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(54) **DIELECTRIC SHIELDING HEAT SINK**

(57) The present invention relates to a dielectric shielding heat sink (10), the dielectric shielding heat sink comprising:  
- a body (20);

wherein the body is configured to be mounted around a

movable contact (30) of a circuit breaker and around a part (40) of a copper contact (50) connected to the movable contact;  
wherein the body is configured to directly contact at least a portion of the part of the copper contact connected to the movable contact.

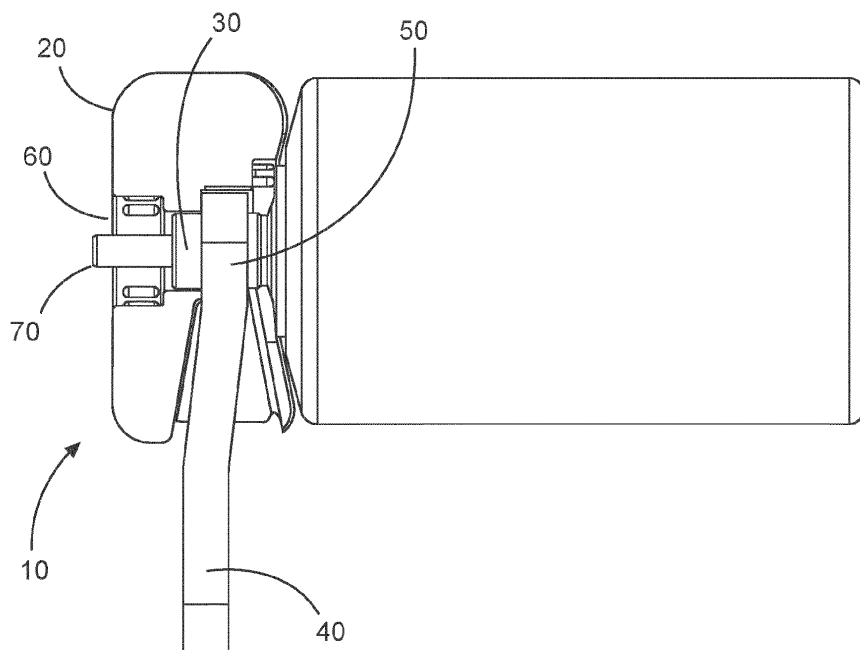


Fig. 1

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates to a dielectric shielding heat sink, to a circuit breaker and a dielectric shielding heat sink, and to a medium or high voltage switchgear.

### BACKGROUND OF THE INVENTION

**[0002]** Medium or high voltage switch gears have one or more circuit breakers, such as vacuum interrupters. Many bold parts of such circuit breakers use a flexible copper connection to the movable contact of the vacuum interrupter. The flexible copper connection is mounted around the movable contact at one end and at the other end is generally held in a rigid position. The flexibility is provided via a flexible copper contact being in the form of a copper strip or laminate. This then means that the flexible copper contact has sharp edges, or at least edges with small radius of curvature. From a dielectric point of view, this then is problematic and can lead to electrical breakdown issues.

**[0003]** Furthermore, this area is one of the hottest areas of the pole part, where for high current applications this area can become very hard due to Joule heating. However, normally heatsinks again have relatively sharp edges with respect to ribs, which again are problematic from a dielectric point of view.

**[0004]** There is a need to address these issues.

### SUMMARY OF THE INVENTION

**[0005]** Therefore, it would be advantageous to have a technology that addresses both the dielectric issues associated with flexible copper connections to the movable contact of a circuit breaker and the heating issues associated with Joule heating of the flexible copper connections.

**[0006]** The object of the present invention is solved with the subject matter of the independent claims, wherein further embodiments are incorporated in the dependent claims.

**[0007]** In a first aspect, there is provided dielectric shielding heat sink, the dielectric shielding heat sink comprising a body.

**[0008]** The body is configured to be mounted around a movable contact of a circuit breaker and around a part of a copper contact connected to the movable contact. The body is configured to directly contact at least a portion of the part of the copper contact connected to the movable contact.

**[0009]** In this manner, the heat sink not only cools through radiative cooling from the outer surface the movable contact and copper contact of a circuit breaker such as a vacuum interrupter but can act as dielectric shielding for the copper contact that is generally in the form of a

flexible laminate of copper that necessarily has relatively sharp edges.

**[0010]** In an example, the body is configured to surround the at least a portion of the part of the copper contact connected to the movable contact.

**[0011]** Thus, the heat sink can cool the copper contact and provide for dielectric shielding.

**[0012]** In an example, the body is configured to form a dielectrically closed enclosure.

**[0013]** In an example, the body is configured to form a dielectrically closed enclosure with respect to the at least a portion of the part of the copper contact connected to the movable contact.

**[0014]** In an example, the body is configured to form a dielectrically closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected.

**[0015]** In this manner, electrical breakdown is prevented.

**[0016]** In an example, the body is configured to form a closed enclosure with respect to at least a portion of the part of the copper contact connected to the movable contact. For the closed enclosure there is no direct air path or vacuum path from the at least a portion of the part of the copper contact connected to the movable contact to a region outside of the body.

**[0017]** In an example, the body is configured to form a closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected. For the closed enclosure there is no direct air path or vacuum path from the part of the movable contact to which is connected the part of the copper contact connected to a region outside of the body.

**[0018]** In this manner, electrical breakdown is prevented because there is no direct path from the parts inside the heatsink to outside the heat sink.

**[0019]** In an example, the body comprises a central conduit configured to allow a stem of movable contact to protrude out of the body.

**[0020]** In an example, the body comprises one or more holes or recesses in an outer surface of the body.

**[0021]** In an example, the one or more holes or recesses do not connect the outer surface of the body to an inner surface of the body.

**[0022]** In an example, one or more of the holes or recesses extend from one part of the outer surface of the body to another part of the outer surface of the body.

**[0023]** Thus, the holes or recesses are in effect open tubes through which air, or an isolation-gas such as Air-Plus or SF<sub>6</sub>, can flow from one part of the outer surface into the body of the heat sink and out of the outer surface to cool the heat sink without going into the inside of the heat sink, in terms of its inner surface, as such.

**[0024]** In an example, corners and edges of the body are rounded.

**[0025]** In an example, the radius of curvature of the substantially cylindrical shape is selected such that in operation the electric field strength at the at least one

third outer surface is minimized below that for electrical breakdown.

**[0026]** Thus, electrical breakdown is mitigated through the heat sink having commensurately shaped rounded outer surfaces.

**[0027]** In this manner, the copper connection a problem associated with electrical breakdown caused by the sharp edges of the thin flexible copper used is mitigated by enclosing the copper connection by an enclosure that connects to and surrounds the copper connection, which then in effect provides a combined feature with edges that are no longer sharp. At the same time, this enclosure acts as a heat sink to cool the copper connection.

**[0028]** In a second aspect, there is provided a circuit breaker and a dielectric shielding heat sink, the dielectric heat sink comprising a body.

**[0029]** The body is mounted around a movable contact of the circuit breaker and around a part of a copper contact connected to the movable contact, The body directly contacts at least a portion of the part of the copper contact connected to the movable contact.

**[0030]** In an example, the dielectric shielding heat sink is made from an electrically conductive material.

**[0031]** In an example, the electrically conductive material is aluminium.

**[0032]** In an example, the electrically conductive material is copper.

**[0033]** In an example, the circuit breaker is a vacuum interrupter.

**[0034]** In an example, the body surrounds the at least a portion of the part of the copper contact connected to the movable contact.

**[0035]** In an example, the body forms a dielectrically closed enclosure.

**[0036]** In an example, the body forms a dielectrically closed enclosure with respect to the at least a portion of the part of the copper contact connected to the movable contact.

**[0037]** In an example, the body forms a dielectrically closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected.

**[0038]** In an example, the body forms a closed enclosure with respect to at least a portion of the part of the copper contact connected to the movable contact, For the closed enclosure there is no direct air path or vacuum path from the at least a portion of the part of the copper contact connected to the movable contact to a region outside of the body.

**[0039]** In an example, the body forms a closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected. For the closed enclosure there is no direct air path or vacuum path from the part of the movable contact to which is connected the part of the copper contact connected to a region outside of the body.

**[0040]** In an example, the body comprises a central conduit that allows a stem of movable contact to protrude

out of the body.

**[0041]** In an example, the body comprises one or more holes or recesses in an outer surface of the body.

**[0042]** In an example, the one or more holes or recesses do not connect the outer surface of the body to an inner surface of the body.

**[0043]** In an example, one or more of the holes or recesses extend from one part of the outer surface of the body to another part of the outer surface of the body.

**[0044]** In an example, corners and edges of the body are rounded.

**[0045]** In an example, the radius of curvature of the substantially cylindrical shape is selected such that in operation the electric field strength at the at least one third outer surface is minimized below that for electrical breakdown.

**[0046]** In an example, the ribbed surface comprises fins that extend in the axial direction.

**[0047]** In a third aspect, there is provided a medium or high voltage switchgear comprising at least one dielectric shielding heat sink according to the first aspect.

**[0048]** The above aspects and examples will become apparent from and be elucidated with reference to the embodiments described hereinafter.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0049]** Exemplary embodiments will be described in the following with reference to the following drawings:

Fig. 1 shows an example of a dielectric shielding heat sink mounted to a movable contact of a circuit breaker; and

Fig. 2 shows an isometric view of an example of a dielectric shielding heat sink mounted to a movable contact of a circuit breaker.

## DETAILED DESCRIPTION OF EMBODIMENTS

**[0050]** Figs. 1-2 relate to a dielectric shielding heat sink, to a circuit breaker with a dielectric shielding heat sink, and to a medium or high voltage switchgear.

**[0051]** In an example a dielectric shielding heat sink 10 comprising a body 20. The body of the dielectric shielding heat sink is configured to be mounted around a movable contact 30 of a circuit breaker and around a part 40 of a copper contact 50 connected to the movable contact. The body of the dielectric shielding heat sink is configured to directly contact at least a portion of the part of the copper contact connected to the movable contact.

**[0052]** In an example, the dielectric shielding heat sink is made from an electrically conductive material.

**[0053]** In an example, the electrically conductive material is aluminium.

**[0054]** In an example, the electrically conductive material is copper.

**[0055]** According to an example, the body of the die-

lectric shielding heat sink is configured to surround the at least a portion of the part of the copper contact connected to the movable contact.

**[0056]** According to an example, the body of the dielectric shielding heat sink is configured to form a dielectrically closed enclosure.

**[0057]** According to an example, the body of the dielectric shielding heat sink is configured to form a dielectrically closed enclosure with respect to the at least a portion of the part of the copper contact connected to the movable contact.

**[0058]** According to an example, the body of the dielectric shielding heat sink is configured to form a dielectrically closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected.

**[0059]** According to an example, the body of the dielectric shielding heat sink is configured to form a closed enclosure with respect to at least a portion of the part of the copper contact connected to the movable contact. With respect to the closed enclosure there is no direct air path or vacuum path from the at least a portion of the part of the copper contact connected to the movable contact to a region outside of the body.

**[0060]** According to an example, the body of the dielectric shielding heat sink is configured to form a closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected. With respect to the closed enclosure there is no direct air path or vacuum path from the part of the movable contact to which is connected the part of the copper contact connected to a region outside of the body.

**[0061]** According to an example, the body of the dielectric shielding heat sink comprises a central conduit 60 configured to allow a stem 70 of movable contact to protrude out of the body.

**[0062]** According to an example, the body the dielectric shielding heat sink comprises one or more holes or recesses 80 in an outer surface of the body.

**[0063]** According to an example, the one or more holes or recesses do not connect the outer surface of the body to an inner surface of the body.

**[0064]** According to an example, one or more of the holes or recesses extend from one part of the outer surface of the body to another part of the outer surface of the body.

**[0065]** According to an example, corners and edges of the body of the dielectric shielding heat sink are rounded.

**[0066]** According to an example, the radius of curvature of the substantially cylindrical shape is selected such that in operation the electric field strength at the at least one third outer surface is minimized below that for electrical breakdown.

**[0067]** In an example a circuit breaker has mounted to it a dielectric shielding heat sink 10. The dielectric heat sink comprises a body 20. The body of the the dielectric shielding heat sink is mounted around a movable contact 30 of the circuit breaker and around a part 40 of a copper

contact 50 connected to the movable contact. The body of the dielectric shielding heat sink directly contacts at least a portion of the part of the copper contact connected to the movable contact.

**[0068]** This direct contact relates to direct thermal and electrical contact, and clearly there can be an intermediate electrical/thermal medium between the body and the copper connection, such as an intermediate sheet or gel.

**[0069]** In an example, the dielectric shielding heat sink is made from an electrically conductive material.

**[0070]** In an example, the electrically conductive material is aluminium.

**[0071]** In an example, the electrically conductive material is copper.

**[0072]** In an example, the circuit breaker is a vacuum interrupter.

**[0073]** In an example, the body surrounds the at least a portion of the part of the copper contact connected to the movable contact.

**[0074]** In an example, the body of the the dielectric shielding heat sink forms a dielectrically closed enclosure.

**[0075]** In an example, the body of the the dielectric shielding heat sink forms a dielectrically closed enclosure with respect to the at least a portion of the part of the copper contact connected to the movable contact.

**[0076]** In an example, the body forms a dielectrically closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected.

**[0077]** In an example, the body of the the dielectric shielding heat sink forms a closed enclosure with respect to at least a portion of the part of the copper contact connected to the movable contact. With respect to the closed enclosure there is no direct air path or vacuum path from the at least a portion of the part of the copper contact connected to the movable contact to a region outside of the body.

**[0078]** In an example, the body forms a closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected. With respect to the closed enclosure there is no direct air path or vacuum path from the part of the movable contact to which is connected the part of the copper contact connected to a region outside of the body.

**[0079]** In an example, the body of the dielectric shielding heat sink comprises a central conduit 60 that allows a stem 70 of movable contact to protrude out of the body.

**[0080]** In an example, the body comprises one or more holes or recesses 80 in an outer surface of the body.

**[0081]** In an example, the one or more holes or recesses do not connect the outer surface of the body to an inner surface of the body.

**[0082]** In an example, one or more of the holes or recesses extend from one part of the outer surface of the body to another part of the outer surface of the body.

**[0083]** In an example, corners and edges of the body are rounded.

**[0084]** In an example, the radius of curvature of the substantially cylindrical shape is selected such that in operation the electric field strength at the at least one third outer surface is minimized below that for electrical breakdown.

**[0085]** In an example, the ribbed surface comprises fins that extend in the axial direction.

**[0086]** Thus, a medium or high voltage switchgear can comprise at least one dielectric shielding heat sink as described above.

**[0087]** Thus, a closed heat sink has been designed, such that it can be used as an electric shielding for the sharp edges of copper laminations used as contacts and additionally work as a dielectrically optimised heat sink with large rounded edges and corners at the outside to call down art area of the circuit breaker, such as the pole part. The new heat sink can be retrofitted to existing circuit breakers, or circuit breaker can be manufactured with such a heatsink as part of the overall heatsink embodiment.

**[0088]** The heatsink, is from a dielectric point of view, closed and it has no open holes that extend from the inside to the outside. The outside of the heat sink has holes for cooling, and the outside has large radius edges and corners, and no sharp edges. The heat sink is then placed around the movable contact of the vacuum interrupter/circuit breaker and around the flexible copper connection, in the form of elimination. It works as a dielectric shielding for the sharp edges of the copper connection, and is in direct contact with the copper connection where it connects to the movable contact, and is used to cool down this area.

**[0089]** While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing a claimed invention, from a study of the drawings, the disclosure, and the dependent claims.

## Claims

1. A dielectric shielding heat sink (10), the dielectric shielding heat sink comprising:

- a body (20);

wherein the body is configured to be mounted around a movable contact (30) of a circuit breaker and around a part (40) of a copper contact (50) connected to the movable contact;

wherein the body is configured to directly contact at least a portion of the part of the copper contact connected to the movable

contact.

2. Dielectric shielding heat sink according to claim 1, wherein the body is configured to surround the at least a portion of the part of the copper contact connected to the movable contact.
3. Dielectric shielding heat sink according to any of claims 1-2, wherein the body is configured to form a dielectrically closed enclosure.
4. Dielectric shielding heat sink according to claim 3, wherein the body is configured to form a dielectrically closed enclosure with respect to the at least a portion of the part of the copper contact connected to the movable contact.
5. Dielectric shielding heat sink according to any of claims 3-4, wherein the body is configured to form a dielectrically closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected.
6. Dielectric shielding heat sink according to any of claims 1-5, wherein the body is configured to form a closed enclosure with respect to at least a portion of the part of the copper contact connected to the movable contact, wherein for the closed enclosure there is no direct air path, or an isolation-gas such as Air-Plus or SF6 path, or vacuum path from the at least a portion of the part of the copper contact connected to the movable contact to a region outside of the body.
7. Dielectric shielding heat sink according to any of claims 1-6, wherein the body is configured to form a closed enclosure with respect to a part of the movable contact to which is connected the part of the copper contact connected, wherein for the closed enclosure there is no direct air path or vacuum path from the part of the movable contact to which is connected the part of the copper contact connected to a region outside of the body.
8. Dielectric shielding heat sink according to any of claims 1-7, wherein the body comprises a central conduit (60) configured to allows a stem (70) of movable contact to protrude out of the body.
9. Dielectric shielding heat sink according to any of claims 1-8, wherein the body comprises one or more holes or recesses (80) in an outer surface of the body.
10. Dielectric shielding heat sink according to claim 9, wherein the one or more holes or recesses do not connect the outer surface of the body to an inner surface of the body.

11. Dielectric shielding heat sink according to any of claims 9-10, wherein one or more of the holes or recesses extend from one part of the outer surface of the body to another part of the outer surface of the body. 5
12. Dielectric shielding heat sink according to any of claims 1-11, wherein corners and edges of the body are rounded. 10
13. Dielectric shielding heat sink according to claim 12, wherein the radius of curvature of the substantially cylindrical shape is selected such that in operation the electric field strength at the at least one third outer surface is minimized below that for electrical breakdown. 15
14. A circuit breaker and a dielectric shielding heat sink (10), the dielectric heat sink comprising: 20
- a body (20);
- wherein the body is mounted around a movable contact (30) of the circuit breaker and around a part (40) of a copper contact (50) 25
- connected to the movable contact;
- wherein the body directly contacts at least a portion of the part of the copper contact connected to the movable contact. 30
15. A medium or high voltage switchgear comprising at least one dielectric shielding heat sink according to any of claims 1-13. 35

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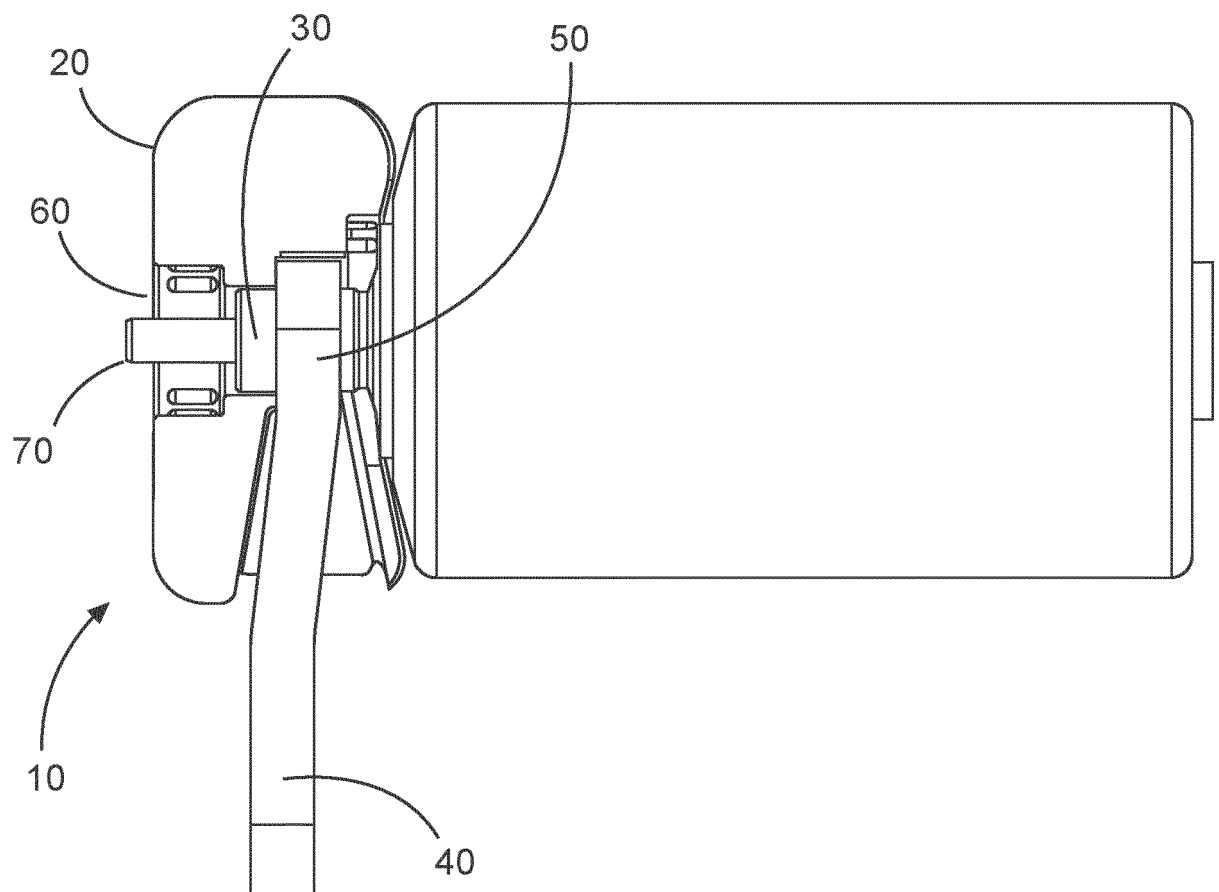


Fig. 1

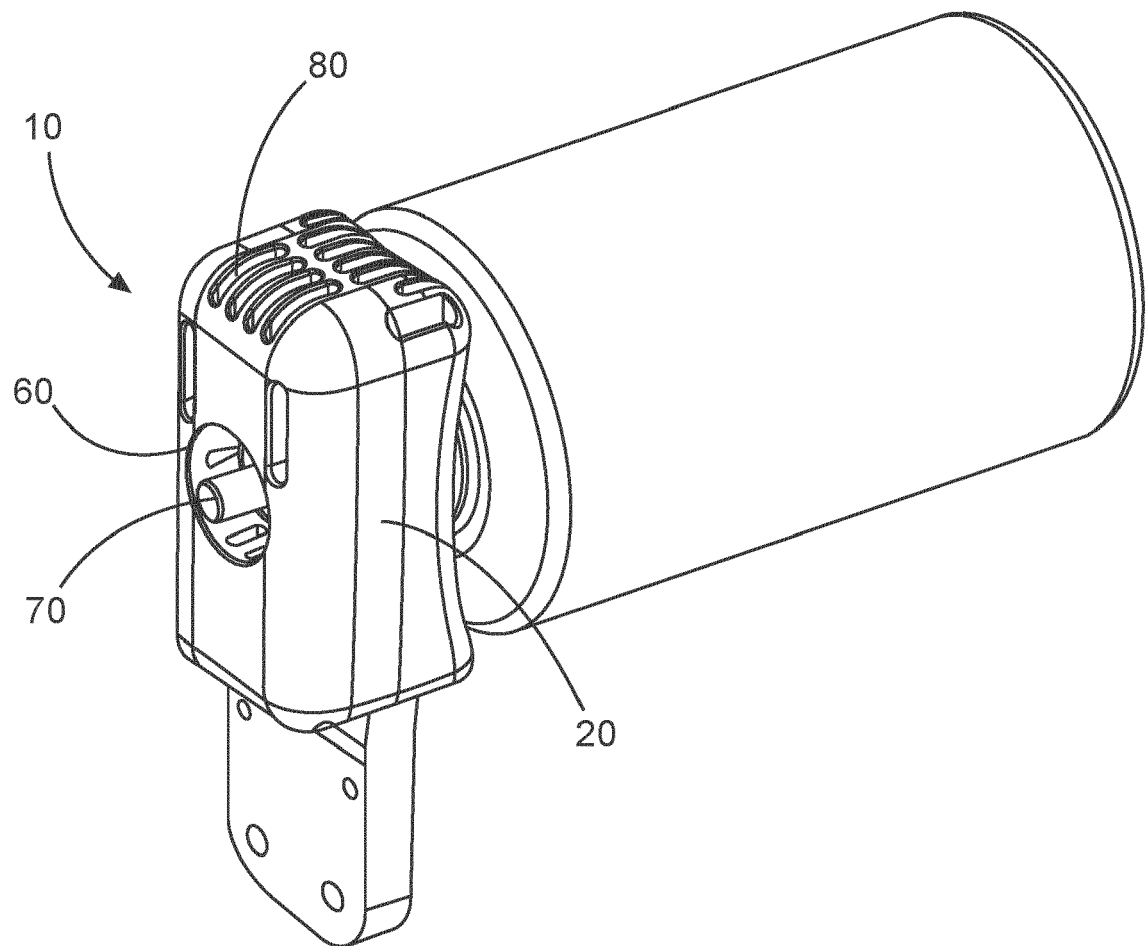


Fig. 2



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