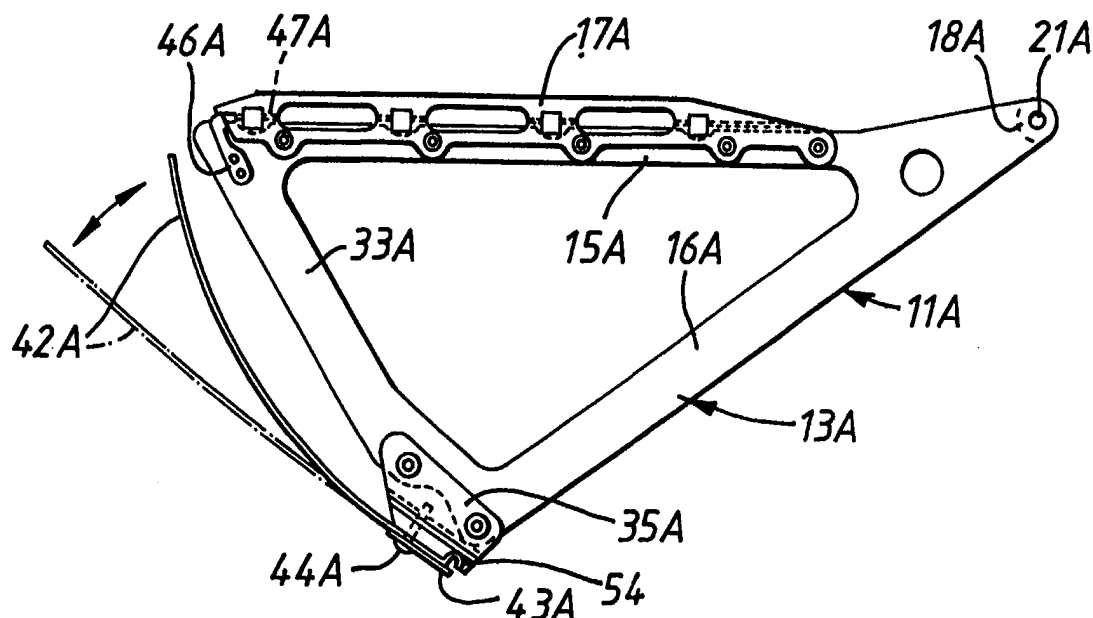




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<p>(21) International Application Number: PCT/GB98/01535</p> <p>(22) International Filing Date: 27 May 1998 (27.05.98)</p> <p>(30) Priority Data: 9710879.9 27 May 1997 (27.05.97) GB</p> <p>(71) Applicant (for all designated States except US): FLIGHT RE-FUELLING LIMITED [GB/GB]; Brook Road, Wimborne, Dorset BH21 2BJ (GB).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): MOUSKIS, Christopher [GB/GB]; Little Stretton, Lawford Road, Bournemouth, Dorset BH9 3JN (GB). EDMONDSON, Bryan, John [GB/GB]; Freshfield, 64 Beacroft Lane, Colehill, Wimborne, Dorset BH21 2PA (GB).</p> <p>(74) Agents: EVERITT, Christopher, James, Wilders et al.; F.J. Cleveland, 40-43 Chancery Lane, London WC2A 1JQ (GB).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report.</p>

(54) Title: A DROGUE ASSEMBLY FOR IN-FLIGHT REFUELLING



(57) Abstract

A drogue assembly (10) for in-flight refuelling includes a circumferential array of triangular support arms which carry a drogue parachute (29) which extends circumferentially around their shorter sides. Each support arm is pivoted and mounted on a pivot pin (19) at its apex for pivotal movement in a radial direction. At least alternate ones of the support arms carry leaf springs which extend into pockets (51) formed in the drogue parachute (29). The leaf springs act on the drogue parachute (29) in opposition to air pressure loading on it in flight so that it tends to increase the chord angle of the drogue parachute (29) from the leading edge. Hence the effective area of the drogue parachute in flight is varied automatically above a certain predetermined minimum which depends on the dimensions of the trailing edge so it is reduced as air speed is increased and vice versa.

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A Drogue Assembly For In-flight Refuelling

This invention relates to a drogue assembly for in-flight refuelling.

5 Drogues are used to stabilise refuelling hose trailing from a tanker aircraft in a generally horizontal attitude. They provide drag for a refuelling coupling at the trailing end of the refuelling hose which is to be coupled for in-flight refuelling with a probe from a following aircraft which is to be refuelled. This 10 drag resists the forward movement of the probe. However, the resistance due to drag should not be so great that the probe may be damaged by impact with the drogue in flight. Also the higher the drag, the greater the power that will be necessary to wind in the refuelling hose 15 after in-flight refuelling has been completed.

It is desirable to be able to use the same in-flight refuelling equipment to refuel either a low speed aircraft, say a helicopter cruising at about 100 knots, or a higher speed aircraft where the speed of refuelling 20 may be governed by the cruising speed of the tanker aircraft, say 270 knots. This is difficult if the equipment has a drogue parachute because drag load on the parachute is proportional to the square of the airspeed.

US-A-2,946,543 discloses a drogue assembly for 25 in-flight refuelling including a drogue parachute which comprises an annular strip of sheet material having two circumferentially continuous edges, and means for towing the drogue parachute in flight so that it is extended with one of its edges leading the other and encircling 30 an area which is larger than the area encircled by the other when the drogue parachute is fully extended whereby the material presents a certain effective area to air through which it is being towed, the towing means being connected to the leading edge substantially uniformly 35 around it and a notional line which lies in a radial plane of the drogue parachute and which passes through the two edges makes a certain chord angle with the direction of flight. A number of beams are connected to

the edges at circumferentially spaced intervals and each of an annular array of coil springs acts through a respective one of the beams in opposition to air pressure loading on the drogue parachute in flight so as to
5 increase the chord angle of the drogue parachute such that the effective area of the drogue parachute in flight is varied automatically above a certain predetermined minimum which depends upon the dimensions of the other or trailing edge, so that it is reduced as the air speed
10 is increased and vice versa. This arrangement is complex requiring many parts and is vulnerable to those parts being broken in flight due to impact by the probe of a following aircraft which is to be refuelled. This can lead to engine damage as such broken parts may be
15 dislodged from the drogue assembly and drawn into an engine air intake. Furthermore the drogue assembly that forms the subject of US-A-2,946,543 is designed for relatively high speed flight and drag it exerts would be relatively low, too low for the range of airspeeds
20 referred to above.

An object of this invention is to minimise the range of drag loads established by a drogue parachute when conducting in-flight refuelling with the same in-flight refuelling equipment at different air speeds and to avoid
25 using complex equipment having many parts which are vulnerable to fracture due to impact by the probe of a following aircraft which is to be refuelled.

According to this invention there is provided a drogue assembly for in-flight refuelling including a
30 drogue parachute which comprises an annular strip of sheet material having two circumferentially continuous edges, and means for towing the drogue parachute in flight so that it is extended with one of its edges leading the other and encircling an area which is larger
35 than the area encircled by the other when the drogue

parachute is fully extended whereby the material presents a certain effective area to air through which it is being towed, the towing means being connected to the leading edge substantially uniformly around it, and a notional
5 line which lies in a radial plane of the drogue parachute and which passes through the two edges makes a certain chord angle with the direction of flight, resilient biasing means being provided which act on the material substantially uniformly around it and in opposition
10 to air pressure loading on it in flight so as to tend to increase the chord angle such that the effective area of the drogue parachute in flight is varied automatically above a certain predetermined minimum which depends upon the dimensions of the other or trailing edge so that it
15 is reduced as air speed is increased and vice versa, wherein the resilient biasing means are incorporated in the drogue parachute.

Preferably the resilient biasing means that are incorporated in the drogue parachute comprise spring
20 means.

The preferred form of towing means comprise a circumferential array of support arms, each pivotally mounted at one end by a respective pivot mounting, the pivot mountings being arranged in a ring from which the
25 support arms extend in one direction which is generally parallel to an axis with which the array is concentric, each support arm being mounted so as to be pivotable in a direction which is radial with respect to said axis, wherein each of the support arms is fitted to the leading
30 edge of the drogue parachute, the arrangement being such that the support arms with the drogue parachute thereon can be collapsed within a cylindrical envelope having a diameter which is approximately that of the ring of pivot mountings, whereas when the drogue assembly is towed
35 in-flight, it is extended in the manner of a parachute

with the support arms flared outwardly from the axis trailing the ring of pivot mountings.

Conveniently the resilient biasing means comprise an annular array of leaf springs, each leaf spring of the annular array being fixed by one end to a respective one of the support arms in the region of the leading edge of the annular strip of sheet material and projecting radially with respect to that annular strip. Preferably each leaf spring is curved in its natural relaxed state so as to present a concave face to the respective support arm to which it is fixed and the other end of the curved spring is spaced from the respective support arm. This introduces a camber into the drogue parachute which increases the drag.

Each leaf spring may extend into a respective pocket formed on the annular strip of sheet material by a respective patch which is fastened to the annular strip of sheet material, the pocket having a mouth through which the respective leaf spring projects.

There may be one leaf spring for each support arm. Alternatively, the leaf springs may be fitted to alternate support arms in which case each support arm may carry two such leaf springs one laid upon the other.

One form of drogue assembly in which this invention is embodied and some modifications thereof are described now by way of example only with reference to the accompanying drawings, of which:-

Figure 1 is a general view in perspective of the drogue assembly with its clamping rings shown separately, displaced therefrom;

Figure 2 is a view in perspective and to a larger scale of the drogue assembly shown in Figure 1, with the clamping rings fitted and with the drogue parachute

removed to reveal hidden details;

Figure 3 is a side elevation of one of the support arms of the drogue assembly shown in Figures 1 and 2;

5

Figure 4 is a side elevation of another of the support arms of the drogue assembly shown in Figures 1 and 2;

Figure 5 is a side elevation of the drogue parachute shown in Figure 1;

10

Figure 6 is a view similar to Figure 3, but drawn to the opposite hand, of a modified form of support arm fitted with a modified form of leaf spring; and

15

Figures 7 and 8 are views similar to Figure 6 showing modifications of the support arm shown in Figure 6.

Figure 1 shows a drogue assembly 10 which comprises a circumferential array of support arms.

20

Figure 2 shows that the circumferential array of support arms is alternately a support arm 11 and a support arm 12 so that each support arm 11 is between a pair of support arms 12. The support arms 11 and 12 are similar to a major extent, the differences being shown to the right-hand side of each of Figures 3 and 4.

25

Each support arm 11 and 12 comprises a generally triangular metal frame 13 having a short side and two longer sides 15 and 16. One, 15 of those longer sides, which is a little longer than the other longer side 16, is disposed radially inwardly with respect to that other side 16 and is fitted into the channel of a metal channel section member 17. There is a clearance between the edge of the frame 13 within the channel and the base of that channel. The frame 13 is riveted to the channel section

30

35

member 17.

Each support arm 11 and 12 is pivotally mounted in the region of its apex 18 which is formed by the two longer sides 15 and 16 for swinging movement in a radial direction. Each support arm 11,12 is pivotally mounted on a pivot pin 19 which passes through a hole 21 in the frame 13 in the region of the apex 18. The pivot pins 19, which are arranged end-to-end in a ring, as can be seen in Figure 1, are trapped between inner and outer clamp rings 24 and 25. The inner clamp ring 24 is castellated around its outer surface at one end so that it forms a circumferential array of abutments 26. The pivot pins 19 are held against the abutments 26 by the outer clamp ring 25 which is fitted over the remainder of the inner clamp ring 24 which projects through the ring of pivot pins 19. The outer clamp ring 25 which tapers away from the support arms 11 and 12, has an annular array of slots 27 formed in its larger diameter end, each slot 27 being aligned with a respective one of the support arms 11 and 12. The slots 27 are also aligned with the spaces between the abutments 26 and each slot 27 and the space with which it is aligned allows for the swinging movement of the aligned support arm 11 and 12. The rings 24 and 25 are bolted together with pivot pins 19 trapped between them. The pivot pins 19 are trapped between the clamp rings 24 and 25 in a manner which allows each support arm 11 and 12 to pivot independently of the others.

As is described in our co-pending International Patent Application PCT/GB98/00560, filed 04 March 1998, priority British Patent Application No.9704472.1, filed 04 March 1997, each juxtaposed pair of support arms 11 and 12 is joined together by a net 28 which is joined to each of those support arms 11 and 12 at spaced intervals along the channel section member 17 of that support arm 11,12. The formation of the net 28 and the manner of its

connection to the respective juxtaposed pair of support arms 11 and 12 that it interconnects is described in detail in our co-pending International Patent Application PCT/GB98/00560 and need not be repeated here.

5 Figure 1 shows that the support arms 11 and 12 carry a drogue parachute 29 which extends circumferentially around their short sides. The drogue parachute 29 comprises a circumferentially continuous strip of fabric which is reinforced along each of its axially spaced
10 peripheral edges by a respective fabric cord hoop 31,32.

 Figures 2, 3 and 4 show that each support arm 11 differs from each support arm 12 in the configuration of its short side and in the attachments that are fitted to it in the region of that short side.

15 Figure 3 shows that the short side 33 of each support arm 11 is enlarged at the end that is connected to the longest side 15 to form a protuberance 34 which projects away from the apex 18. A block 35 is bolted to the support arm 11 at the junction of the short side 33
20 and the other, longer side 16. The block 35 is generally T-shaped. It has a slot formed substantially symmetrically and centrally within its stem and opening at the base of that stem. The junction between the short side 33 and the other, longer side 16 is received within
25 the slot.

 Figure 3 shows that a pair of leaf springs 42, which are face-to-face one with the other, are clamped to the end of the T-shaped block 35 that forms the arms of the T, by a clamp plate 43 which is screwed to the block by
30 setscrews 44. The remote end of the pair of leaf springs 42 abuts the protuberance 34. The dimensions of the latter are such that it deflects the leaf springs 42 from their flat natural relaxed condition so that the leaf springs 42 apply a preload to that protuberance 34.

35 A P-clip 45 is fixed to the block 35 by a setscrew

45A and is located on the side of that block 35 remote from the protuberance 34 so that its end, which is in the form of a partially closed loop, is in line with the leaf springs 42 from which it is displaced.

5 A retaining element 46 of spring metal is fastened to the side face of the short side 33 near to the protuberance 34. Its end remote from the block 35 is formed with a lateral flange which projects into a gap formed between the short side 33 and the longest side 15
10 of the support arm 11. That flange closes the adjacent end of the passage 47 which is formed by the space between the base of the channel section member 17 and the edge of the frame 13 so as to retain therein the pin (not shown) by which the net 28 is connected to the support
15 arm 11 as described in our co-pending International Patent Application PCT/GB98/00560. In order to release the pin, the retaining element 46 is deflected so that the flange is withdrawn from the gap thus exposing the end of the passage 47 thereby enabling withdrawal of the
20 pin.

Figure 4 shows that each support arm 12 is provided with a similar retaining element 46 but no other fitting in the region of the junction of the short side 48 and the longest side 15. A hook element 49 of plastics
25 material is secured to the frame 13 at the junction of its short side 48 and the other, longer side 16. The hook cavity of the hook element 49 faces the other end of the short side 48.

Figure 5 shows that the fabric of the drogue
30 parachute 29 is cut away at circumferentially spaced locations around its larger perimeter to reveal the respective cord hoop 31 that extends continuously around the perimeter. The hoop 31 is received within the cavities of the alternate P-clips 45 of the support arms
35 11 and hook elements 49 of the support arms 12 whereby

the drogue parachute 29 is anchored to the array of support arms 11 and 12 around its larger perimeter. The drogue parachute 29 is provided with a circumferential array of pockets 51 which are formed by stitching
5 respective fabric panels to its circumferentially continuous strip of fabric at circumferentially spaced intervals which are similar to the spacing of the support arms 11. Each pocket 51 is open at its end nearer to the larger perimeter and receives the respective pair of leaf
10 springs 42 which projects into it from its anchorage on the respective block 35.

The exposed portions of the respective hoop 31 that are received within the cavities of the P-clips 45 and hook elements 49 are passed into those cavities during
15 assembly. There is sufficient clearance at the mouth of the hook cavity of each hook element 49 for the hoop 31 to be passed through it during assembly. Each hoop 31 is retained in the respective hook cavity of a hook element 49 by an enlarged end 52 of a strap element 53 which is
20 fitted into the hook cavity between the hoop 31 and the mouth of the hook cavity and which is too large to be passed through the mouth of the hook cavity. The enlarged end 52 of the strap element 53 was inserted into the hook cavity from one side thereof and is a sliding fit
25 therein. The remainder of the strap element 53 extends from the enlarged end 52 through the mouth of the hook cavity and around the outer surface of the respective hook element 49 to which it is joined. The strap element 53, including its enlarged end 52 is integral with the
30 respective hook element 49, the whole being a moulding of plastics material.

When the drogue assembly 10 is towed by an aircraft in flight, it is extended with the support arms 11 and 12 flared outwardly from the axis, trailing the ring of
35 pivot pins 19, by the parachute action of the drogue

parachute 29. Once the air pressure loading that acts upon the drogue parachute 29 as it is towed, exceeds the preload of the pairs of leaf springs 42, the circumferentially continuous fabric of the drogue parachute 29 acts on the leaf springs 42 to deflect them away from the abutments formed by the respective circumferential array of protuberances 34. As a result the effective area of the drogue parachute 29 presented to the slip-stream is reduced allowing air to spill past the radially inner perimeter of the drogue parachute 29. The deflection of the leaf springs 42 continues until an equilibrium state is established. The cord hoop 32 that extends circumferentially continuously around the radially inner periphery of the drogue parachute 29 limits deflection of the drogue parachute 29 away from protuberances 34. Such deflection of the drogue parachute 29 reduces the drag loading acting on the drogue assembly 10. Hence the drag loading varies inversely with the speed at which the drogue assembly 10 is towed.

If necessary all the support arms of the support array may be provided with respective leaf springs 42, each engaged within a respective pocket formed in the drogue parachute 29. In such a modification there need be only one leaf spring 42 for each support arm which may be a support arm otherwise as shown in Figure 3. However, there would be a weight penalty were that arrangement to be adopted.

We have realised that the pre-loaded, naturally flat leaf springs 42 restrict the extent to which the fabric of the drogue parachute 29 will inflate in flight so that the drag will be less than would have been the case had the fabric not been so restrained by the action of the leaf springs 42 incorporated therein. Figure 6 shows another form of support arm which is preferred for use in place of the support arms 11 described above with

reference to and as shown in Figure 3 because it imparts a camber to the drogue parachute for low speed envelopes when the air pressure loading on the drogue parachute is insufficient to overcome the spring loading. Such a
5 camber increases the drag.

The support arm shown in Figure 6 is referenced 11A and parts of it which are similar to corresponding parts of the support arm 11 described above are identified in Figure 6 by the same reference characters but with the
10 suffix A. The following description is limited to the principal differences. Support arms 12A (not shown) used with support arms 11A will be geometrically similar to the support arms 11A shown in Figure 6 and will differ in substantially the same way as has been described above
15 with reference to Figure 4.

The support arm 11A is designed for a drogue parachute which has a greater width between its circumferentially continuous edges than does the drogue parachute 29 carried by the support arms 11 and 12. This
20 is the reason for the geometrical differences between the triangular frames 13 and 13A and follows from the support arm 11A being designed as part of a drogue assembly which is designed for a wider speed envelope, with lower speeds, than was the case for the drogue assembly 10
25 described above with reference to Figures 1 to 5.

The support arm 11A does not have a protuberance 34, nor is its block 35A fitted with a P-clip 45. The leaf spring 42A is curved in its natural relaxed state, rather than being flat as has been described above for the leaf
30 spring 42 of the support arm 11. The curved leaf spring 42A presents a concave face to the short side 33A and its end remote from the block 35A is unsupported. The end face of the block 35A to which the leaf spring 42A is clamped forms a U-shaped channel 54 which is juxtaposed
35 to the end edge of the leaf spring 42A but which is not

covered by the leaf spring 42A. The channel 54 receives the hoop 31 and is covered by the clamp plate 43A whereby the hoop 31 is retained in the channel 54.

5 It will be appreciated that the leaf springs 42A tend to straighten out to a substantially flat condition as is shown in chain-dotted lines in Figure 6 when the air pressure loading on the drogue parachute 29 exceeds the loading of the leaf springs 42A.

10 Figure 7 shows the support arm 11A fitted with a modification which is used with a modified form of drogue parachute 29A. The modification to the drogue parachute comprises the provision of an additional outwardly-flared annular skirt portion at the larger diameter end whereby the circumferentially-continuous strip of fabric that
15 forms the drogue parachute is projected beyond the larger diameter hoop 31 and thus beyond the longer side 16A of each support arm 11A, 12A. The modification to the support arm 11A shown in Figure 7 comprises the provision of a strut 55 which is fixed at one end 56 to the concave
20 face of the leaf spring 42A intermediate its ends and which is fixed at its other end 57 to the larger diameter perimeter of the additional annular skirt portion 58 of the modified drogue parachute 29A.

25 This modification results in the larger diameter perimeter of the additional skirt portion of the modified drogue parachute 29A being deflected towards the longer sides 16A of the support arms 11A and 12A as the leaf springs 42A straighten out. This is due to the struts 55. Hence the struts 55 act to alter the camber of the drogue
30 parachute 29A and the angle of attack at the leading edge of the drogue parachute 29A, that is to say the angle the leading edge portion makes with the airflow. These alterations to the camber and the angle of attack further reduce drag by aligning the leading edge portion of the
35 drogue parachute with the airflow and further reducing

the effective area of the drogue parachute.

The strut 55 may be replaced by a beam 61, fixed at its ends to the leaf spring 42A and to the leading edge of the drogue parachute as described above with reference to Figure 7, but pivotally mounted on the block 35A as shown at 62 in Figure 8.

CLAIMS

1. A drogue assembly (10) for in-flight refuelling including a drogue parachute (29) which comprises an annular strip of sheet material having two
5 circumferentially continuous edges (31,32), and means (11 and 12, 11A and 12A) for towing the drogue parachute (29) in flight so that it is extended with one (31) of its edges leading the other (32) and encircling an area which is larger than the area encircled by the other (32) when
10 the drogue parachute (29) is fully extended whereby the material presents a certain effective area to air through which it is being towed, the towing means (11 and 12, 11A and 12A) being connected to the leading edge (31) substantially uniformly around it, a notional line which
15 lies in a radial plane of the drogue parachute (29) and which passes through the two edges (31 and 32) making a certain chord angle with the direction of flight, wherein resilient biasing means (42,42A) are provided which act on the material substantially uniformly around it and
20 in opposition to air pressure loading on it in flight so as to tend to increase said chord angle such that the effective area of the drogue parachute (29) in flight is varied automatically above a certain predetermined minimum which depends upon the dimensions of the other
25 or trailing edge (32) so that it is reduced as air speed is increased and vice versa, characterised in that said resilient biasing means (42,42A) are incorporated in the drogue parachute (29).

30 2. A drogue assembly (10) according to claim 1 wherein said resilient biasing means that are incorporated in the drogue parachute comprise spring means (42,42A).

3. A drogue assembly (10) according to claim 1 or claim 2 wherein the towing means comprise a circumferential array of support arms (11 and 12, 11A and 12A), each pivotally mounted at one end (18,18A) by a respective
5 pivot mounting (19), the pivot mountings (19) being arranged in a ring from which the support arms (11 and 12, 11A and 12A) extend in one direction which is generally parallel to an axis with which the array is concentric, each support arm (11, 12, 11A, 12A) being
10 mounted so as to be pivotable in a direction which is radial with respect to said axis, wherein each of the support arms (11,12,11A,12A) is fitted to the leading edge (31) of the drogue parachute (29), the arrangement being such that the support arms (11 and 12, 11A and 12A)
15 with the drogue parachute (29) thereon can be collapsed within a cylindrical envelope having a diameter which is approximately that of the ring of pivot mountings (19), whereas when the drogue assembly (10) is towed in-flight, it is extended in the manner of a parachute with the
20 support arms (11 and 12, 11A and 12A) flared outwardly from the axis trailing the ring of pivot mountings (19).

4. A drogue assembly (10) according to claim 3 wherein the resilient biasing means comprise an annular array of
25 leaf springs (42,42A), each leaf spring (42,42A) of the annular array being fixed by one end to a respective one of the support arms (11,11A) in the region of the leading edge (31) of the annular strip of sheet material and projecting radially inwardly with respect to that annular
30 strip.

5. A drogue assembly (10) according to claim 4 wherein, in its natural relaxed state, each leaf spring (42,42A)

is curved so as to present a concave face to the respective support arm (11,11A) to which it is fixed and the other end of the curved leaf spring (42,42A) is spaced from the respective support arm (11,11A).

5

6. A drogue assembly (10) according to claim 4 or claim 5 wherein each leaf spring (42,42A) extends into a respective pocket (51) formed in the annular strip of sheet material by a respective patch which is fastened to the annular strip of sheet material, the pocket (51) having a mouth through which the respective leaf spring (42,42A) projects.

10

7. A drogue assembly (10) according to any one of claims 4 to 6, wherein there is one leaf spring (42,42A) for each support arm (11,11A).

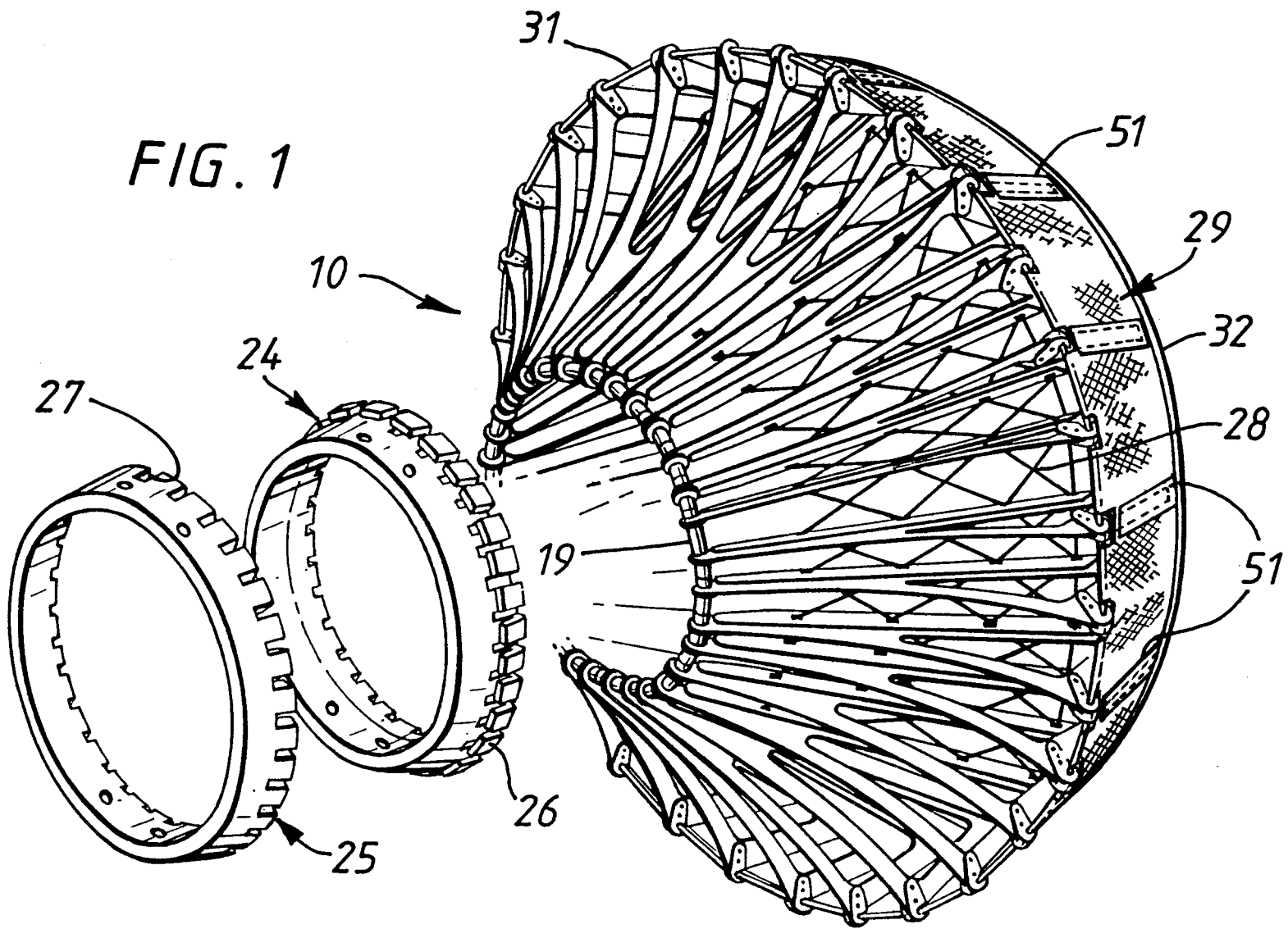
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8. A drogue assembly (10) according to any one of claims 4 to 6, wherein the leaf springs (42,42A) are fitted to alternate support arms (11,11A).

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9. A drogue assembly (10) according to claim 8 wherein each support arm (11) carries two leaf springs (42), one laid upon the other.

25



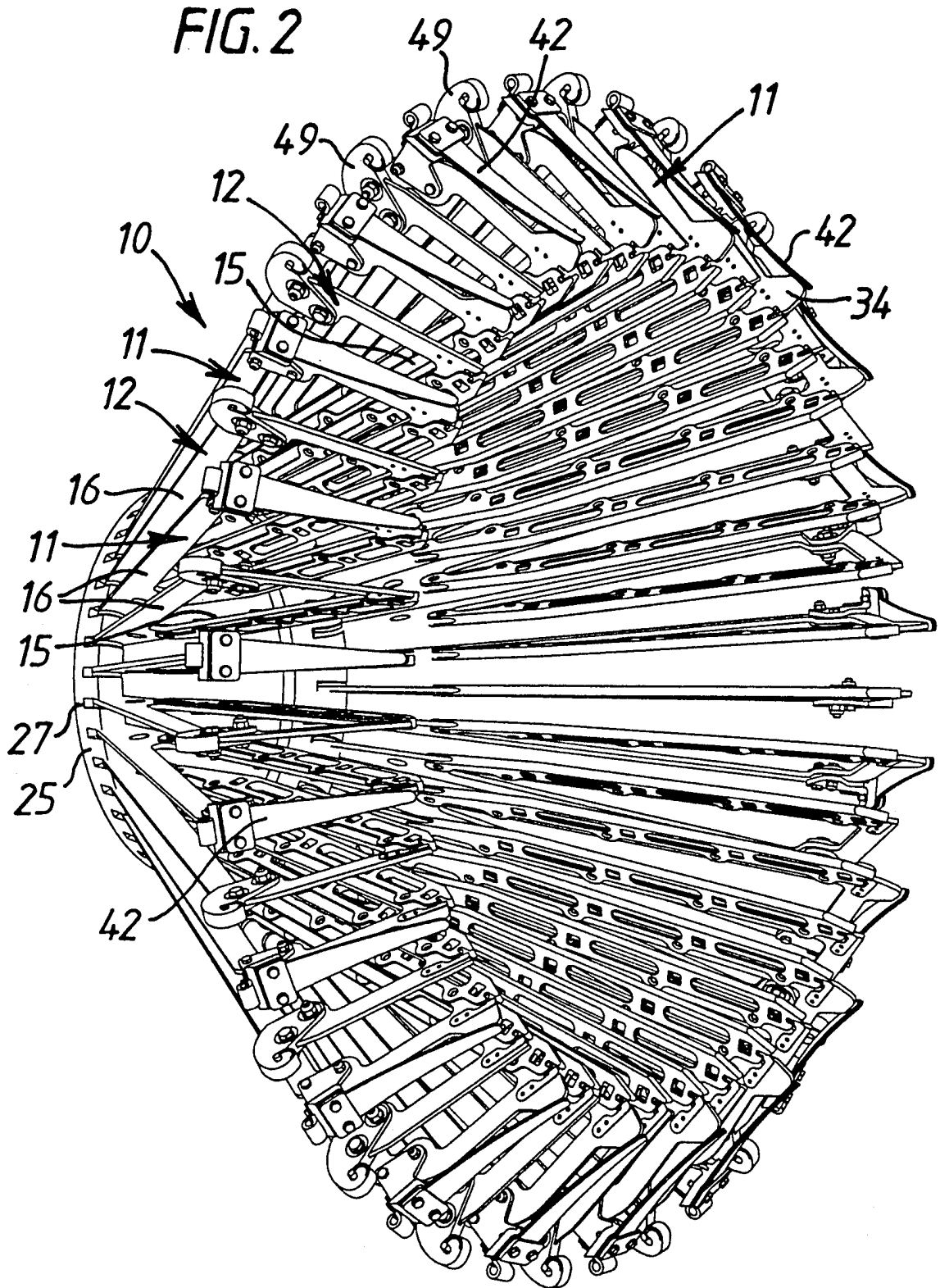


FIG. 3

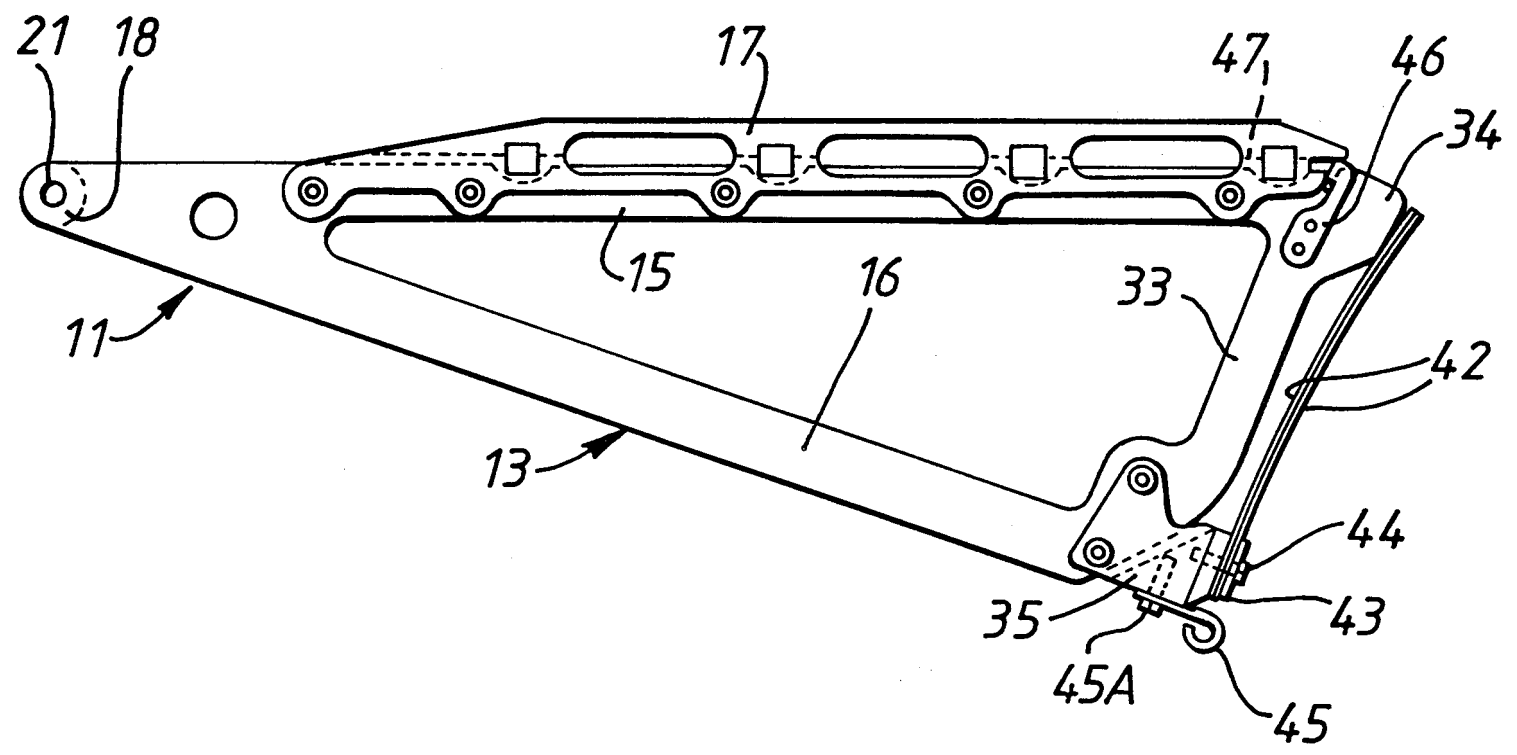
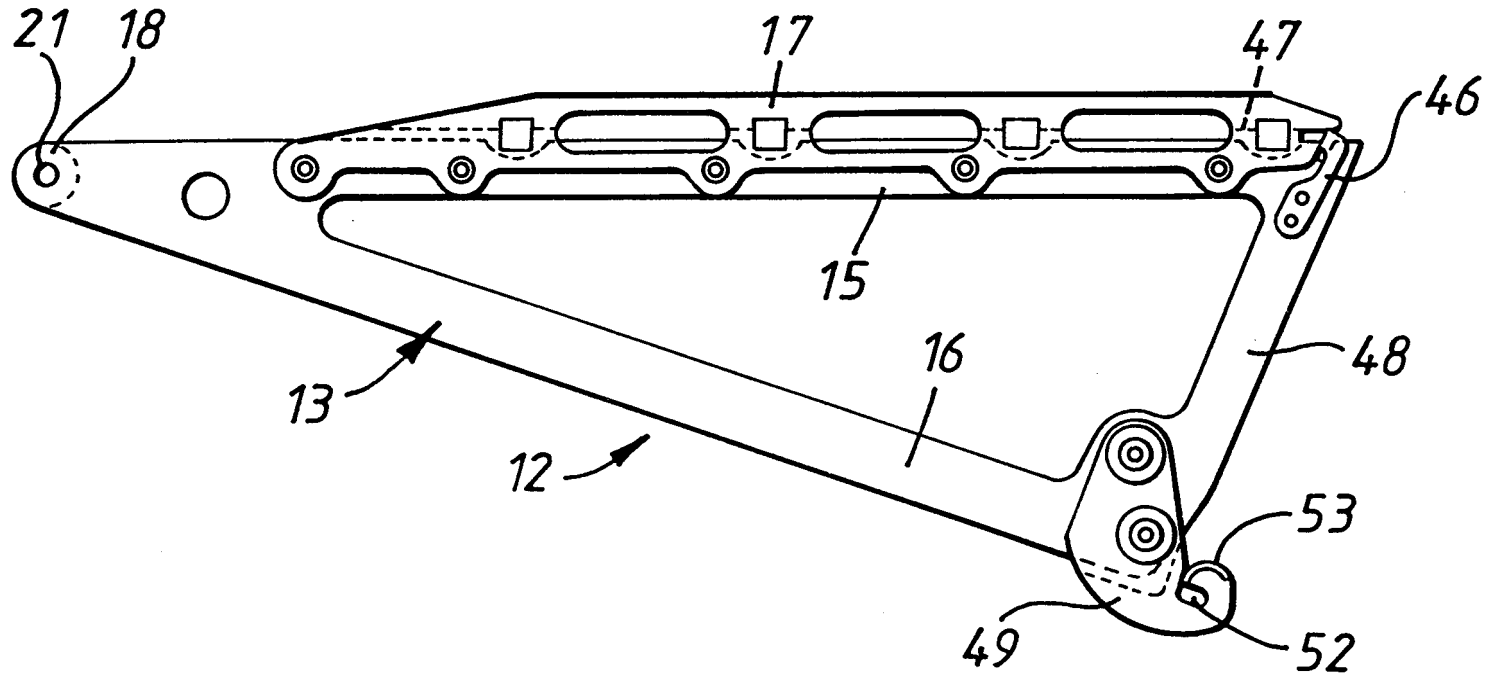


FIG. 4



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FIG. 5

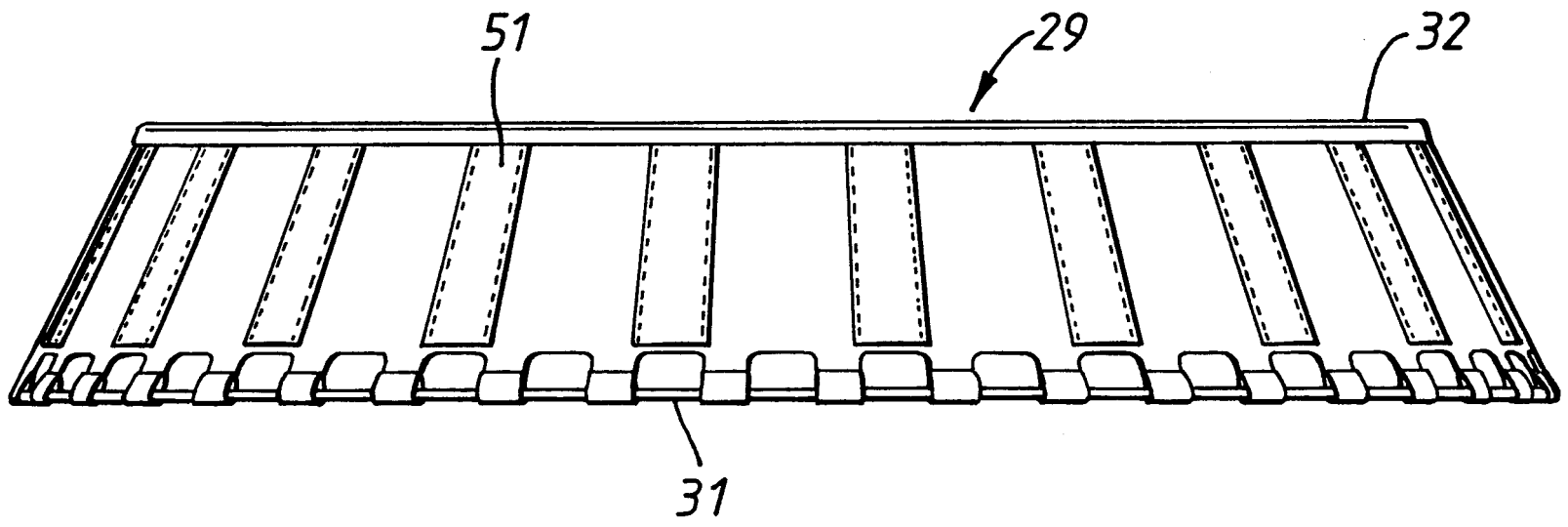


FIG. 6

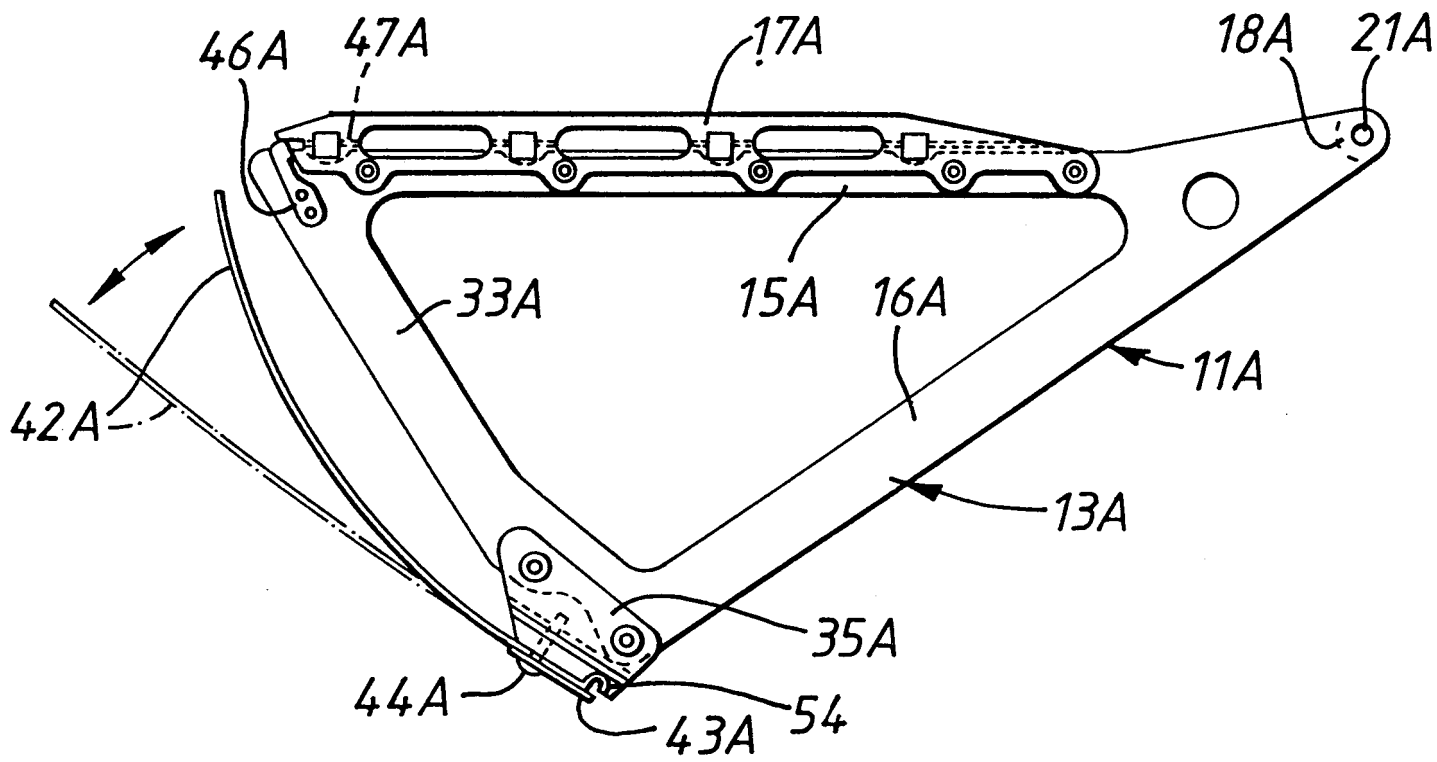
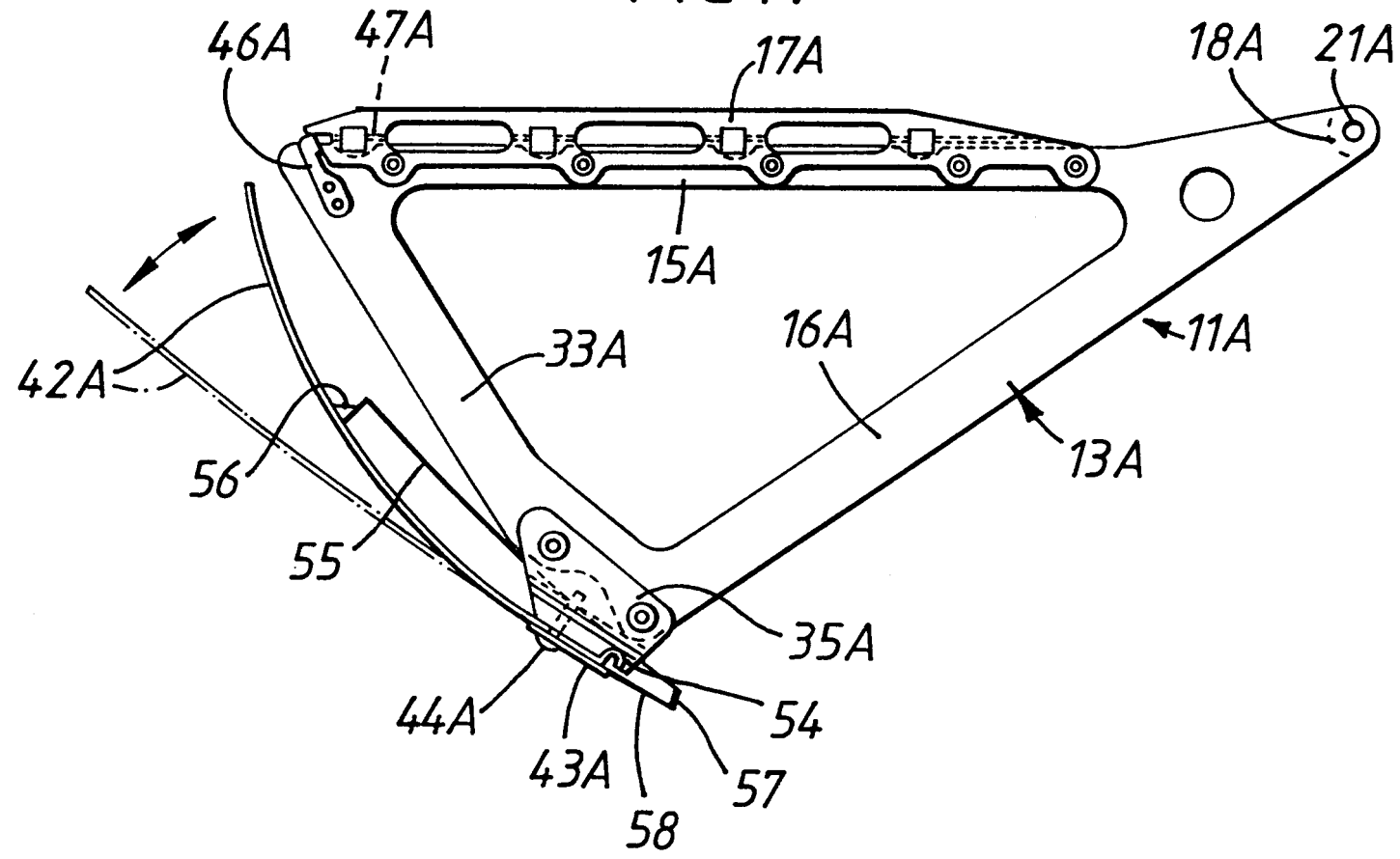


FIG. 7



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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/01535

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B64C27/615 B64C9/10 B64C13/50 B64D39/00

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B64D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2 946 543 A (C.G. GORDON) 26 July 1960 cited in the application see column 4, line 35 - line 63 see column 5, line 29 - column 7, line 56 see figures 1,2,8-11 -----	1-4,7-9
A	EP 0 694 471 A (WEST COAST NETTING INC) 31 January 1996 see abstract see figures -----	1

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

28 August 1998

Date of mailing of the international search report

03/09/1998

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INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/GB 98/01535

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2946543	A	26-07-1960	NONE	
EP 0694471	A	31-01-1996	US 5427333 A	27-06-1995