the material in the plates but, at the same time, gives wings which, without specific mechanics, will be unfurled as soon as a locking function ceases to lock the wing in its furled and closed position.

As has been mentioned above, the material in the wing must have an extremely high limit of elasticity and high mechanical strength. Examples of suitable such materials are high-strength titanium alloys, spring steel and certain fibre-reinforced plastic materials. However, other materials could also conceivably be used. The choice of material must be determined from case to case although at the present time titanium is arguably the most readily applicable alternative.

Two different alternative wing anchorages are intimated in Figs. 1-3. In the first alternative according to Fig. 2 (Fig. 1 being common to both alternatives), the lower wing plate 2 is provided with guiding beads or pins 5 and 6 which fit into recesses 7 and 8 in the projectile body and thereby positionally fix the wing against twisting at the same time as the wing is held in place by a flexible but not extensible band 4 which is tensioned across the upper surface of the wing and secured in the projectile body. Thus the band 4 can be folded together at the same time as the wing portions 1 and 2 are urged together as a preparatory measure for furling the wings inwardly.

According to the second variant which is illustrated in Fig. 3, the wing has been positionally fixed against twisting in that the lower wing plate 2 is secured to the projectile body by means of bolts 9 and 10 with shims 11 and 12. In order for the bolts 9 and 10 to be mounted in place, and in order for the plates 1 and 2 to be completely clamped together, two apertures 13 and 14 are provided in the upper wing plate 1. In this fastening, it is not always necessary to supplement the arrangement with the flexible band 4 even if this may occasionally be needed in view of the aerodynamic forces acting on the wing.

It is desirable in many projectiles to provide the same degree of control in both the pitch and roll directions. In such cases, four radially directed wings are required instead of two. Fig. 4 illustrates such a projectile.

Two different conceivable variants of furlable radially directed wings will be discussed hereinafter. In this particular instance, Figs. 4-11 refer to the first variant and Figs. 12 and 13 to the second.

All of these radial wings must be rendered furlable in against the projectile body about pivotal journals axially disposed in the longitudinal direction of the projectile. Both of these variants of "radial" wings described hereinafter differ in respect of the design of their pivotal journals while many other detail arrangements are common to both.

In the first variant of the projectile according to Figs. 4-11, the wing 15 consists of two cupped plates 16 to 17 which are interconnected along their common edges by the joint 18, while the fourth edge of each respective plate is free and provided with anchorage fittings 19 and 20 respectively. The joint 18 may, as in the previously described embodiment according to Figs. 1-3, be a soldered, glued or welded joint.

On inward furling, the plates 16 and 17 are first urged into dead abutment with one another, whereafter the wing is folded down towards the projectile body K about an axially directed reversible journal, whereafter the wing is furled, from a substantially tangential position in relation to the projectile body K, around said projectile body K. The wings may also overlap in this case. This is facilitated by the formation of an abrupt longitudinal notch in the projectile body at each wing anchorage (see for example Fig. 5). The furled positions of the wings are apparent from the broken lines V^{11} in Figs. 5 and 6.

When the wings have, in such a manner, been furled around the projectile, considerable tensile and compressive forces will, as has already been mentioned, arise in the plates, these being absorbed in the joints 3 and 18 between the plates in the form of shearing tension. In the case of the wing according to Figs. 1 and 3, there was no free plate edge which could be deformed.

In the radial wing designs now under consideration, requiring reversible journals along the periphery of the projectile body, there are no joints between the plates along the journals. This part of the wings could therefore very well be deformed if the anchorage fittings 19 and 10 along the inner end edge of each respective plate are not made sufficiently rigid. In order to reduce the stresses on the anchorage details, some different measures out of the many which may be adopted are shown.

One such measure may be to apply a flat surface 21 along the projectile body in immediate association with the reversibly pivotal anchorage of the wing so that the wing, when it is furled around the projectile body, need not be deformed (flexed) further in the immediate proximity of the pivotal shaft and the free end edges of the plates.

The second measure is to provide the plates with fixing means cooperating in the compressed state, for instance in the form of plugs 22 on the one plate and corresponding apertures 23 in the second plate. The fixing means may be designed in a large variety of manners and could, for instance, also consist of folds or creases in the plates. With the aid of these fixing means, the plates are forced to follow one another when they are furled around the projectile body.

The fixing means and the "straight" portion of the projectile periphery are solutions which may be applicable in all types of radial wings. However, the reversibly pivotal anchorage may be of different designs.

In the variant illustrated in Figs. 5-11, the anchorage fitting 19 consists of a rod of a substantially semicircular cross-section which is secured to the inner free end or edge side of the flat or straight portion 24 of the plate 16. The reason for this is that the compression of the plates constituting the wings and their furling around the projectile body is always facilitated if the plates constituting the wings are provided with a straight or flat portion disposed centrally between the edge joints flush with the anchorage of the wing to the projectile body. The ends of the rod 19 are extended beyond the "straight" portion of the plate by substantially semicircular journal pins 30, 31. The anchorage fitting 20 also consists of a rod designed as two end-to-end semicircular journal pins 32, 33 and a locking bead 26 secured along the flat portion 25 of the plate 17 and being of rectangular cross-section. With the plates in the compressed state, there will thus be obtained circular composite stub shafts at each respective end edge of the planar plate portions.

That part of the projectile which retains the wings is designed as a first ring 17 (Fig. 10) and two retaining rings 28, 29 (Fig. 11) on either side thereof, these latter being both provided with pairwise corresponding oval holes 34 and 35 for the stub shafts 30-32 and 31-33, respectively. On assembly, the wings are mounted on the ring 27, whereafter the retaining rings 28, 29 are mounted so that the projecting journal pins 30, 31, 32, 33 of the anchorage fittings will project into the oval holes 34 and 35 in the retaining rings 28 and 29, respectively. The assembled position with the wings in the operative or unfurled state is apparent from Fig. 5. In this position the pins 30-33 abut against the outer edges in each respective oval aperture 34 and 35 respectively. In the unfurled position, the wing is held in place partly by the ends of the journal pins 30-33 in the apertures of the retaining rings 28-29 and partly by the fact that the semi circular portion of the anchorage fitting 19 abuts against the inside of a cooperating similarly semicircular groove 36 in the ring 27 at the same time as the anchorage fitting 20 fits, with its locking bead 26, into a specifically adapted locking groove 37 which is also disposed in the ring 27. The groove 36 and the locking groove 37 are disposed in register with one another in a recess or bottom groove 38 in the periphery of the ring 27. The groove runs axially in relation to the main direction of the projectile. At the bottom of the recess 38, there is provided a callipered leaf spring 39 which originally is compressed against the bottom of the recess but, as soon as the wing is completely unfurled, will snap in between the plates 15 and 16 and prevent these from being pressed together by aerodynamic forces. The width of the leaf spring 39 corresponds to the inner space between the flat portions of the plates 15 and 16. The leaf spring 39 also prevents the anchorage fittings 19 and 20 from being displaced out from theri respective recesses in the ring 27.

The wing is held in the furled state by a device which is not shown on the Drawings. As is the case with a single wing, the device may consist of an outer casing which is removed when the wing is to be unfurled or when th wings are held furled by the discharge barrel.

It is apparent from broken lines in Fig. 6 how the anchorage fittings lie in the apertures 34 and 35 as long as the wing is in the furled position. The anchorage fittings and the plates forming the wing thus lie in the secured position in a relatively central manner in order, after unfurling, to splay out towards the opposing edges of the oval holes 34 and 35. The Figure also shows that the locking bead 26 lies somewhat inside, i.e. more proximate the axis of the projectile than the anchorage fitting 19.

Figs. 12 and 13 shown one alternative of the reversible journalling of the wing according to Figs. 5-11. The main principle is, however, the same. The difference lies in the fact that, in this case, the wing is anchored to a rotary shaft 40. This shaft is provided with an axially directed rectangular bottom groove 47. The one plate of the wing, here designated 41, is joined, with its flat or straight portion, with the one longitudinal edge of the shaft groove along the joint 43. The second plate, here designated 42, has a fitting 44 with a locking edge 45 which, when the wing is unfurled, engages with a corresponding recess 46 in the opposing longitudinal edge of the groove 47 in the shaft 40. In order for the wing not to be compressed by aerodynamic forces, a bulging leaf spring 48 is disposed in the bottom of the recess, this spring being capable, as previously described, of snapping in between the plates in the wing as soon as the wing has reached the completely unfurled position. The leaf spring 48 effectively prevents compression between the plates of the wing.

Since, in this design, the plates of the wing will, in the unfurled position, both be locked in the same reversible journal shaft, this shaft must be locked to prevent reverse movement. This arrangement has been provided for so that the shaft 40 is displaceable in its longitudinal direction by a spring (not shown). With the wing in the fully unfurled position, this spring will draw the shaft to a position where a number of recesses 48 lock the shaft against further rotation.

It is assumed for all alternatives according to the present invention that the natural striving of the wing to assume its original form will cater for the unfurling operation. One method of increasing reliability in unfurling of "radial" wings is for the guide fins 50 of the projectile to be enabled to set the projectile in rotation in the direction which gives an aerodynamic force striving to unfurl the wings.

Claims

1. In a missile or other projectile, an unfurling wing (V, 15) or fin which is unfurlable from a first furled (V^1) position bent in towards the projectile body (K) and initially locked, on cessation of the locking function, to a second position where it generates desired lifting force and/or guiding impetus for the projectile (P) and the forces required for unfurling the wing or fin to its

second position derive from the stresses stored in the material in the wing or fin as a result of that deformation to which the material is subjected on its bending in towards the projectile body, **characterized in that** the wing or fin consists, in the unfurled state, of two plates (1, 2, 16, 17) which are cupped away from one another and are immovably interconnected (3, 18) along all edge sides which are not directly or indirectly secured to the projectile body and whose cupping is selected so that they together impart to the wing or fin its cross-section conditioned by aerodynamic considerations.

2. The wing (V, 15) or fin as claimed in Claim 1, **characterized in that** it is, from its securement anchorage in the projectile body (K) and out to its outer end, entirely ribless and is rigidified solely by the cupping of the plates (1, 2, 16, 17) and the natural rigidity of the material.

3. The wing or fin (V, 15) as claimed in Claim 2, **characterized in that** it consists of two plates (1, 2) cupped away from one another and welded together along the edges (3) or fixedly connected to one another by other means, the plates, in the unfurled state, extending equal distances out on either side of the projectile body (K) against whose periphery the one plate (2) abuts and is secured or alternatively guided, while the outer side of the second plate (1) facing away from the first plate is supported by a support member (4) defined in a direction away from the projectile body (K) and freely movable in towards the projectile body (K) together with the plates (1, 2) when these are pressed together and furled about the projectile body (K).

4. The wing or fin as claimed in Claim 2 or 3, **characterized in that** the direct securement anchorage against the projectile body is made along a portion of the profile cross-section of the wing or fin where both of the cupped plates (2, 3, 16, 17) forming same are, in the unfurled state, substantially flat (2, 5, 26) and run parallel with one another.

5. The wing or fin as claimed in Claim 4, **characterized in that** it is, along its end edge facing towards the projectile body, reversibly journalled in a journal (19, 20, 34, 25, 40) which is reversible through at least a quarter or a turn and extends in the longitudinal direction of the projectile body, about which journal the wing or fin is furlable in towards the projectile body (K) provided that both of the cupped plates (2, 3, 16, 17) forming the wing or fin have prior thereto been pressed together to right and flat abutment against one another, and the one (16) of the two cupped plates (2, 3, 16, 17) forming the wing or fin is, at its end edge facing the journal, secured (24, 43) against the journal (19, 40) along the outside of its flat portion (24), while the other cupped plate (17) is, along the outside of its end edge parallel therewith and along its flat portion (25), provided with a locking edge (26, 45) running parallel with the journal, the locking edge, with the wing or fin in the unfurled state, gripping into a recess (37, 46) which is adapted therefor, is connected to the projectile body and extends parallel with the journal.

6. The wing or fin as claimed in Claim 5, **characterized in that** its journal consists of one first and one second pair of substantially semicircular guide pins (30-32) which are secured with theri semicircular sides facing outwardly away from one another to the outside of the edge of the flat portions (24, 25) of both of the cupped plates, the guide pins having pairwise (31, 32 and 30, 33) been journalled in oval journals (34, 35) secured in the projectile body.

7. The wing or fin as claimed in Claim 6, **characterized in that** a guide edge (19) runs along the flat portion of one of the cupped plates between their guide pins, the guide edge being of the same cross-section as and manufactured integrally with the guide pins of the plate, and for which there is provided a semi circular groove (36) connected to the projectile, while a locking edge (26) runs between the guide pins of the second plate, the locking edge being of rectangular cross-section and for which there is provided a locking groove (37) connected to the projectile body and in which the locking edge (26) may snap in when the wing or fin is completely unfurled.

8. The wing or fin as claimed in Claim 5, **characterized in that** the journal consists of a rotary shaft (40) provided with a longitudinal groove (47) axially centred along the middle of the shaft and being of rectangular cross-section, the first of the cupped plates (41) being, at its flat portion, secured to the rotary shaft (40) against the one longitudinal edge of the groove (47) along its end edge, while the second of the cupped plates is, with a locking edge (44) disposed along its edge, operative in the unfurled position to grip into a recess (46) adapted therefor in the opposing longitudinal edge of the groove (47).

9. The wing or fin as claimed in Claim 8, **characterized in that** the shaft (40) constituting the journal is, by means of a separate spring, axially displaceable from a first position intended to be assumed as long as the wing or fin is fully or partly furled, to a second position which it may not assume until it has been turned to that position which corresponds to the fully unfurled wing or fin, and where the shaft, by means of engagement in members (48) connected to the projectile body, is locked against any further twisting thereof, whereby the wing or fin is locked in the unfurled position.

10. The wing or fin as claimed in any one or more of Claims 5-9, **characterized in that** a movable locking member (39, 48) is disposed in the projectile body in the immediate proximity of the securement anchorage of the wing or fin therein, and said locking member being, by spring force or other means, movable from a first furled position which it assumes as long as

the wing or fin is fully furled, to a second position which it cannot assume until the same is fully unfurled, and said locking member (39, 48) being inserted between both of the cupped plates (16, 17, 41, 42), and there extending from the inside of the one plate to the inside of the opposing plate.

11. The wing or fin as claimed in any one or more of Claims 1-10, **characterized in that** the cupped plates (15, 16) united with one another along the edge sides, display, along their broad sides, mutually opposing guide bosses (27) and recesses (23), respectively, which when the plates are pressed into dead abutment against one another, enter into engagement with one another and, on their bending around the projectile body, force the plates into an equivalent strain in every portion of the wing or fin.

12. The wing or fin as claimed in any one or more of Claims 1-11, **characterized in that** it is made of a titanium alloy, a spring steel or a reinforced plastic material.

13. The wing or fin as claimed in any one or more of the preceding Claims, **characterized in that** it is designed to be able, from a first wholly unfurled position, to be urged down to a second furled position where the mutually compressed plates tightly abut against a flat portion (21) of the projectile body located in the immediate vicinity of their reversible journal, said flat portion progressively merging into a bellied configuration characteristic of the projectile body, and along which the furling of the wing or fin about the body is commenced.

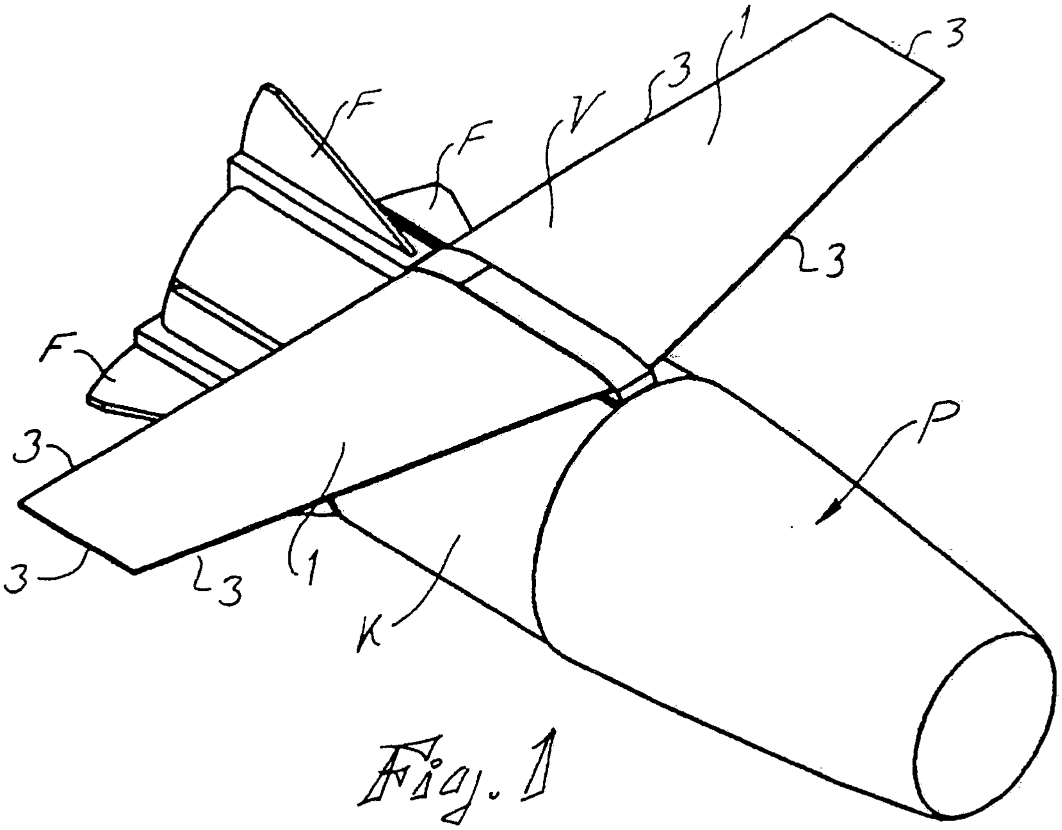

Fig. 1

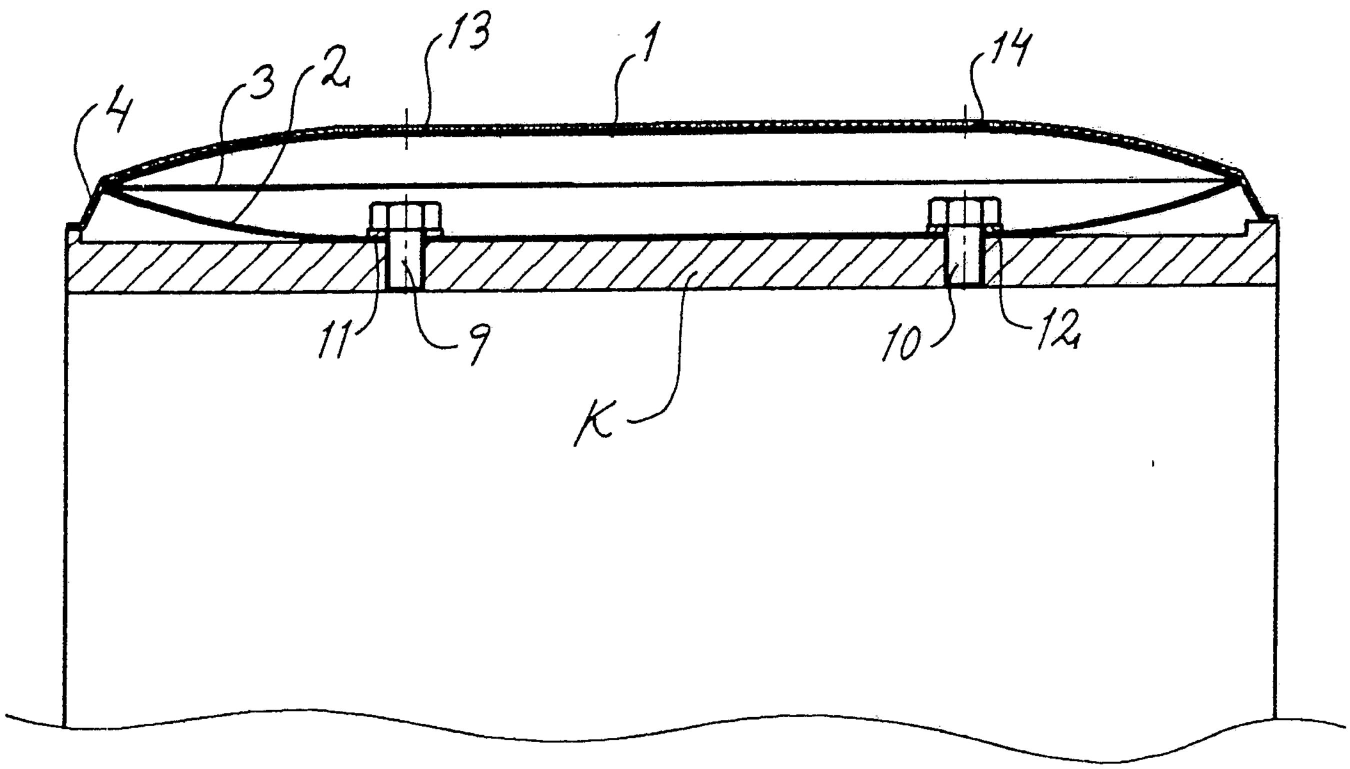

Fig. 3

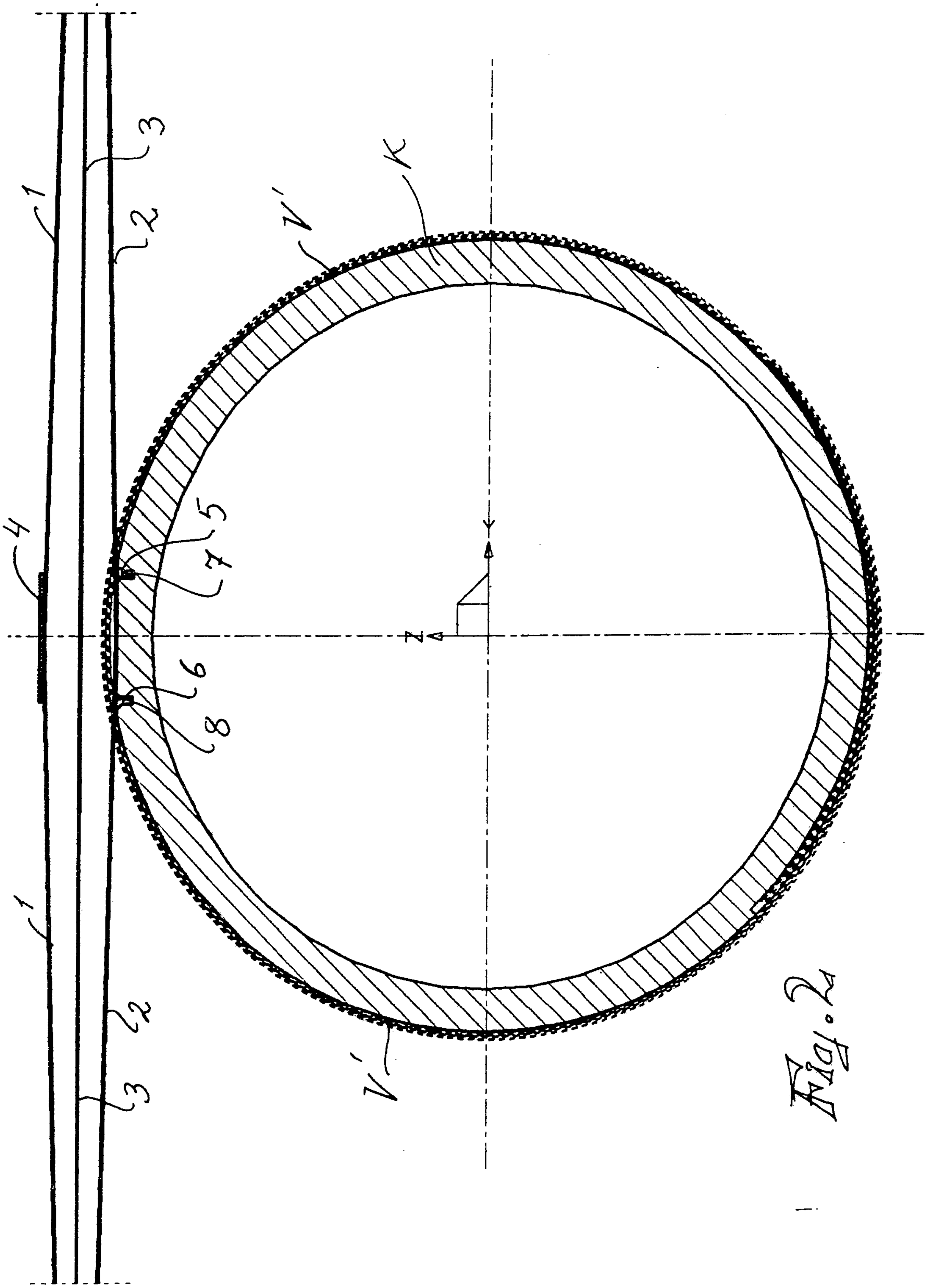

Fig. 2

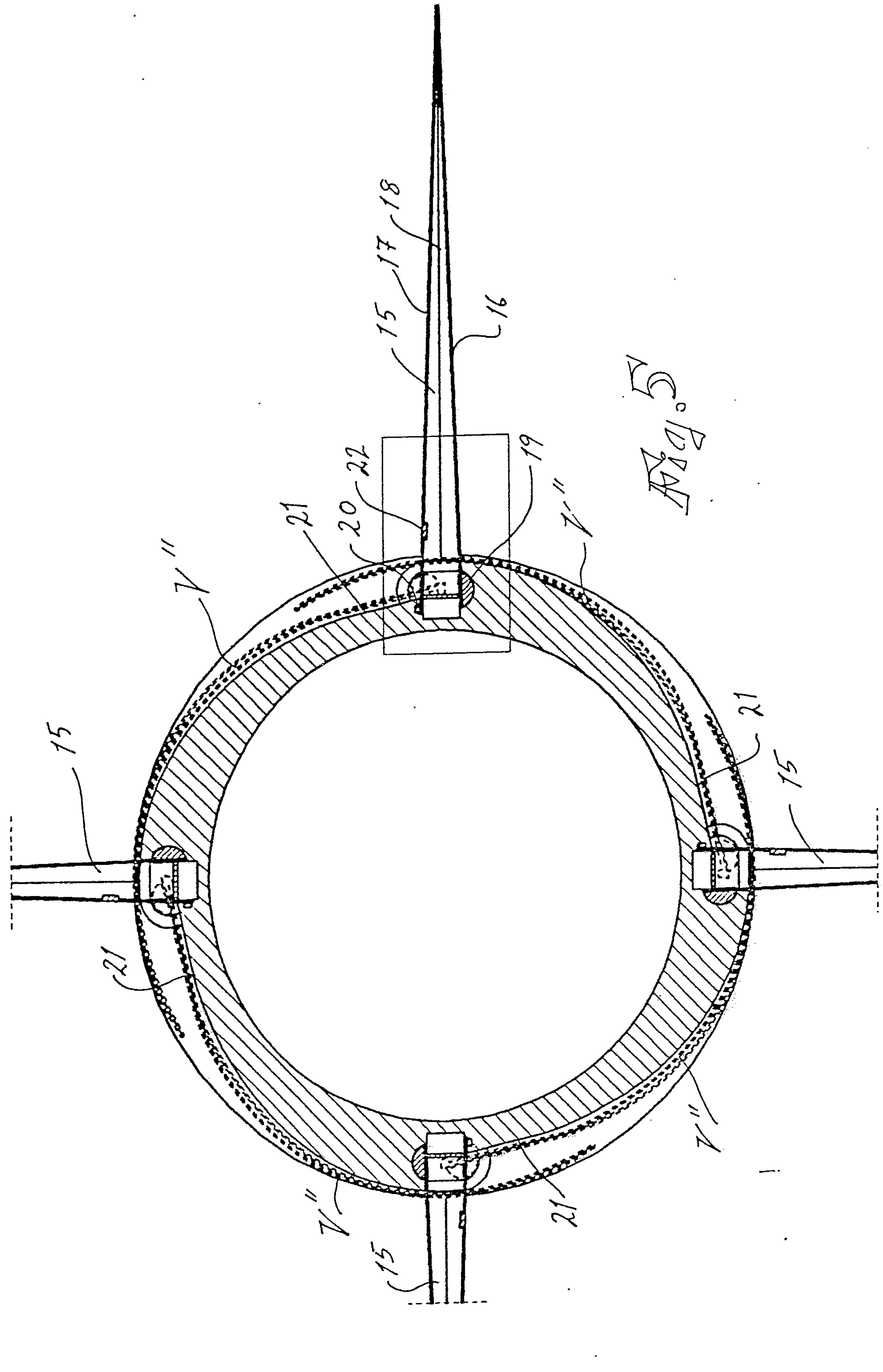

Fig. 5

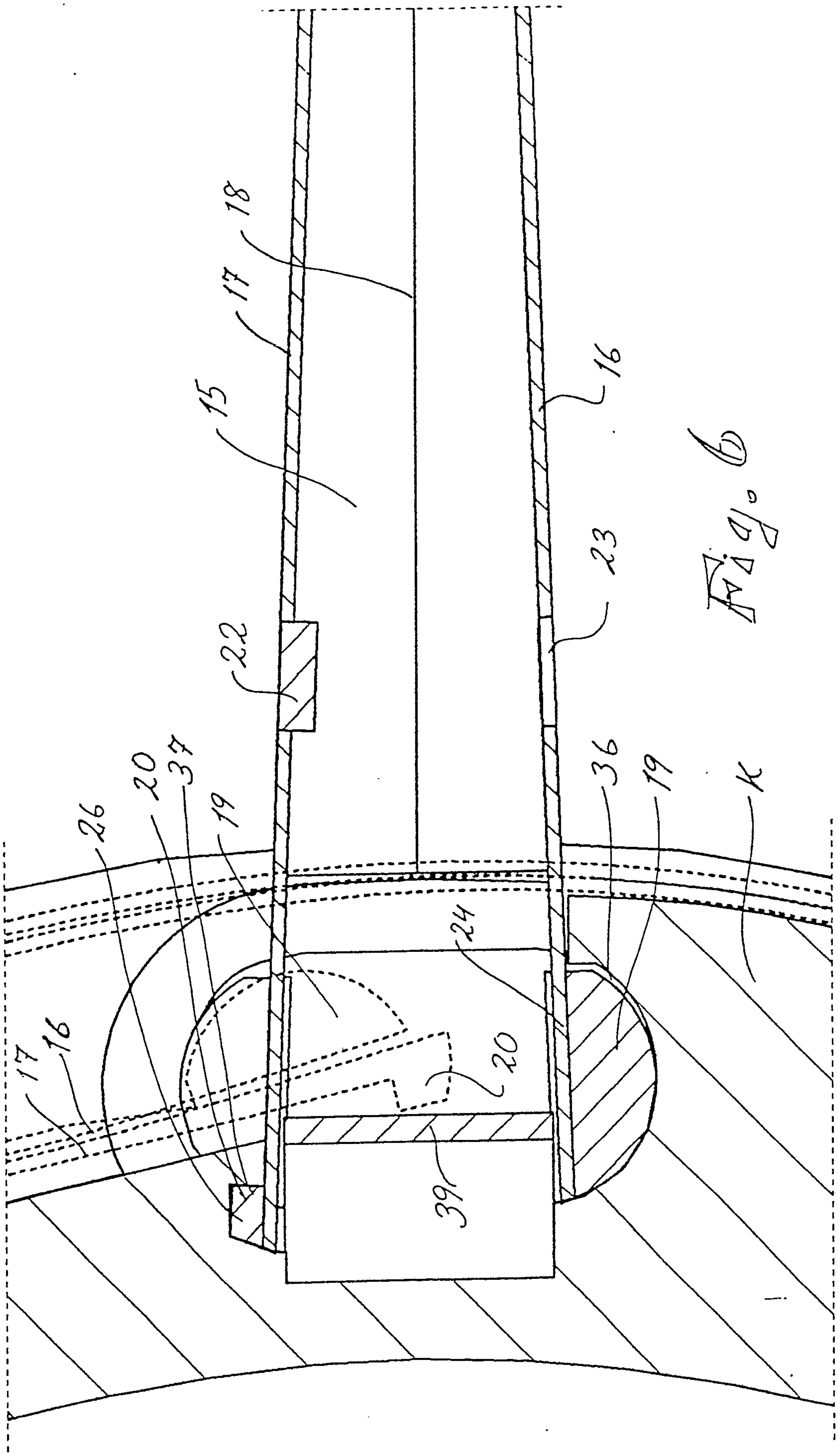

Fig. 6

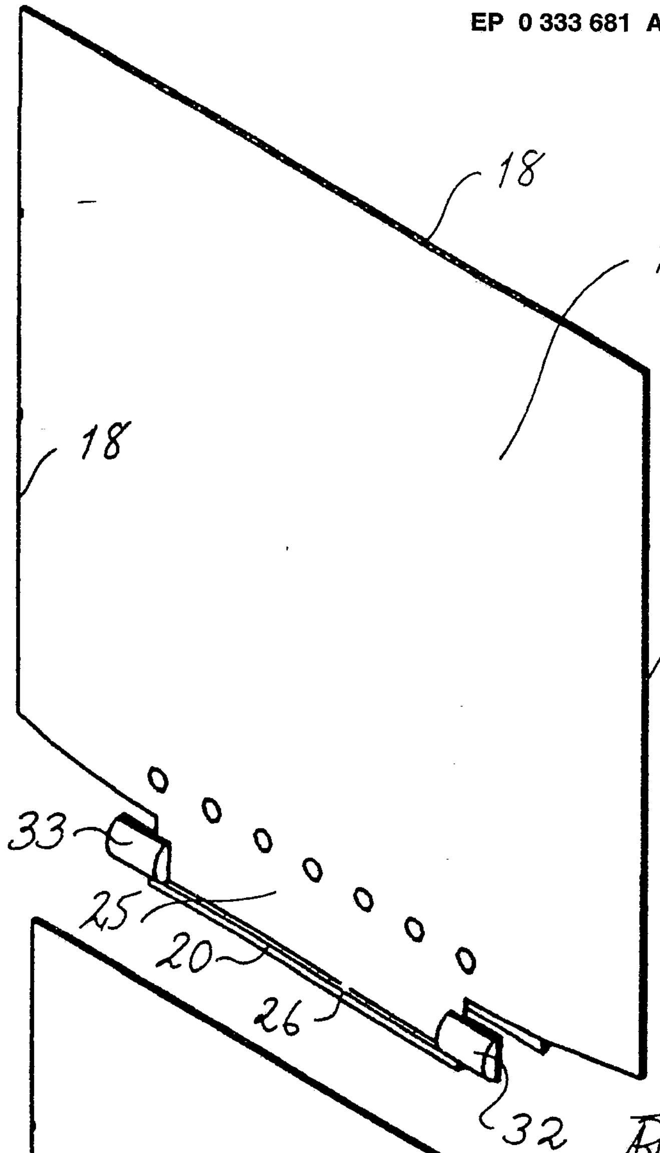

Fig.7

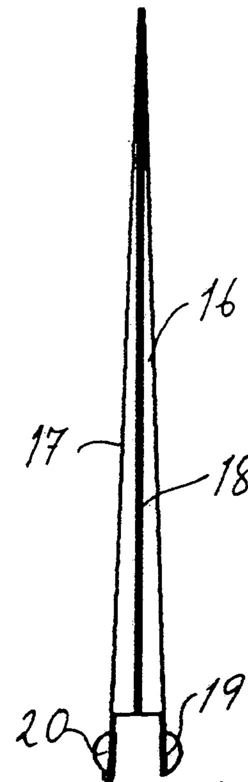

Fig.9

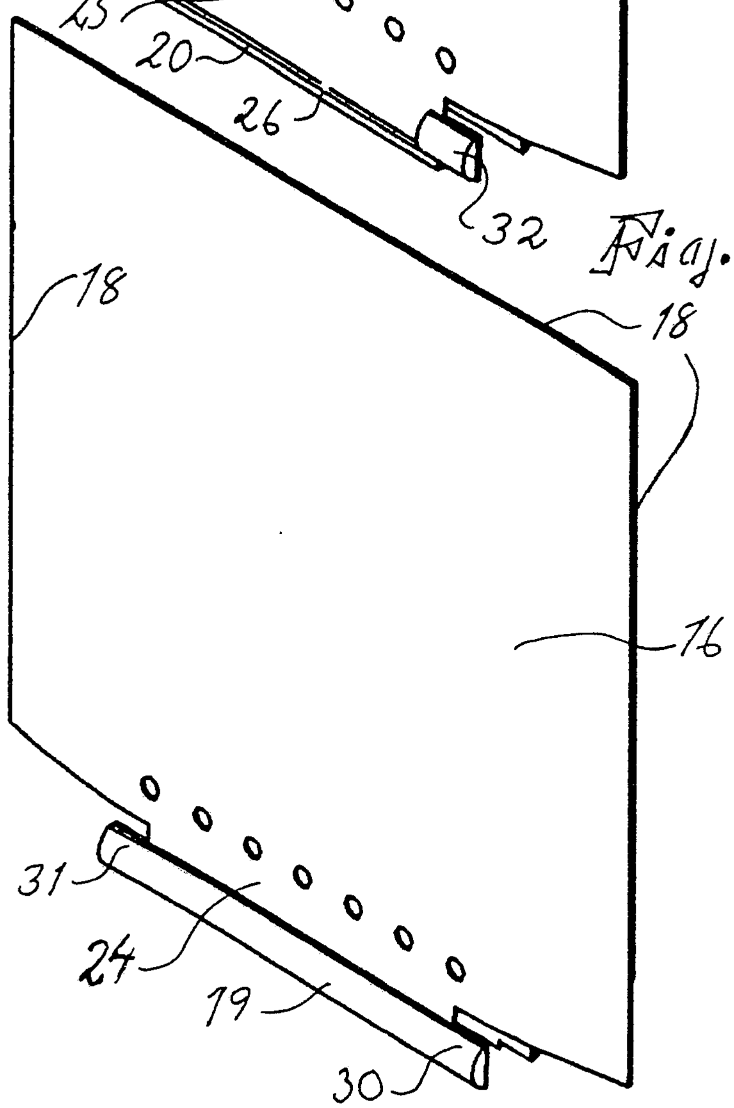

Fig.8

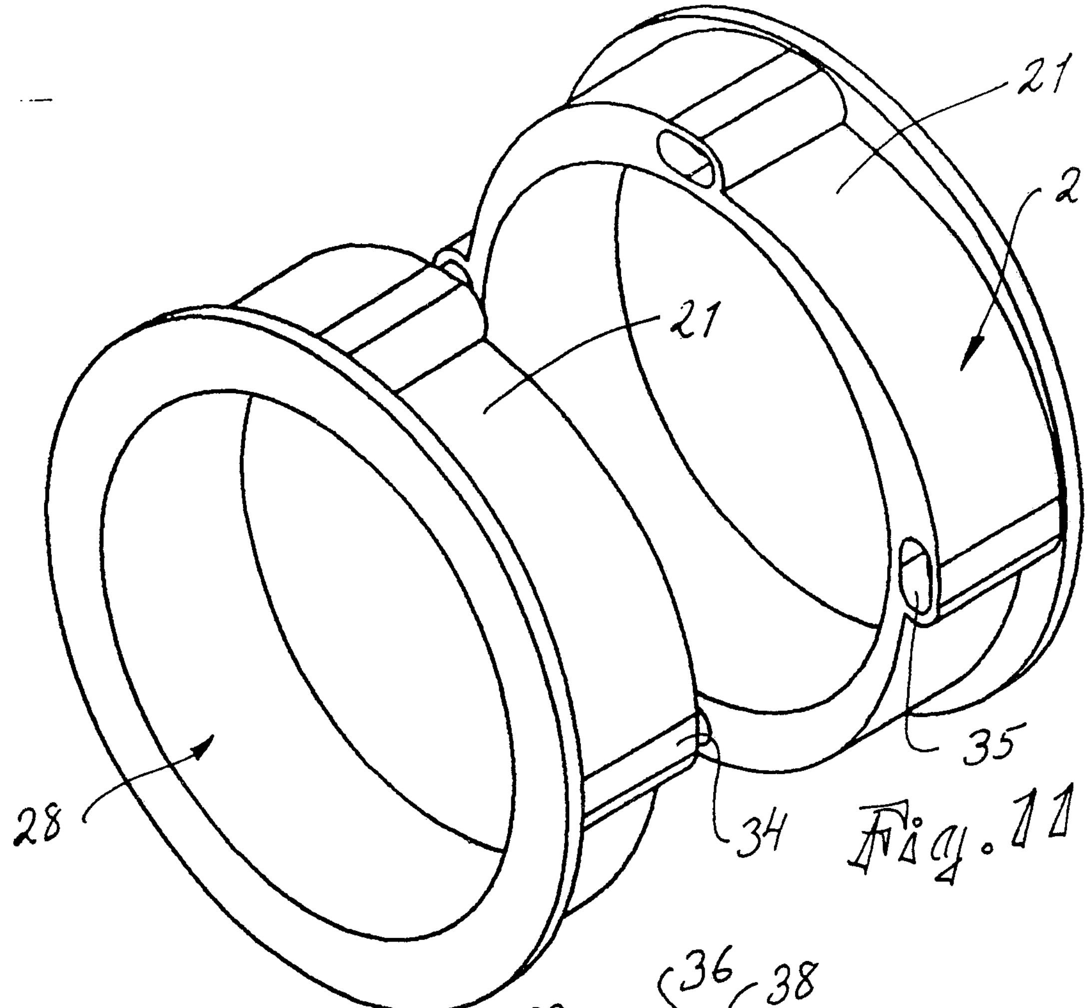

Fig. 11

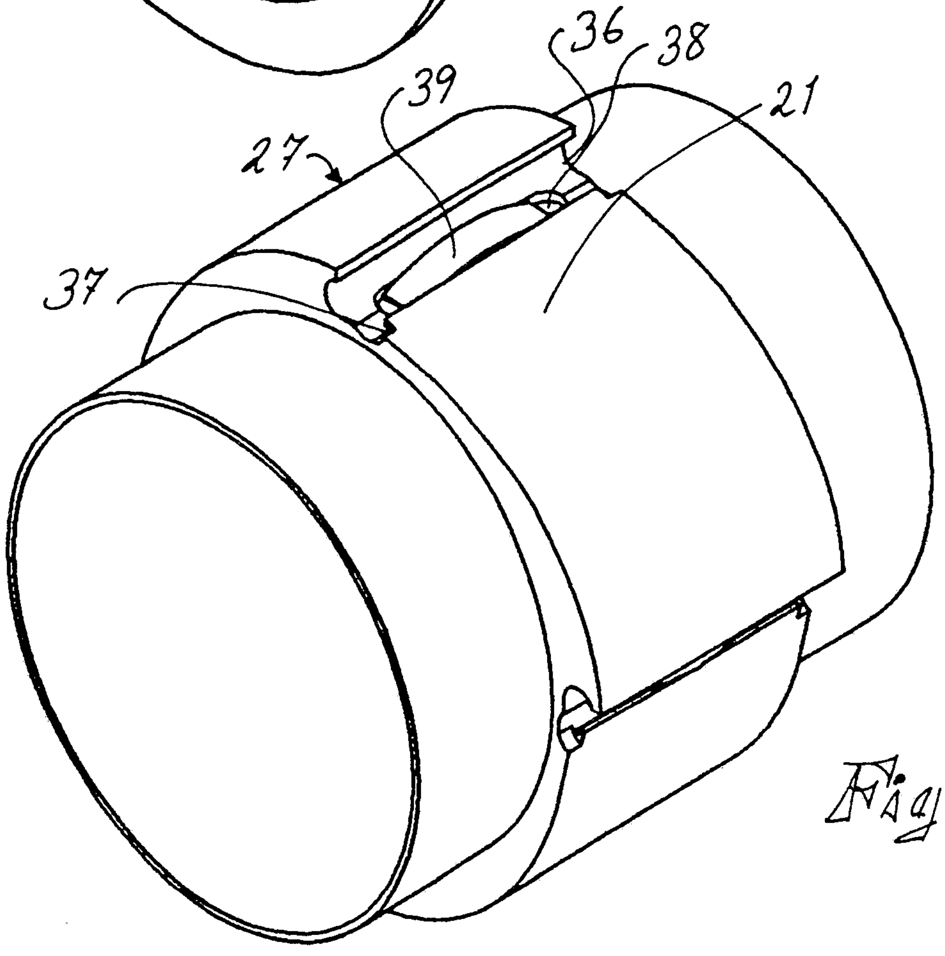

Fig. 10

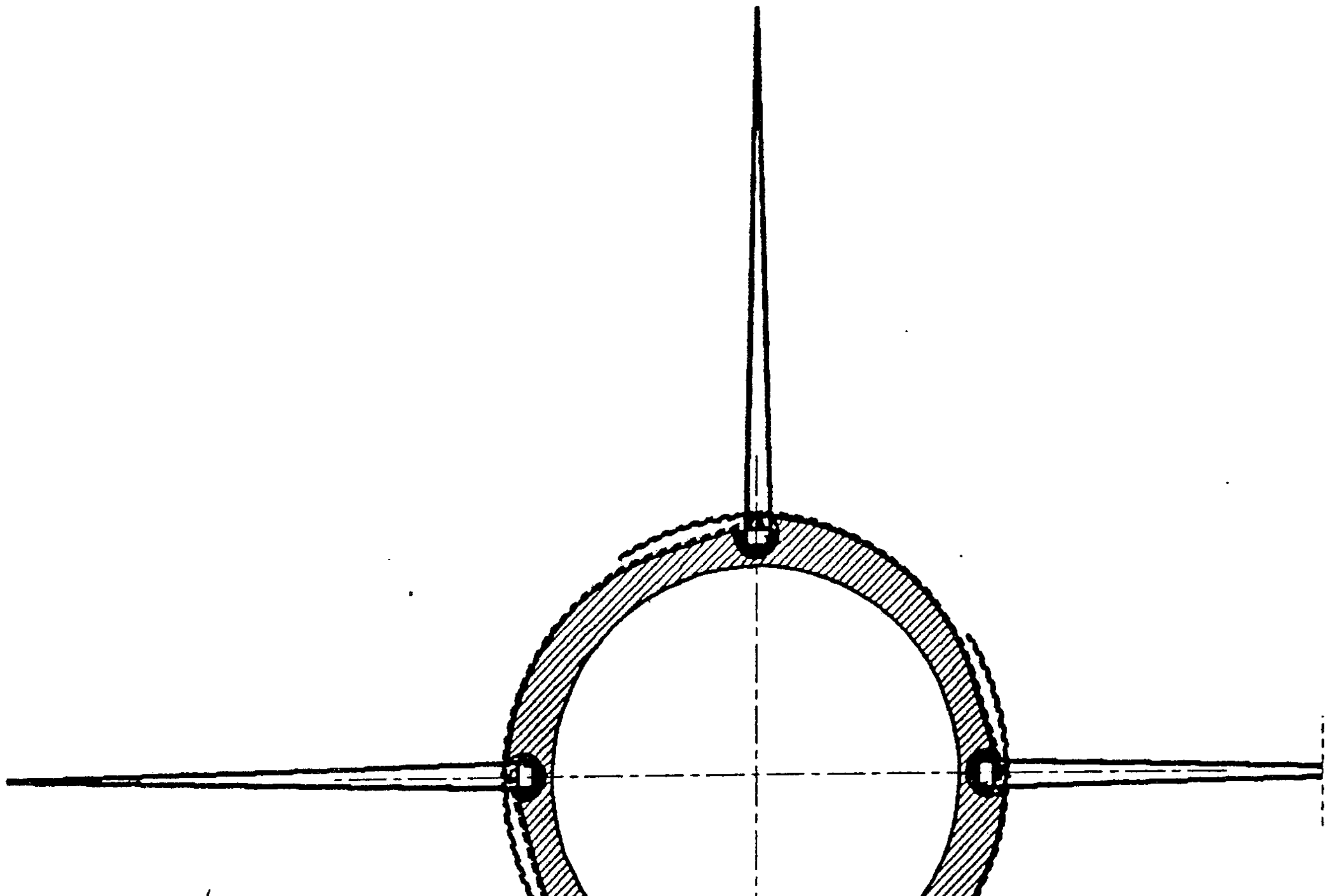

Fig. 12

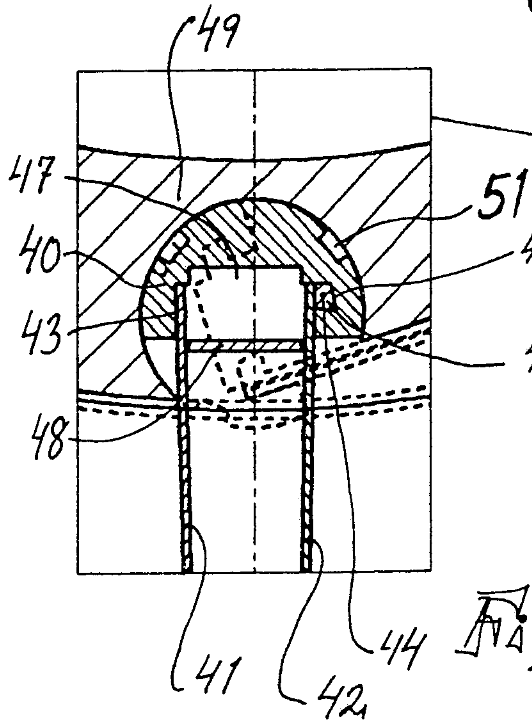

Fig. 13

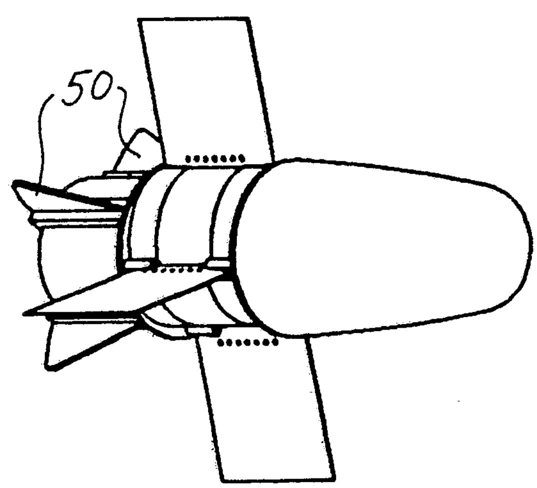

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 89850054.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	DE - A1 - 2 226 123 (AKTIEBOLAGET BOFORS) * Page 4, line 35 - page 5, line 6; fig. 2 * --		F 42 B 13/32 F 42 B 15/053
A	DE - A1 - 2 609 932 (MESSERSCHMITT-BÖLKOW-BLOHM GMBH) * Page 5, line 18 - page 7, line 24; page 8, line 17 - page 9, line 6; fig. 1 * --		
A	DE - A1 - 3 026 409 (GENERAL DYNAMICS CORP.) * Page 7, lines 19-30; page 10, lines 1-30; fig. 1,2,5, 12 * --		
D,A	DE - C1 - 3 618 956 (RHEINMETALL GMBH) * Fig. 1,4,5 * -----		TECHNICAL FIELDS SEARCHED (Int. Cl.4) F 42 B 13/00 F 42 B 15/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	21-06-1989	KALANDRA

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