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(54) Towed aerial target.

(57) A towed aerial target is launchable in a collapsed configuration from an aircraft in flight and deployable into an open configuration in which the target is towed by the aircraft on a tow line for engagement by aircraft during weapon firing practice. The target comprises a support frame (11) having pivotal arms (14,15,16) pivotally connected to the rear end of a mounting bar (12) and pivotal from collapsed dispositions in which they lie adjacent the mounting bar (12), to extended dispositions in which they extend radially from the rear end of the bar (12). Rear panels (20,21,22) of a flexible material are attached to the pivotal arms (14,15,16) and arranged to take up a streaming configuration behind them when the target is deployed and the pivotal arms (14,15,16) are in their extended dispositions. A resilient ring is mounted on the mounting bar (12) and compressible by the pivotal arms (14,15,16) when they are moved to their collapsed dispositions. The pivotal arms (14,15,16) are releasably held in their collapsed dispositions prior to launching of the target and are after launching released so as to are deploy to their extended dispositions under the biasing action of the ring.

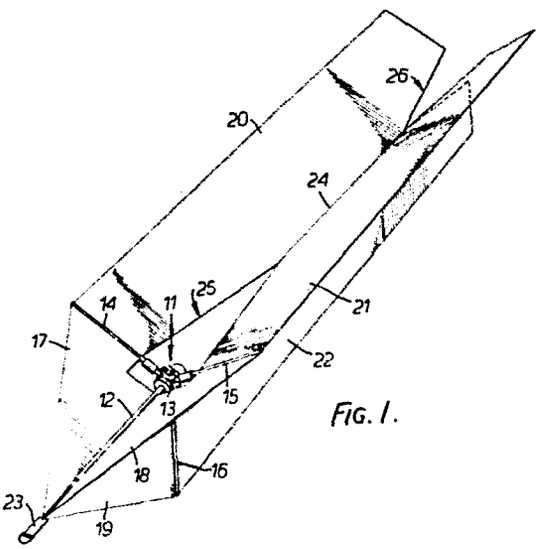

FIG. 1.

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TOWED AERIAL TARGET.

The present invention relates to targets and is particularly although not exclusively concerned with towed aerial targets launchable in a collapsed configuration from an aircraft in flight and deployable into an open configuration in which the target is towed by the aircraft on a tow line for engagement by aircraft during weapon firing practice.

Air-launchable towed aerial targets have been in use for many years and have taken various forms. While many have been launchable in a collapsed configuration and deployable on launching in to an open configuration the air speeds of the aircraft used for towing the targets have usually been low and the loads placed on the target during deployment also low. The packing of the target into its collapsed configuration and the manner in which it deploys into its open configuration has not therefore been critical.

Practice combat using high speed aircraft requires the use of an aerial target towed at high air speeds and there is the need for an air-launchable towed aerial target which can successfully be deployed from an aircraft whose launching speed far exceeds the launching speed of a conventional towing aircraft.

In a towed aerial target hitherto proposed, the target is launchable in a collapsed configuration from an aircraft in flight and deployable after launching into an open configuration. The target comprises four right triangular panels of a flexible material, each having a

long side and a short side forming the right angle and being connected together along their long sides with their short sides positioned at the rear of the target from the point of view of the direction of towing and a support frame comprising four pivotal arms attached to the short sides of the triangular panels and pivotally connected to the rear end of a mounting bar extending forwardly along and attached to the connected long sides of the panels. A tow line is connected to the panels at their foremost points at their common apex. The target is collapsed by swinging the four pivotal arms forwardly so that they lie against the mounting bar and then folding the panels upon the collapsed frame to form a package which is stowed in a container provided on the towing aircraft.

During launching of the hitherto proposed target an explosive charge is detonated to project the target package into the air in which it automatically unfolds to its deployed form by the drag imposed upon it by its passage through the air. The panels attached to the tow line at their common apex first unfold forwardly of the collapsed frame, and the pivotal arms then move from their collapsed dispositions to their extended dispositions under the loads exerted on the frame by the deploying panels. Unfolding of the target in this way is usually very abrupt especially when the launch speed of the aircraft is high. Any assymmetrical loading of the frame during deployment can give rise to permanent distortion of the pivotal arms or their pivotal connections and lead to an irregular target flight path, making the target completely unusable unless the frame is repaired or replaced.

In the target hitherto proposed, the four right triangular front panels are supplemented by four small rectangular rear panels of a flexible material which are connected to the pivotal arms and arranged to take up a streaming configuration to the rear of the frame. The rear panels clearly add to the stresses placed on the frame during deployment of the target.

An object of the present invention is to provide an air-launchable towed aerial target which utilises a collapsible frame which extends during deployment of the target but in which the risk of permanently distorting the frame is substantially reduced.

According to the present invention there is provided a target launchable in a collapsed configuration and deployable after launching into an open configuration comprising a support frame movable upon or after launching of the target from a collapsed configuration to an extended configuration, one or more panels of a flexible material attached to the frame and deployable after launching from a collapsed configuration to an open configuration in which the one or more panels are supported by the support frame and biasing means operative upon or after launching of the target to bias the frame from its collapsed configuration to its extended configuration.

Preferably, the support frame comprises a plurality of arms which are movable between collapsed dispositions in which they lie in proximity to each other in the collapsed configuration of the frame and extended dispositions in which they extend away from each other in

the extended configuration of the frame and in a preferred embodiment of the invention hereinafter to be described the arms are pivotal arms pivotally connected to the rear end of a mounting bar and pivotable from their extended dispositions in which they extend radially from the rear end of the bar to their collapsed dispositions in which they lie adjacent the mounting bar.

In the embodiment of the invention hereinafter to be described, the biasing means takes the form of a resilient ring mounted on the mounting bar and compressible by the pivotal arms when they are moved into their collapsed dispositions adjacent the mounting bar and the pivotal arms are releasably held in their collapsed dispositions prior to launching of the target and released after launching so that the arms are deployed to their extended dispositions under the biasing action of the ring.

The panels preferably comprise rear panels attached to the pivotal arms and arranged to take up a streaming configuration behind them when the target is deployed and the pivotal arms are in their extended dispositions. Preferably, each of the rear panels has a long side and a short side forming a right angle, the panels are connected along their short sides to the pivotal arms from which they take up the streaming configuration and the long sides of the panels which are adjacent each other are connected together over a part at least of their length.

In the preferred embodiment of the invention the panels include right triangular front panels connected to the

pivotal arms along one of their two sides forming the right angle and to the mounting bar along the other of their sides forming the right angle. The rear panels preferably then extend when deployed rearwardly of the pivotal arms by an amount greater than that by which the front panels extend forwardly of the pivotal arms, whereby the support frame takes up a forward disposition in the deployed target.

In the embodiment of the invention hereinafter to be described the target is an air-launchable towed aerial target stowable in its collapsed configuration in the towing aircraft and deployable into its open configuration after launching from a tow line.

Preferably, the target forms part of a target assembly which also includes a valise for housing the target in its collapsed configuration. The valise in the preferred embodiment of the invention serves to hold the target in its collapsed configuration against the biasing action of the resilient ring and is held closed by quick release ties which upon release after launching of the assembly from an aircraft allow the valise to open out and fall away from the target which then deploys under the action of the resilient ring.

The valise containing the target in its collapsed configuration is preferably connected at its forward end to a main tow line paid out from the towing aircraft when the target is launched and the main tow line is arranged when paid out to effect release the quick release ties on the valise. The main tow line is preferably connected at its paid out end to one end of an intermediate tow line

which is contained in the valise and which commences to pay out when the valise falls away and the target commences to deploy and the intermediate tow line is connected at its other end to a nose element of the target for towing the deployed target.

By arranging for very rapid deployment of the support frame upon launching of the target according to the invention, the load applied to the frame by the panels can with advantage be increased without leading to distortion of the frame. For example, the rear panels which take up a streaming configuration to the rear of the support frame may be made substantially larger than those provided in the target hitherto proposed. With considerably extended rear panels, the target according to the present invention may, if desired, exclude the provision of triangular front panels or may be provided with front panels less forwardly extended than those provided in the hitherto proposed target. Clearly, the target configuration then changes from one in which the frame is located generally to the rear of the target to one in which the frame is positioned generally to the front of the target.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Fig. 1 is a schematic perspective view of an air-launchable towed aerial target according to the invention;

Fig. 2 is a schematic side elevation of a collapsible support frame employed in the target illustrated in Fig. 1;

Fig. 3 is a schematic end view of the support frame shown in Fig. 2; and

Fig. 4 is a schematic perspective view of the target shown in Fig. 1 arranged in its collapsed configuration in a target valise following launching from an aircraft.

Referring first to Fig. 1, the target shown comprises a support frame 11 consisting of a mounting bar 12, a pivot block 13 rigidly attached to the rear end of the bar 12 and three pivotal arms 14, 15 and 16 which are pivotally mounted in the pivot block 13 and which are shown in Fig. 1 in extended dispositions in which they extend radially outwardly from the rear end of the mounting bar 12 in a plane at right angles to the axis of the mounting bar 12. The pivotal arms 14, 15 and 16 support right triangular front panels 17, 18 and 19 and rectangular rear panels 20, 21 and 22. The panels 17, 18 and 19 are of identical size and shape and each has a long side and a short side forming the right angle. The long sides of the three panels 17 to 19 are connected together and a sleeve is provided along their connection into which the mounting bar 12 is fitted. The short sides of the panels 17 to 19 are attached to the pivotal arms 14 to 16 as shown in Fig. 1. A target nose loop 23 is secured to the common apex of the front panels 17 to 19 for attachment of a tow line. The rectangular rear panels 20 to 22 are attached along their foremost short sides to the pivotal arms 14 to 16 so that when the target is deployed they take up a

streaming configuration to the rear of the frame 11 as shown in Fig. 1. The adjacent long sides of the rear panels 20 to 22 are connected together over an intermediate part 24 of their length but are free from each other in a region 25 immediately to the rear of the frame 11 and in a region 26 at the rear end of the target.

The pivotal arms 14, 15 and 16 are pivotally mounted on the pivot block 13 in a manner best illustrated in Fig. 3. The pivotal arm 14 is pivotally mounted between lugs 27 and 28 on a shouldered bolt 29 which passes through aligned bores in the lugs 27 and 28 and through a transverse bore in the arm 14 and which is held in place by a lock nut 30. The pivotal arms 15 and 16 are pivotally mounted between lugs of the pivot block 13 in the same manner as the pivotal arm 14. As best seen in Fig. 2, the mounting bar 12 extends forwardly from the pivot block 13 to which it is rigidly connected and carries a ring 31 of a highly resilient material. The ring 31 is fitted on to the bar 12 by passing it over the forward end of the bar and is held in the position shown in Fig. 2 by an interference fit with the bar 12. The ring 31 is shown in Fig. 2 compressed by the arms 14, 15 and 16 illustrated in Fig. 2.

Referring again to Fig. 2, the pivotal arm 16 is made from a rigid tube portion 32 closed at its forward end by a cap 33 and mounted at its rear end in a mounting block 34 fitted with a lug 35 by which the arm 16 is pivotally mounted in the pivot block 13. The pivotal arms 14 and 15 are constructed in the same manner as the arm 16. The mounting bar 12 likewise comprises a rigid

metal tube portion 36 closed at its forward end by a cap 37 and mounted at its rearward end in the pivot block 13. An aluminium alloy radar reflector 41 is secured to the rear of the pivot block 13 by a centrally located bolt (not shown) and held in position by an appropriately cut-away spacer tube 42.

In bringing the target from its open configuration as shown in Fig. 1 to its collapsed configuration for stowage, the pivotal arms 14 to 16 are pivoted forwardly to bring them to their collapsed dispositions adjacent the mounting bar 12 as shown in Figures 2 and 3. The pivotal arms 14 to 16 in moving to their collapsed dispositions engage the resilient ring 31 and a substantial force is required to compress the ring and bring the pivotal arms to their final collapsed dispositions adjacent the bar 12, where they are held together by a temporary tie. Each of the triangular front panels 17 to 19 is then pulled out to form a folded sheet. The rear panels 20 to 22 are next folded so as to bring the outer long side of each panel to the centre and then folded again in this way to reduce the panel width to one quarter of that of the original panel. The rear panels 20 to 22 as folded are then brought forward and flaked to and fro over the collapsed frame and the flaked material then rolled up round the collapsed frame.

The rolled up target is then bound in this disposition by temporary ties and the tie holding the pivotal arms 14 to 16 in their collapsed dispositions removed. The target thus folded up and bound is then placed in a quick release valise in which is also placed an intermediate tow line attached at its rear end to the towing loop 23

and projecting at its forward end from the valise. The valise is closed by quick-release ties and the temporary ties binding the rolled up target removed.

The valise containing the folded up target is housed in a launch container provided on the towing aircraft, with the forward end of the intermediate tow line secured to the end of a main tow line which is paid out from the aircraft when the target is launched.

Referring now to Fig. 4, the towing aircraft is positioned for air launching the target and the target in its valise 40 then ejected from its launch container 38 on the end of the main tow line 39 so that it takes up a trailing position behind the aircraft as shown in Fig. 4. When the main tow line 39 has been fully paid out the pull exerted by it is applied to quick-release cords on the valise which release the closure ties for the valise, whereupon the valise opens out and falls away from the collapsed target. Immediately the target becomes free from constraint by the valise, the biasing ring 31 becomes effective to force the pivotal arms 14 to 16 out into their extended dispositions and bring the triangular front panels 17, 18 and 19 into their open configuration. At this time the intermediate tow line commences to pay out and when fully paid out brings the target under tow by its connection to the target nose loop 23. The rear panels 20 to 22 also rapidly unfold and take up a streaming configuration behind the pivotal arms 14 to 16.

It has been found that by the use of biasing means for biasing the pivotal arms 14 to 16 to their extended dispositions immediately upon release of the folded target into the airstream prevents assymmetrical loading on the arms. The rear panels 20 to 22 can therefore be of considerable size without giving rise to distortion of the frame 11 and by virtue of their size can present a better visual image for use in practice air combat. The increased panel size furthermore provides for better assessment of hits produced in practice. Furthermore, the target may readily be released from the towing aircraft following a practice session and recovered on the ground for subsequent use, without the need for replacement or repair of the frame.

CLAIMS

1. A target launchable in a collapsed configuration and deployable after launching into an open configuration comprising a support frame (11) movable upon or after launching of the target from a collapsed configuration to an extended configuration and one or more panels (17 - 22) of a flexible material attached to the frame (11) and deployable after launching from a collapsed configuration to an open configuration in which the one or more panels (20,21,22) are supported by the support frame (11) characterised by the provision of biasing means (31) operative upon or after launching of the target to bias the frame (11) from its collapsed configuration to its extended configuration.

2. A target according to claim 1 wherein the support frame (11) comprises a plurality of pivotal arms (14,15,16) pivotally connected to the rear end of a mounting bar (12) and pivotable from extended dispositions in which they extend radially from the rear end of the bar (12) in the extended configuration of the support frame (11) to collapsed dispositions in which they lie adjacent the mounting bar (12) in the collapsed configuration of the support frame (11), characterised by the fact that the biasing means takes the form of a resilient ring (31) mounted on the mounting bar (12) and compressible by the pivotal arms (14,15,16) when they are moved into their collapsed dispositions adjacent the mounting bar (12) and that the pivotal arms (14,15,16) are releasably held in their collapsed dispositions prior to launching of the target and released after

launching so that the arms (14,15,16) are deployed to their extended dispositions under the biasing action of the ring (31).

3. A target according to claim 2, characterised by the fact that the panels (17 - 22) comprise rear panels (20,21,22) attached to the pivotal arms (14,15,16) and arranged to take up a streaming configuration behind them when the target is deployed and the pivotal arms (14,15,16) are in their extended dispositions.

4. A target according to claim 3 wherein the panels (17 - 22) include right triangular front panels (17,18,19) connected to the pivotal arms (14,15,16) along one of their two sides forming a right angle and to the mounting bar (12) along the other of their sides forming the right angle, wherein each of the rear panels (20,21,22) has a long side and a short side forming a right angle and wherein the rear panels (20,21,22) are connected along their short sides to the pivotal arms (14,15,16) from which they take up the streaming configuration, characterised by the fact that the rear panels (20,21,22) extend when deployed rearwardly of the pivotal arms (14,15,16) by an amount greater than that by which the front panels (17,18,19) extend forwardly of the pivotal arms (14,15,16), whereby the support frame (11) takes up a forward disposition in the deployed target.

5. A target according to claim 3 or 4, characterised by the fact that the long sides of the rear panels (20,21,22) which are adjacent each other are

connected together over a part at least of their length.

6. A target according to any of the preceding claims, characterised by the fact that the target is an air-launchable towed aerial target stowable in its collapsed configuration in the towing aircraft and deployable into its open configuration after launching from a tow line (39).

7. A target assembly characterised by the fact that it includes a target according to any of claims 2 to 6 and a valise (40) for housing the target in its collapsed configuration, that the valise (40) serves to hold the target in its collapsed configuration against the biasing action of the resilient ring (31) and that the valise is held closed by quick release ties which upon release after launching of the assembly from an aircraft allow the valise (40) to open out and fall away from the target which then deploys under the action of the resilient ring (31).

8. A target assembly according to claim 7, characterised by the fact that the valise (40) containing the target in its collapsed configuration is connected at its forward end to a main tow line (39) paid out from the towing aircraft when the target is launched and that the main tow line is arranged when paid out to effect release of the quick release ties on the valise (40).

9. A target assembly according to claim 8, characterised by the fact that the main tow line (39) is connected at its paid out end to one end of an

intermediate tow line which is contained in the valise (40) and which commences to pay out when the valise (40) falls away and the target commences to deploy and that the intermediate tow line is connected at its other end to a nose element (23) of the target for towing the deployed target.

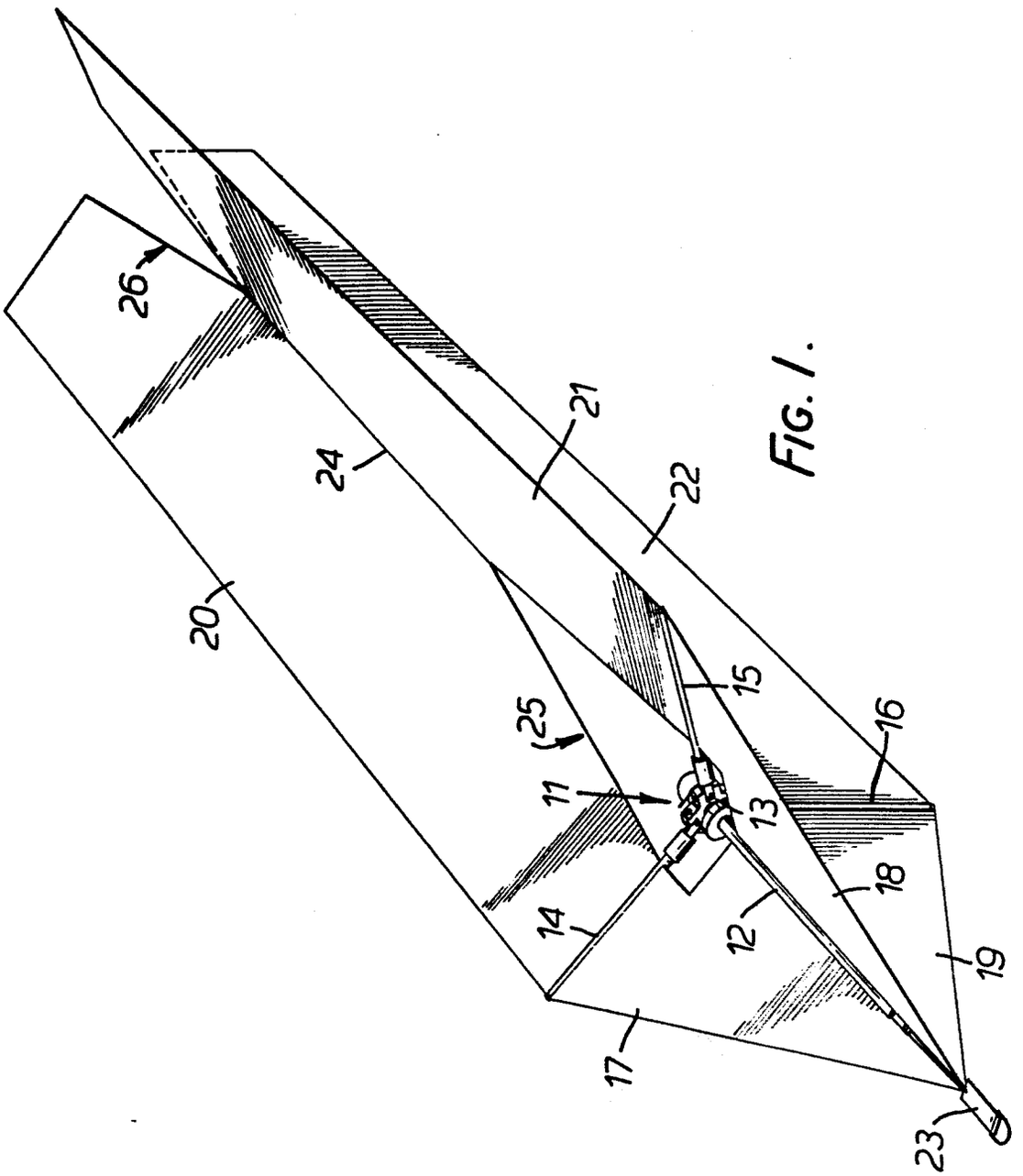

FIG. 1.

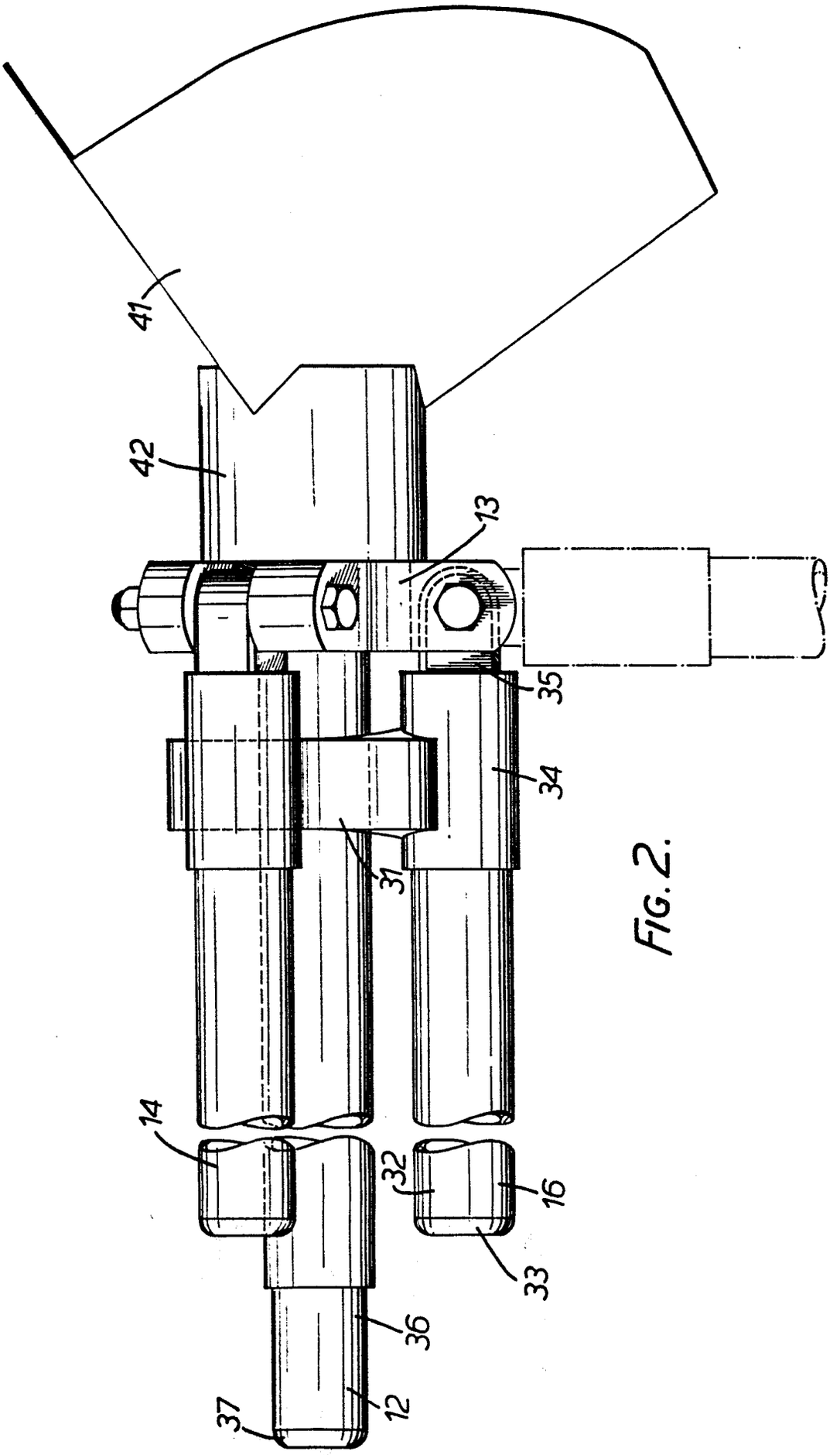

FIG. 2.

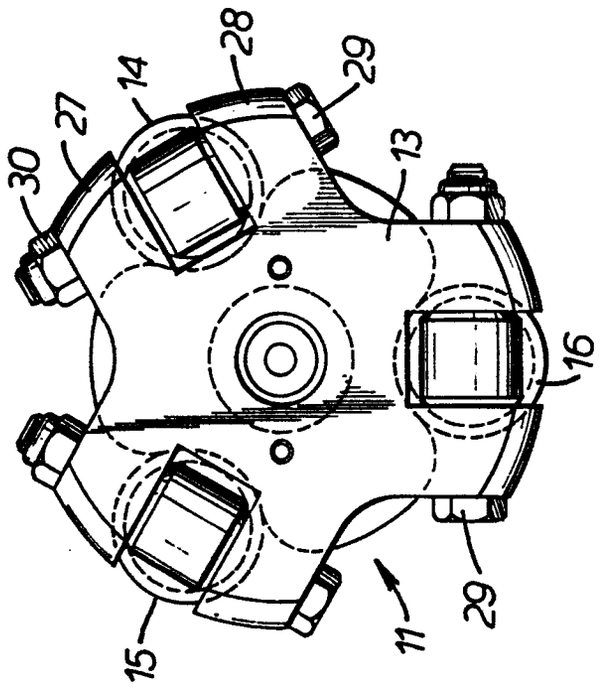

FIG. 3.

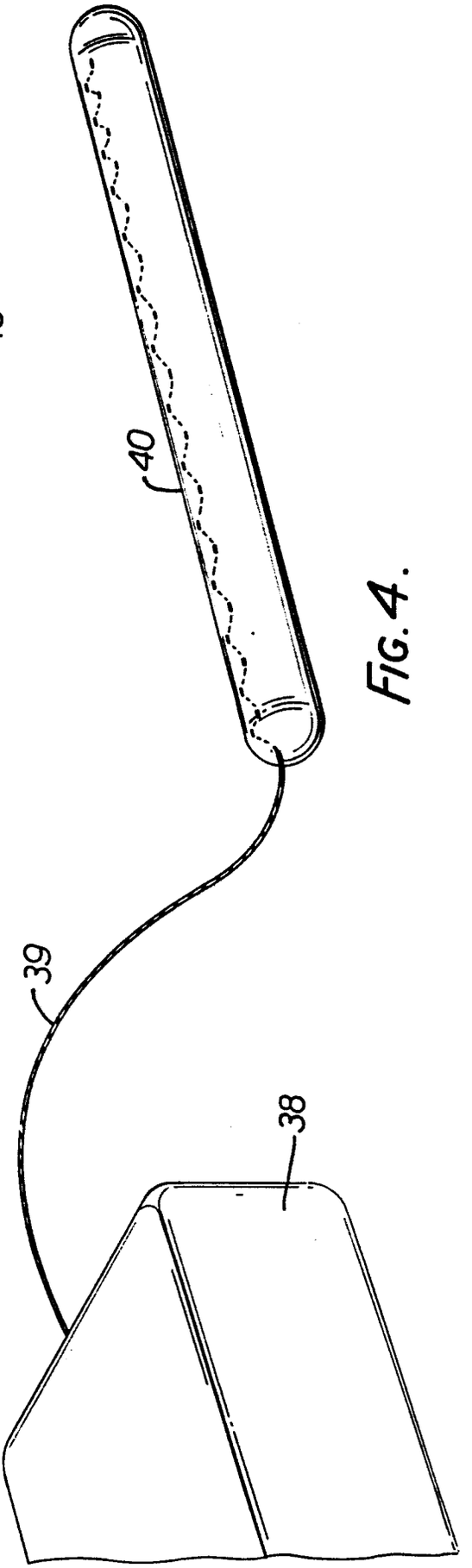

FIG. 4.