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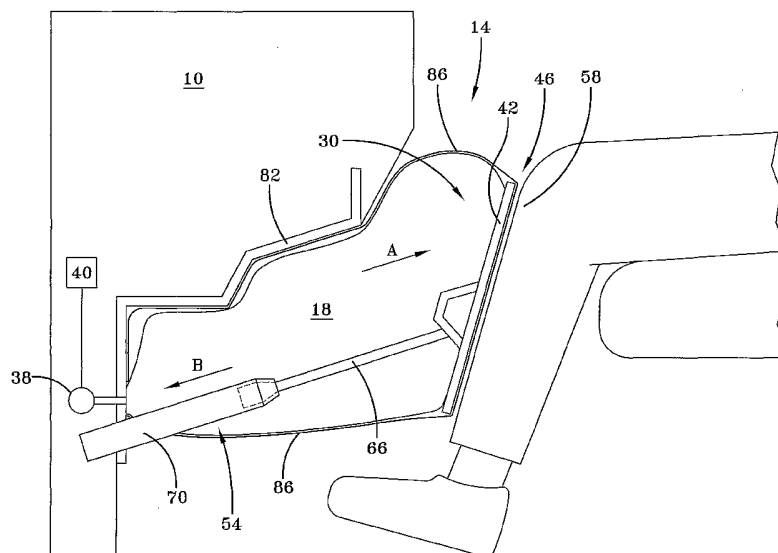
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[Continued on next page]

(54) Title: UPWARD DEPLOYING INFLATABLE KNEE BOLSTER WITH MECHANICAL GUIDES



(57) Abstract: A knee bolster (14) for a vehicle has an airbag (18) and an airbag inflator (38). The airbag (18) has an inflated condition (30) and a condition (34) when the airbag (18) has not yet been deployed. The airbag (18) is attached to the knee bolster (14), which is moveable with the airbag (18). The knee bolster (14) may move from an unactuated position when the airbag (18) is in the condition (34) where the airbag (18) has not yet been deployed to an actuated position when the airbag (18) is inflated. A guide structure (54), which is attached to the knee bolster (14) directs the bolster along a linear path from the unactuated position to the actuated position.



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UPWARD DEPLOYING INFLATABLE KNEE BOLSTER WITH MECHANICAL GUIDES

This invention relates to a knee bolster for a vehicle.

In a vehicle crash, the knee of a vehicle occupant is frequently susceptible to injury. A significant number of knee injuries result from impact forces on the leg that cause the lower leg (tibia) to travel in a direction opposite to the path of the upper leg (femur). As a result, the tibia shears relative to the femur, causing ligaments and tendons in the knee to tear.

Existing knee bolsters fail to address this shearing effect. For example, one such design merely deploys an airbag in the vicinity of the knee of the occupant. Such an airbag does not prevent movement of the knee relative to the tibia because the deploying airbag contacts both the knee and the tibia.

An alternative knee bolster design uses a mechanical carriage to direct a padded cushion toward the knee of the vehicle occupant. This design advances the padded cushion through a telescoping support. The telescoping support expands through either a spring or a pyrotechnic force within the telescoping support. This alternative design does not offer the benefits of cushioning a vehicle impact with an airbag.

A need therefore exists for a knee bolster that uses an airbag to stop movement of the femur relative to the tibia.

The present invention uses an airbag to advance a knee bolster toward an anticipated location of a knee of a vehicle occupant. The airbag is inflated by an airbag inflator. The inventive knee bolster uses a guide structure attached to the bolster to direct the bolster along a generally linear path toward the knee. In this way, the bolster may focus its cushioning effect on the knee rather than on both the knee and the tibia while still providing the cushioning effect from an airbag.

The guide structure may comprise a first member and a second member. The first member may extend from an unactuated position, when the airbag has not yet been deployed, to an actuated position, when the

airbag is inflated, along a linear path relative to the second member. The first member may be disposed within the second member and comprise a guide pin disposed within a guide tube. The guide pin may have a tapered surface to be received by another tapered surface of the guide tube.

The knee bolster may have an airbag housing to store the airbag when the airbag has not yet been deployed. The airbag may have a rear and a front area. The rear area is located closer to the airbag housing than the front area when the airbag is inflated. The knee bolster may be located at the front area of the airbag. A tether may attach the airbag to the knee bolster. Moreover, the knee bolster may be cushioned.

The guide structure may expand and retract between the actuated position and the unactuated position so that the airbag may be allowed to deflate once the vehicle occupant has contacted the knee bolster. Moreover, by placing the knee bolster at the front area of the airbag, the knee bolster may advance quickly and directly to the anticipated location of the knee. The vehicle occupant will also have the benefit of the full cushioning effect of the airbag at this location. In this way, the knee bolster may move with the knee of the vehicle occupant to collapse the airbag from front to rear for a full cushioning.

The airbag is thus inflated. Because the knee bolster is attached to the airbag, the knee bolster advances with the airbag. The knee bolster may be directed along a linear path to the anticipated location of a knee.

Figure 1 is a side view of the inventive knee bolster with an airbag in an inflated condition.

Figure 2 is a side view of the knee bolster when the airbag has not yet been deployed.

Figure 3 is an exploded view of the knee bolster of Figures 1 and 2.

Figure 4 illustrates the guide pin disposed within the guide tube in an unactuated position.

Figure 5 illustrates the guide pin extended from the guide tube in an actuated position.

Figure 1 is a side view of inventive knee bolster 14. The inventive knee bolster 14 is located within vehicle 10, preferably under a vehicle instrument panel as shown. In Figure 1, knee bolster 14 is shown with airbag 18 in inflated condition 30 while, in Figure 2, airbag 18 has not yet been deployed.

An inventive knee bolster 14 comprises an airbag 18, an airbag inflator 38, a knee contact plate 42, and a guide structure 54. In contrast to existing knee bolster designs, the inventive knee bolster 14 uses a guide structure 54 to direct a knee contact plate 42 along a linear path A to an anticipated location of a knee of a vehicle occupant 58.

The operation of the inventive knee bolster 14 will now be explained. Figure 2 illustrates the knee bolster 14 with the airbag 18 in a condition 34 when the airbag has not yet been deployed and a knee contact plate 42 in an unactuated position 50. As shown, the airbag 18 has rear area 22 and a front area 26. The contact plate 42 is located at the front area 26 of the airbag 18 while the airbag housing 82 is located near the rear area 22 of the airbag 18. The airbag 18 is further in communication with an airbag inflator 38. In the event of a vehicle crash, a crash detection system 40 may instruct the airbag inflator 38 to inflate the airbag 18. The airbag 18 is attached to a knee contact plate 42 through tethers 86, which wrap around the airbag 18 and the knee contact plate 42. The knee contact plate 42 may be cushioned. When the airbag 18 expands from a condition 34 when it has not yet been deployed (see Figure 2) to an inflated condition 30 (see Figure 1), the knee contact plate 42 moves from the unactuated position 50 along a linear path A to an actuated position 46, an anticipated location of a knee of the vehicle occupant. When the knee of the vehicle occupant contacts the knee contact plate 42, the airbag 18 as well as knee contact plate 42 collapses in the direction of arrow B to thereby cushion any vehicle impact.

Figure 3 is an exploded view of the inventive knee bolster 14. As shown in Figure 3, the knee contact plate 42 is located at the front area 26 of the airbag 18. The rear area 22 of the airbag 18 is located near an airbag

housing 82. A guide structure 54 comprises a first member 66, here a guide pin, and a second member 70, here a guide tube.

As shown in Figures 4 and 5, the first member 66 is disposed within a second member 70. The first member 66 has first tapered surface 74 while the second member 70 has a tapered surface 78. In Figure 4, with the first member 66 at an unactuated position 50, the first tapered surface 74 is spaced away from the second tapered surface 78. However, in Figure 5, when the guide structure 54 is in an actuated position 46, the first tapered surface 74 is in contact with the second tapered surface 78 to smoothly retain the first member 66 within the second member 70. In this way, the force of actuation by airbag 18 may be distributed across the tapered surfaces 74, 78 rather than abruptly stopped.

CLAIMS

1. A knee bolster assembly (14) for a vehicle comprising:
an airbag (18) having an inflated condition (30) and a condition (34) when the airbag (18) has not yet been deployed;
an airbag inflator (38) in communication with the airbag (18) for filling the airbag (18) to the inflated condition (30);
a knee contact plate (42) movable with the airbag (18), the knee contact plate (42) having an actuated position with the airbag (18) in the inflated condition (30) and an unactuated position with the airbag (18) in the condition (34) when the airbag (18) has not yet been deployed; and
a guide structure (54) attached to the knee contact plate (42), the guide structure (54) for directing the knee contact plate (42) along a generally linear path from the unactuated position to the actuated position.
2. A knee bolster assembly (14) as described in Claim 1 wherein the guide structure (54) directs the knee contact plate (42) to an anticipated location of a knee of a vehicle occupant.
3. A knee bolster assembly (14) as described in either Claim 1 or 2 wherein the guide structure (54) comprises a first member (66) and a second member (70), the first member (66) extendable from the unactuated position to the actuated position along the generally linear path relative to the second member (70).
4. A knee bolster assembly (14) as described in Claim 3 wherein the first member (66) is disposed within the second member (70).
5. A knee bolster assembly (14) as described in Claim 4 wherein the first member (66) comprises a guide pin and the second member (70) comprises a guide tube.

6. A knee bolster assembly (14) as described in Claim 5 wherein the guide pin (66) has a first tapered surface (74) and the guide tube (70) has a second tapered surface (78), the first tapered surface (74) mating with the second tapered surface (78) in the actuated position.

7. A knee bolster assembly (14) as described in Claim 1 or 2 including an airbag housing (82) for storing the airbag (18) in position when the airbag (18) has not yet been deployed.

8. A knee bolster assembly (14) as described in Claim 7 wherein the airbag (18) has a rear area (22) and a front area (26), the rear area (22) disposed closer to an airbag housing (82) than the front area (26) in the inflated condition (30) and wherein the knee contact plate (42) is disposed at the front area.

9. A knee bolster assembly (14) as described in Claim 1 or 2 including a tether (86) attaching the airbag (18) to the knee contact plate (42), with the knee contact plate (42) comprising a cushion.

10. A knee bolster assembly (14) as described in Claim 1 or 2 wherein the guide structure (54) is expandable and retractable between the actuated position and the unactuated position.

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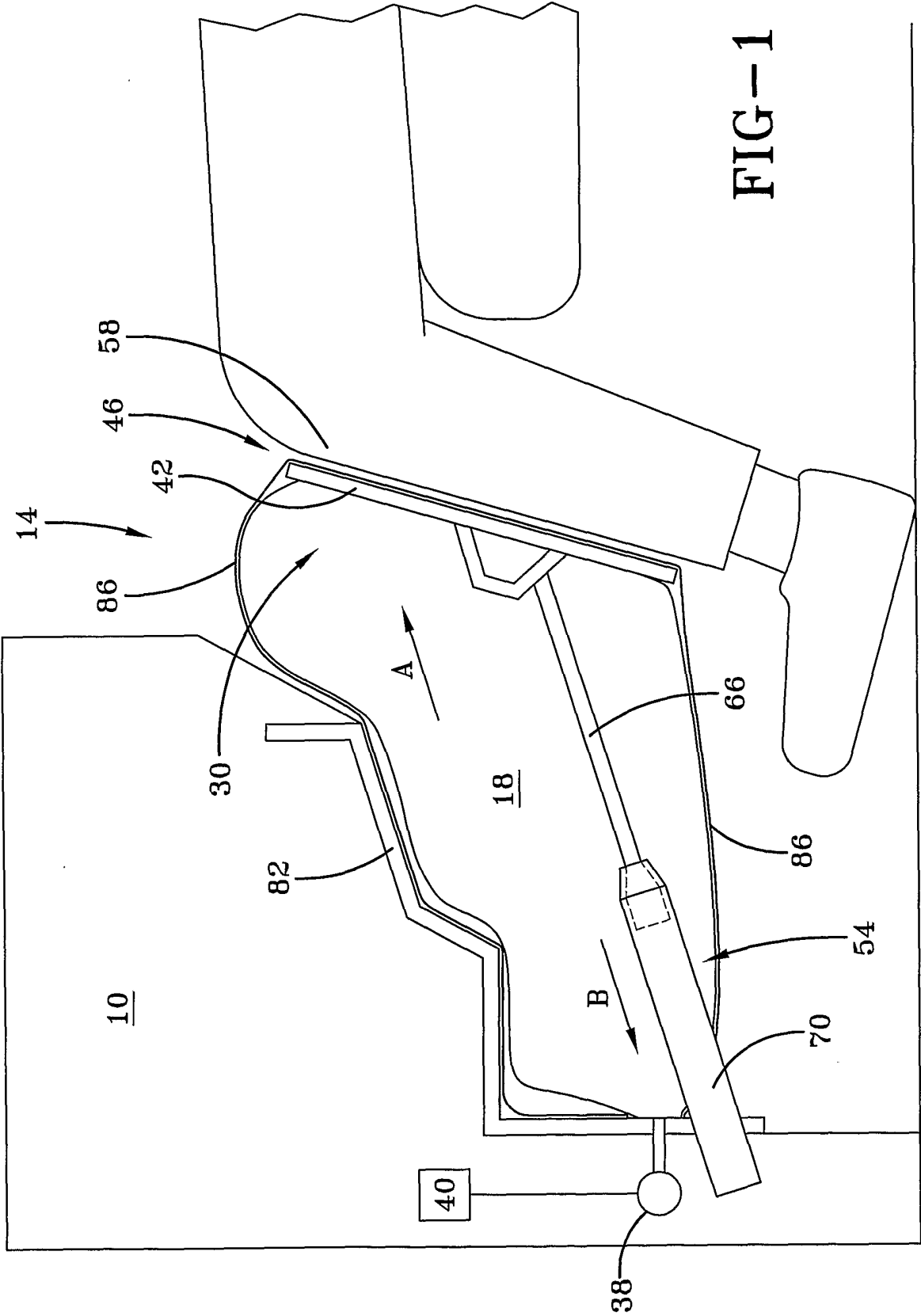


FIG-1

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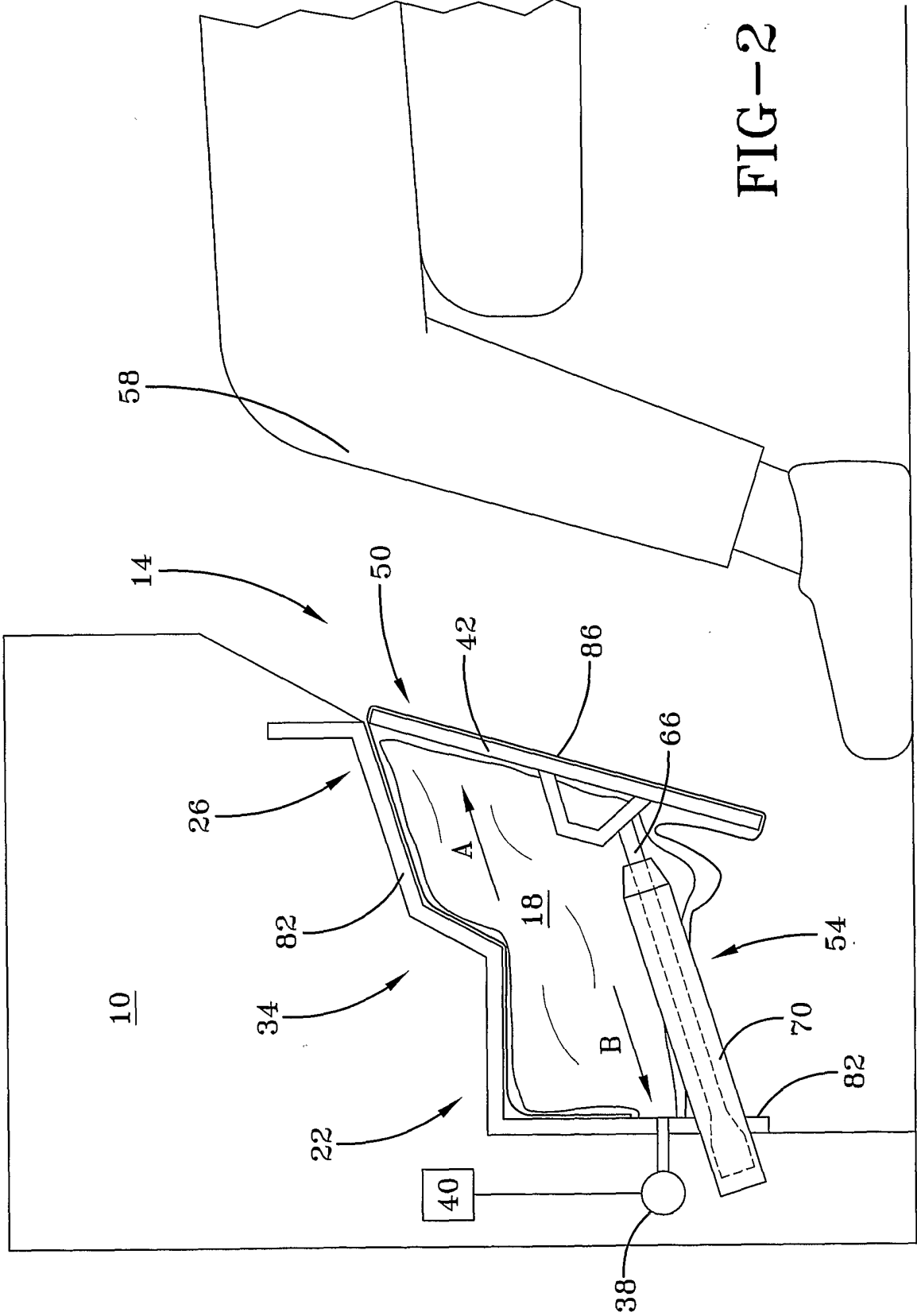


FIG-2

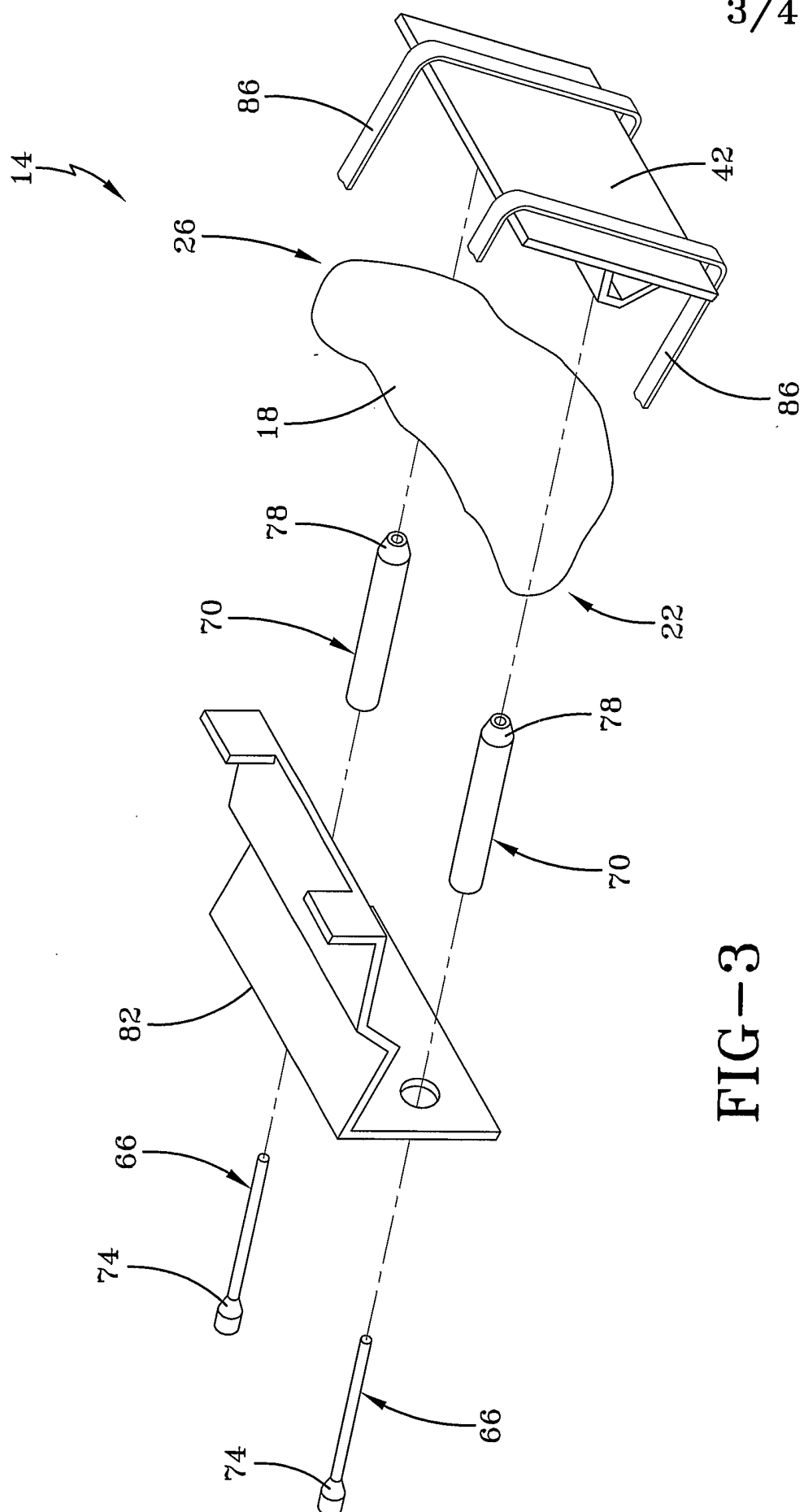


FIG-3

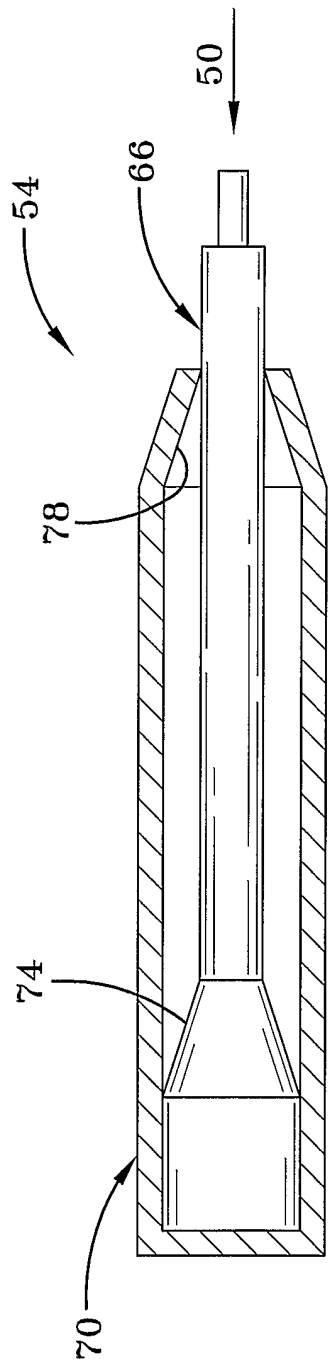


FIG-4

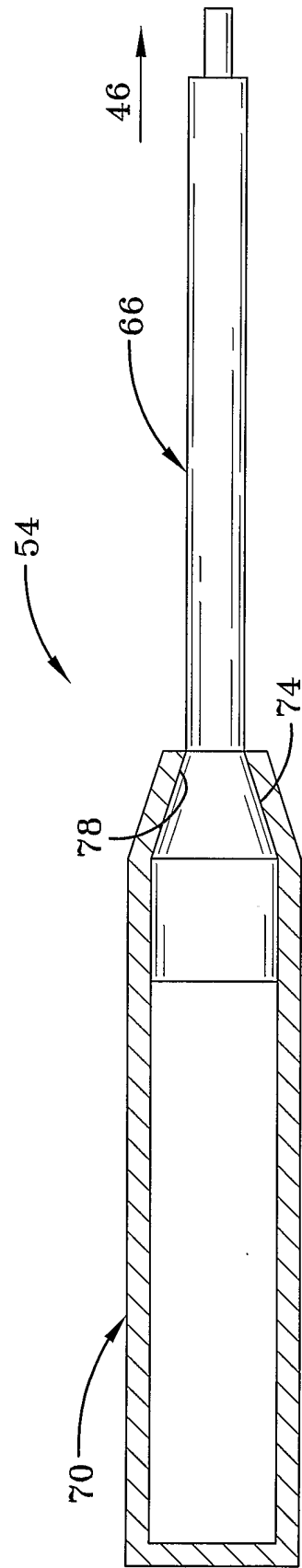


FIG-5