(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

PCT

(43) International Publication Date
22 March 2007 (22.03.2007)

(10) International Publication Number
WO 2007/031967 A2

(51) **International Patent Classification:** **Not classified**

(21) **International Application Number:**
PCT/IB2006/053315

(22) **International Filing Date:**
15 September 2006 (15.09.2006)

(25) **Filing Language:** Italian

(26) **Publication Language:** English

(30) **Priority Data:**
TO2005U000137
16 September 2005 (16.09.2005) IT

(71) **Applicant** *(for all designated States except US):* **FIORAVANTI S.r.l.** [IT/IT]; Via Avogadro 12/a, 1-10121 Torino (IT).

(72) **Inventor; and**
(75) **Inventor/Applicant** *(for US only):* **FIORAVANTI, Leonardo** [IT/IT]; Strada S. Brigida 68, 1-10024 Moncalieri (IT).

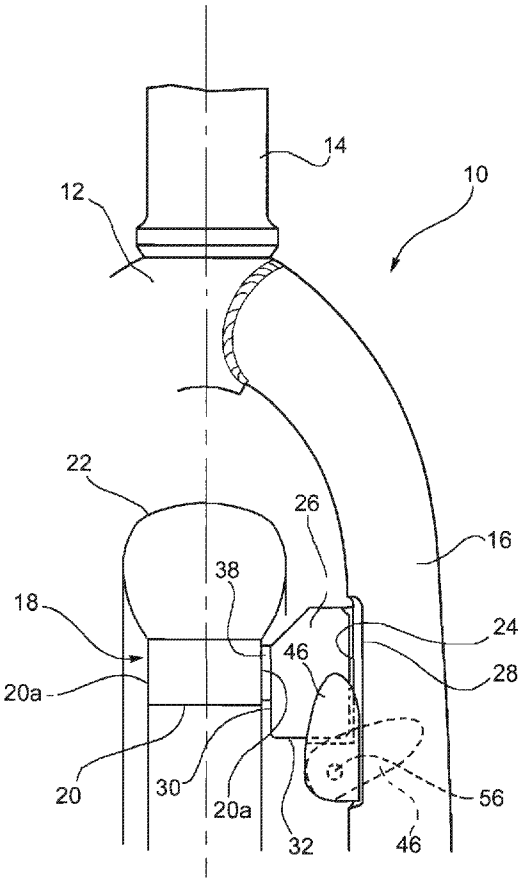
(74) **Agents: RONDANO, Davide** et al; c/o Jacobacci & Partners S.p.A., Corso Emilia 8, 1-10152 Torino **(IT).**

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, **BR,** BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, **HR,** HU, **ID,** IL, IN, IS, **JP,** KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, **DK,** EE, ES, FI,

[Continued on next page]

(54) Title: BICYCLE FORK WITH INTEGRATED HYDRAULIC BRAKE



(57) Abstract: The fork (10) comprises a pair of legs (16) adapted to support for rotation a wheel (18) and a hydraulic braking device including a pair of hydraulic braking actuators (26) , each of which is mounted on a respective leg (16) and is provided with a friction member (38) . Each braking actuator (26) is arranged to press the respective friction member (38) against a braking surface (20a) of the wheel (18) so as to exert a braking force. According to the invention, each leg (16) has, on the side facing the wheel (18) , a side abutment surface (24), a lower support surface (50) and a front stop surface (52), and each hydraulic actuator (26) has an outer side face (28) arranged against the side abutment surface (24), a lower face (32) resting on the lower support surface (50), a front face (34) retained longitudinally by the front stop surface (52) and an inner side face (30) on which the friction member (38) is mounted.

WO 2007/031967 A2

FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))*

— *of inventorship (Rule 4.17(iv))*

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Bicycle fork with integrated hydraulic brake

The present invention refers to a bicycle fork with integrated hydraulic brake, as specified in the preamble of claim 1.

A bicycle front fork of the above-indicated type is known from International Patent Application WO9013470. According to this known solution, the fork is provided with a hydraulic brake comprising a piston and cylinder unit, wherein the cylinder is fixed within a transverse through hole provided in one of the fork legs and the piston is slidably arranged in the cylinder and is controlled by a brake lever on the handlebar through a hydraulic connection line which runs within the handlebar and the steer tube of the fork and comes out through the outer side of the fork head. The piston and cylinder unit is mounted in an upper end portion of the leg, substantially at the same height as the sidewalls of the wheel rim. The hydraulic piston is provided, on its transversely inner side, that is, on the side facing the sidewall of the rim, with a friction member which is pressed against the sidewall of the rim upon operation of the brake by the user to apply the required braking force.

The idea of providing a hydraulic brake arranged to apply the braking force directly on the sidewalls of the rim offers a number of advantages with respect to a conventional hydraulic disc brake, in which the brake calipers act on a brake disc fixed to the wheel hub. First of all, it makes it possible to obtain a stronger braking action for the same clamping force applied, as the clamping force is applied with a longer lever arm. Moreover, the braking action is balanced since it is exerted on the sidewalls of the wheel rim and hence on symmet-

ric surfaces with respect to the plane of the wheel, instead of being exerted on a disc located outwardly of the plane of the wheel. A further advantage is represented by the reduction in the overall size with respect to a conventional hydraulic disc brake, owing in particular to the elimination of the disc.

The solution known from the above-mentioned patent application has however the drawback that it requires to make through holes of large diameter in the fork legs. This results in a reduction in the mechanical strength of the fork, which is even more serious as these holes are provided in the most stressed area of the legs. Moreover, according to this known solution the wheel-side end section of the hydraulic connection line comes out through the outer side of the fork, thus worsening the aesthetic appearance of this latter.

It is therefore the object of the present invention to provide a bicycle fork with integrated hydraulic brake, which is not affected by the above-discussed drawbacks of the prior art.

This object is fully achieved according to the invention by virtue of a fork having the characteristics set forth in the characterizing portion of claim 1.

The characteristics and the advantages of the present invention will appear from the detailed description which follows, given purely by way of non-limiting example with reference to the appended drawings, in which:

Figure 1 shows a front elevation view of a bicycle front fork according to a preferred embodiment of the invention;

Figure 2 shows a side elevation view of the fork of Fig-

ure 1;

Figure 3 shows a view from below of the fork of Figure 1, sectioned along line 3-3 of Figure 2; and

Figure 4 shows a detailed perspective view of a braking hydraulic actuator of the fork of Figure 1.

In the following description and claims, terms such as "longitudinal" and "transverse", "inner" and "outer", "front" and "rear", "horizontal" and "vertical" are to be intended as referred to the mounted condition of the fork on a bicycle.

With reference to the figures, a bicycle fork according to the invention, in this case a front fork, is generally indicated 10. The fork 10 comprises in per-se-known manner a head 12, a steer tube 14 extending upwards from the head 12 to be inserted into a head tube (not shown) of the bicycle frame, and a pair of legs 16 (only one of which is illustrated in the figures, the other leg being identical to the illustrated one) which are joined at their upper ends to the head 14 and may be formed integrally with this latter. The hub (not shown) of a bicycle wheel 18 is mounted at the lower ends of the legs (also not shown). The wheel 18 includes in per-se-known manner a rim 20 and a tyre 22 mounted on the rim 20. The rim 20 has a pair of sidewalls which are substantially vertical or slightly inclined so as to converge towards the centre of the wheel 18 and have each a braking surface 20a.

As can be seen in particular from Figures 1 and 3, a substantially flat abutment surface 24, arranged in a plane essentially vertical or at least essentially parallel to the associated braking surface 20a of the rim 20, is provided on the inner side of each leg 16. Preferably, the abutment surface 24 is directly formed by the leg 16. Each flat abutment sur-

face 24 is arranged at such a height that it faces the associated braking surface 20a and is preferably, though not necessarily, inclined by an angle α (Figure 3) with respect to a vertical plane π parallel to the middle plane of the wheel, that is, to the plane of symmetry of the fork, so as to converge forward, that is, in the driving direction of the bicycle. The angle α, the function of which will be explained in the following part of the description, is preferably comprised between 0° and 5°, for example equal to 3°.

A pair of hydraulic actuators 26, forming the operating members of the hydraulic brake, are each mounted against a respective abutment surface 24. The hydraulic actuators 26 as such are well-known components to the skilled man in the art and will not therefore be described in detail, if not as far those parts which are essential for understanding the invention are concerned.

Each hydraulic actuator 26 is made as a generally parallelepiped body having a pair of outer and inner longitudinal vertical flat faces 28 and 30, respectively, a lower horizontal flat face 32 and a pair of front and rear transverse vertical flat faces 34 and 36, respectively. A friction member 38 of per-se-known type, adapted to be pressed against the associated braking surface 20a of the rim 20 upon operation of the brake, is mounted on the inner vertical face 30 of each hydraulic actuator 26.

A pair of support structures 40, which in the embodiment illustrated in the drawings are made as separate components from the legs 16, but which could alternatively be formed integrally with the legs themselves, are also provided in order

to support vertically and retain longitudinally the hydraulic actuators 26.

Each support structure 40 comprises a lower support element 42 and a pair of front and rear vertical stop elements 44 and 46, respectively. In the illustrated embodiment, the lower support element 42 and the front vertical stop element 44 form a single L-shaped component which is fixed to the leg 16, preferably in a releasable manner, for example by means of screws 48, whereas the rear vertical stop element 46 is joined to the end of the lower support element 42 on the opposite side to the front vertical stop element 44.

The lower support element 42 of each support structure 40 forms a substantially horizontal flat abutment surface 50, on which the respective hydraulic actuator 26 rests with its lower horizontal flat face 32. The vertical stop elements 44 and 46 form in their turn respective vertical stop surfaces 52 and 54 against which the transverse vertical flat faces 34 and 36 of the respective hydraulic actuator 26 are retained longitudinally .

Each hydraulic actuator 26 rests therefore at its bottom on the abutment surface 50 of the support structure 40 and on its outer side against the abutment surface 24 of the respective leg 16 and is also retained longitudinally, though with a certain freedom of movement (as shown in particular in Figures 2 and 3 by the gap between the corresponding pairs of front 34, 52 and rear 36, 54 stop surfaces), by the stop surfaces 52 and 54 of the support structure 40.

In order to retain each hydraulic actuator 26 in the transversely inner direction, a straight-guide coupling (not il-

lustrated) between the actuator 26 and the lower support element 42 can be provided, which is formed for instance by a longitudinal groove made approximately in the centre of the lower flat face 32 of the actuator 26 and by a corresponding guide projection which is provided on the abutment surface 50 of the lower support element 42 and engages in the above-mentioned longitudinal groove. The use of such a kind of coupling between the hydraulic actuator 26 and the support structure 40 makes it possible advantageously to guide the longitudinal forward movement of the actuator when the friction member 38 is pressed against the braking surface 20a of the rim 20 upon operation of the brake and tends therefore to be drawn forward by this latter. Alternatively, a guide edge projecting upwards and extending along the transversely inner side of the abutment surface 50 can be provided instead of a straight-guide coupling.

Advantageously, the rear vertical stop element 46 is rotatably mounted about a longitudinal axis defined by a pin 56, in such a manner that it can be moved between a vertical position (illustrated with solid line in Figure 1), in which it performs its function of rear stop for the hydraulic actuator 26, and a horizontal or inclined position (illustrated with dotted line in Figure 1), in which it allows the hydraulic actuator 26 to be withdrawn rearwards from the support structure 40. This further feature makes it possible easily to remove the actuator 26 to perform servicing operations.

As previously mentioned, the abutment surfaces 24 are preferably formed directly by the legs 16. Alternatively, each abutment surface 24 could be formed by a further portion of the respective support structure 40 or by a further support element separate therefrom and interposed between the respec-

tive leg 16 and the respective hydraulic actuator 26. Moreover, the abutment surfaces 24 are preferably inclined relative to a longitudinal vertical plane so as to converge forward. This makes it possible to obtain an advantageous self-clamping effect of the friction members 38 on the rim 20, which allows to increase the braking action for the same pressing forced applied on the friction members 38. In fact, when the friction members 38 are brought into contact with the braking surface 20a of the rim 20 upon operation of the brake, they tend to be drawn forward by the rim itself, as already mentioned before. Due to the inclination of the abutment surfaces 24, the forward longitudinal movement of the friction members 38 results in a transverse movement of the friction members 38 towards the braking surfaces 20a of the rim 20, and therefore in an increase in the effective braking force applied.

Finally, as far as the brake operating system is concerned, it is not illustrated in the drawings since it is of per-se-known type. What needs to be said in order to implement the invention is that the operating system comprises a control hydraulic actuator associated to a brake lever mounted on the handlebar and a pair of hydraulic connection lines which connect the control hydraulic actuator to the two braking hydraulic actuators 26. For aesthetical reasons, the hydraulic connection lines runs for all their length within the handlebar and the fork.

Alternatively, the brake-side end sections of the connection lines can project from the head of the fork or from the upper ends of the legs towards the inner side of the fork. Even though this second solution is aesthetically worse than the first one, it does not affect too much the appearance of the

fork, since the connection lines are not very visible or not visible at all from the outside, in particular in the side view. In this case, in order better to hide the hydraulic connection lines, these latter can be at least partially housed in corresponding groves formed on the inner side of the legs .

As will appear in the light of the foregoing description, by virtue of the fact that the hydraulic actuator is no more inserted in a hole provided in the fork leg of the, but is simply arranged against a surface of the leg itself, a fork provided with a hydraulic brake according to the invention ensures substantially the same mechanical strength as a fork of similar shape but without a hydraulic brake. Moreover, by virtue of the fact that the hydraulic actuator is all arranged on the inner side of the fork, the hydraulic connection lines can run wholly within the fork, or at most with their brake-side end section projecting inwards from the head of the fork, and the aesthetical appearance of the fork is hence not affected.

Naturally, the principle of the invention remaining unchanged, the embodiments and details of construction could vary widely with respect to those described and illustrated purely by way of non-limiting example.

For example, although the invention has been described and illustrated with reference to an embodiment relating to a front fork, it can clearly be applied to a rear fork as well. In this case, the abutment surfaces against which the two braking hydraulic actuators have to be mounted will be provided on the inner sides of the seatstays of the frame.

CLAIMS

1. Bicycle fork (10) comprising

a pair of legs (16) adapted to support for rotation a bicycle wheel (18), and

a hydraulic braking device including a pair of hydraulic braking actuators (26), each of which is mounted on a respective leg (16) and is provided with a friction member (38), wherein each braking actuator (26) is operable to press the respective friction member (38) against a respective braking surface (20a) of a rim (20) of the wheel (18);

characterized in that

each leg (16) has, on the side facing the wheel (18), a first side abutment surface (24), a first lower support surface (50) and a third front stop surface (52), and in that

each braking actuator (26) has a first outer side face (28) arranged against said first side abutment surface (24), a second lower face (32) resting on said second lower support surface (50) and a third front face (34) longitudinally retained in the driving direction by said third front stop surface (52), and a fourth inner side face (30) on which the friction member (38) is mounted.

2. Bicycle fork according to claim 1, wherein said first surface (24) is directly formed by the leg (16).

3. Bicycle fork according to claim 1 or claim 2, wherein said second surface (50) is directly formed by the leg (16).

4. Bicycle fork according to claim 1 or claim 2, further comprising a pair of support structures (40) separate from the legs (16) and fixed each to a respective leg (16), wherein each support structure (40) forms said second and

third surfaces (50, 52).

5. Bicycle fork according to claim 4, wherein each support structure (40) forms also a fourth rear stop surface (54) and wherein each braking actuator (26) has also a fifth rear face (36) longitudinally retained in the opposite direction to the driving one by said fourth rear stop surface (54).

6. Bicycle fork according to claim 4 or claim 5, wherein each support structure (40) comprises a L-shaped component formed by a lower support element (42) having said second surface (24) and by a first front vertical stop element (44) having said third surface (52).

7. Bicycle fork according to claim 6 when depending on claim 5, wherein each support structure (40) further comprises a second rear vertical stop element (46) joined to the L-shaped component (42, 44) on the opposite side to the first element (44) and having said fourth surface (54).

8. Bicycle fork according to any of claims 4 to 7, wherein each support structure (40) is releasably (48) fixed to the respective leg (16).

9. Bicycle fork according to claim 7 or claim 8, wherein said second element (46) is rotatably mounted about a longitudinal axis (56) with respect to the L-shaped component (42, 44), in such a manner that it can be moved between a first position in which said fourth surface (54) of the support structure (40) retains longitudinally the respective braking actuator (26), and a second position in which said fourth surface (54) allows the longitudinal movement of the respective braking actuator (26) in the opposite direction to the

driving one .

10. Bicycle fork according to any of the preceding claims, wherein each first surface (24) is arranged at such a height that it faces the associated braking surface (20a) when the wheel (18) is mounted on the fork.

11. Bicycle fork according to any of the preceding claims, wherein each first surface (24) is inclined (oc) to a vertical plane of symmetry of the fork so as to converge in the driving direction.

12. Bicycle fork according to any of the preceding claims, wherein said second face (32) of each braking actuator (26) has a longitudinal groove and said second surface (50) of each leg (16) forms a guide projection which engages in the above-mentioned longitudinal groove.

13. Bicycle fork according to any of claims 1 to 11, further comprising, for each leg (16) , a guide edge cooperating with said fourth face (30) of the respective braking actuator (26) to retain this latter in the transversely inner direction.

14. Bicycle fork according to claim 1, comprising a pair of abutment elements, each of which is interposed between a respective leg (16) and a respective braking actuator (26) and forms said first surface (24) .

15. Bicycle fork according to any of the preceding claims, wherein the legs (16) have on their inner sides grooves suitable for receiving at least partially supply conduits of the braking actuators (26) .

FIG. 1

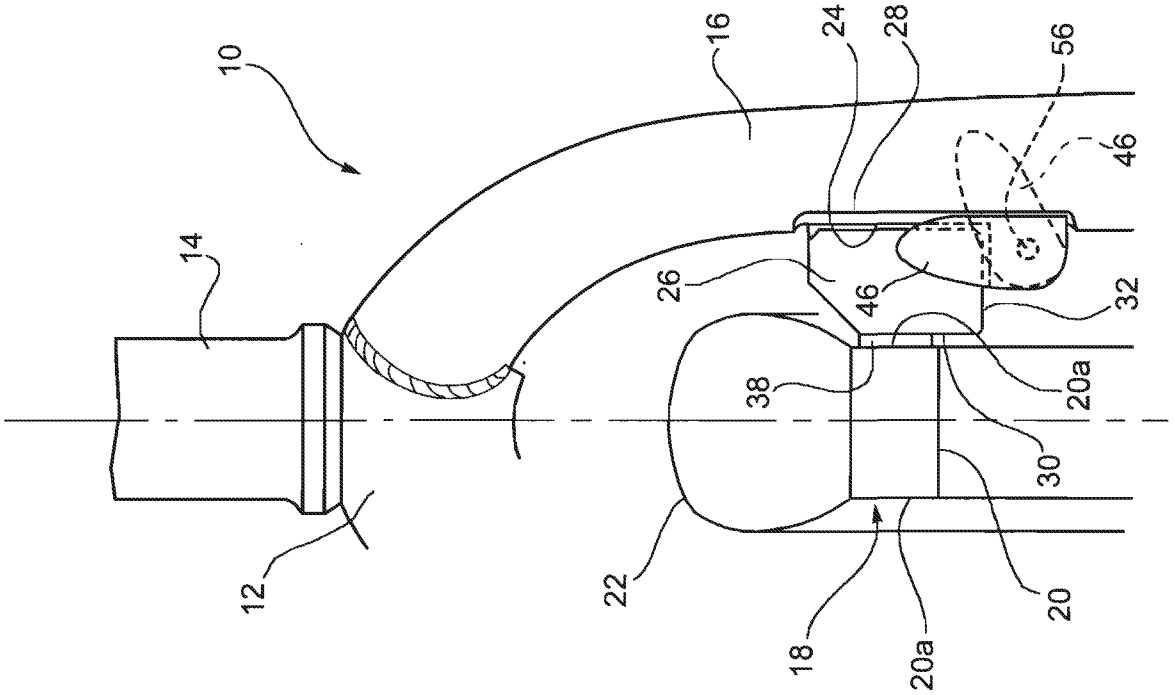


FIG. 3

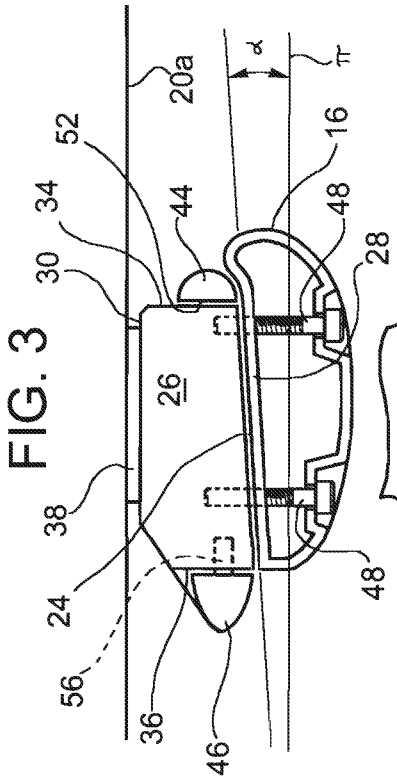


FIG. 2

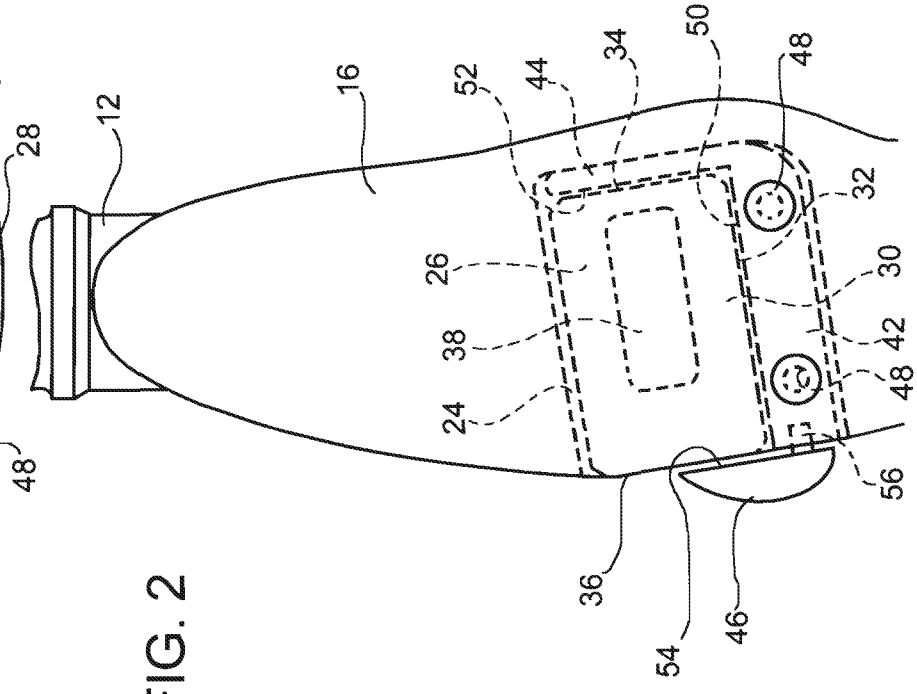


FIG. 4