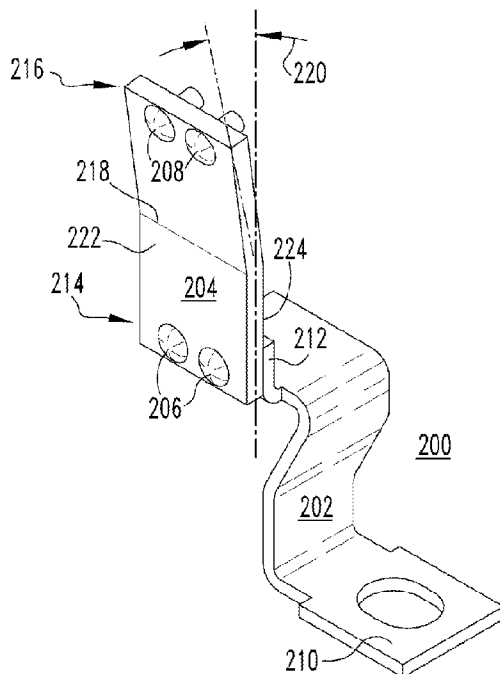




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(54) Titre : APPAREIL DE COMMUTATION ELECTRIQUE ET ENSEMBLE CONDUCTEUR POUR CELUI-CI  
 (54) Title: ELECTRICAL SWITCHING APPARATUS AND CONDUCTOR ASSEMBLY THEREFOR



(57) **Abrégé/Abstract:**

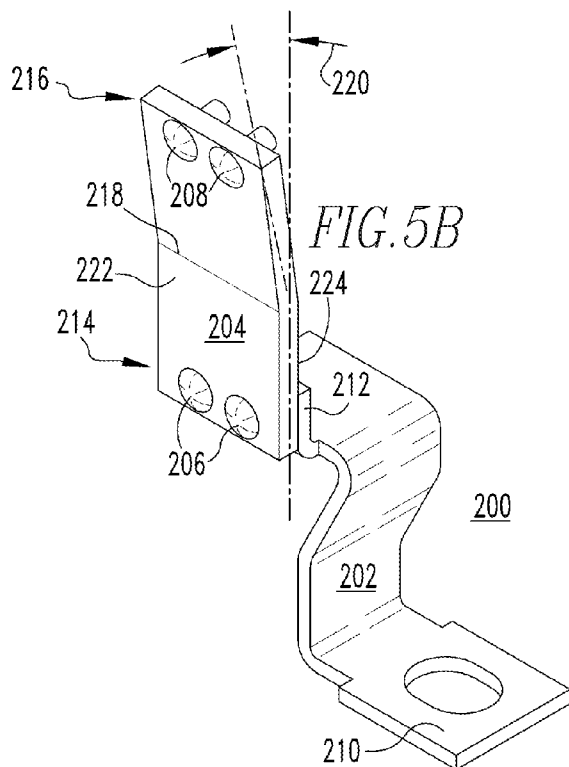
A conductor assembly (200) is provided for an electrical switching apparatus (2), such as a circuit breaker. The circuit breaker includes a housing (4) having an interior (20) and an exterior (22). The conductor assembly (200) includes a first conductor member (202), a second conductor member (204), and a plurality of fasteners (206,208), such as rivets (206), mechanically fastening and electrically connecting the first conductor member (202) to the second conductor member (204). The first conductor member (202) is made from a first material, such as copper, and the second conductor member (204) is made from a second different material, such as aluminum.

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(54) **Title:** ELECTRICAL SWITCHING APPARATUS AND CONDUCTOR ASSEMBLY THEREFOR

(57) **Abstract:** A conductor assembly (200) is provided for an electrical switching apparatus (2), such as a circuit breaker. The circuit breaker includes a housing (4) having an interior (20) and an exterior (22). The conductor assembly (200) includes a first conductor member (202), a second conductor member (204), and a plurality of fasteners (206, 208), such as rivets (206), mechanically fastening and electrically connecting the first conductor member (202) to the second conductor member (204). The first conductor member (202) is made from a first material, such as copper, and the second conductor member (204) is made from a second different material, such as aluminum.

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# **ELECTRICAL SWITCHING APPARATUS AND CONDUCTOR ASSEMBLY THEREFOR**

## BACKGROUND

### Field

The disclosed concept relates generally to electrical switching apparatus and, more particularly, to electrical switching apparatus, such as circuit breakers. The disclosed concept also relates to conductor assemblies for circuit breakers.

### Background Information

Electrical switching apparatus, such as circuit breakers, provide protection for electrical systems from electrical fault conditions such as, for example, current overloads, short circuits, abnormal voltage and other fault conditions.

Typically, circuit breakers include an operating mechanism, which opens electrical contact assemblies to interrupt the flow of current through the conductors of an electrical system in response to such fault conditions. The electrical contact assemblies include stationary electrical contacts and corresponding movable electrical contacts that are typically mounted on movable (e.g., pivotable) arms. The stationary and movable contacts are in physical and electrical contact with one another when it is desired that the circuit breaker provide electrical current therethrough to a load. When it is desired to interrupt the power circuit, the movable contact arm is pivoted, thereby moving the movable contact away from the stationary contact creating a space therebetween.

The movable contact arms and other current carrying components, such as conductor assemblies are typically made from copper. Thus, as the cost of copper increases, the cost of these components increases.

There is, therefore, room for improvement in electrical switching apparatus, such as circuit breakers, and in conductor assemblies therefor.

### SUMMARY

These needs and others are met by embodiments of the disclosed concept, which are directed to a conductor assembly, which among other benefits,  
5 reduces the amount of copper required.

As one aspect of the disclosed concept a conductor assembly is provided for an electrical switching apparatus. The electrical switching apparatus includes a housing having an interior and an exterior. The conductor assembly comprises: a first conductor member; a second conductor member; and a plurality of  
10 fasteners mechanically fastening and electrically connecting the first conductor member to the second conductor member. The first conductor member is made from a first material and the second conductor member is made from a second different material.

The first conductor member and the second conductor member may  
15 combine to form a bimetallic conductor assembly. The first material of the first conductor member may be copper, and the second material of the second conductor member may be aluminum.

The first conductor member may be structured to extend from the exterior of the housing into the interior of the housing, and the fasteners are structured  
20 to fasten the second conductor member to the first conductor member within the interior of the housing. The first conductor member may include a terminal portion and a mounting portion, and the second conductor member comprises a first end and a second end disposed opposite from the first end, wherein the fasteners fasten the first end of the second conductor member to the mounting portion of the first conductor  
25 member. The second conductor member may further comprise a bend between the first end of the second conductor member and the second end of the second conductor member, in order that the second end is disposed at an angle with respect to the first end.

As another aspect of the disclosed concept, an electrical switching  
30 apparatus employing the aforementioned conductor assembly, is disclosed.

### BRIEF DESCRIPTION OF THE DRAWINGS

A full understanding of the disclosed concept can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

5                   Figure 1 is a side elevation view of a circuit breaker and conductor assembly therefor, in accordance with an embodiment of the disclosed concept, showing the circuit breaker in the ON position;

                    Figure 2 is an isometric view of the circuit breaker and conductor assembly of Figure 1, showing the circuit breaker in the OFF position;

10                   Figure 3 is a side elevation view of the circuit breaker and conductor assembly of Figure 2, showing the circuit breaker in the TRIPPED position;

                    Figure 4A is an exploded isometric view of a movable contact arm assembly, shown in Figure 3;

                    Figure 4B is an assembled side elevation view of the movable contact arm assembly of Figure 4A;

15                   Figure 5A is an exploded isometric view of the conductor assembly;  
and

                    Figures 5B and 5C are assembled front and back isometric views of the conductor assembly of Figure 5A.

20

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Directional phrases used herein, such as, for example, left, right, front, back, top, bottom and derivatives thereof, relate to the orientation of the elements shown in the drawings and are not limiting upon the claims unless expressly recited  
25                   therein.

                    As employed herein, the term “fastener” refers to any suitable connecting or tightening mechanism expressly including, but not limited to rivets, screws, bolts and the combinations of bolts and nuts (*e.g.*, without limitation, lock nuts) and bolts, washers and nuts.

30                   As employed herein, the statement that two or more parts are “coupled” together shall mean that the parts are joined together either directly or joined through one or more intermediate parts.

As employed herein, the statement that two or more parts are “attached” shall mean that the parts are directly joined together, without any intermediate parts.

As employed herein, the term “number” shall mean one or an integer greater than one (*i.e.*, a plurality).

Figure 1 shows a movable contact assembly 100 for an electrical switching apparatus, such as for example and without limitation, a circuit breaker 2, in accordance with one non-limiting embodiment of the disclosed concept. The circuit breaker 2 includes a housing 4, separable contacts 6,8 enclosed by housing 4, and an operating mechanism, such as for example and without limitation an operating handle 10, for opening and closing the separable contacts 6,8.

In Figure 1, the separable contacts 6,8 include a stationary contact 6 and a movable contact 8 (partially shown in hidden line drawing in Figure 1), and are shown in electrical contact with one another, corresponding to the circuit breaker 2 being disposed in the ON position.

Figure 2 shows the operating handle 10, separable contacts 6,8, and other circuit breaker components in their respective positions corresponding to the circuit breaker 2 being disposed in the OFF position, such that the movable contact 8 (shown in hidden line drawing in Figure 2) is separated, and electrically disconnected, from the stationary contact 6, as shown. Figure 3 shows the circuit breaker 2 and corresponding components (e.g., without limitation, separable contacts 6,8; operating mechanism 10; movable contact arm assembly 100) in their respective positions corresponding to the circuit breaker 2 being disposed in the TRIPPED position.

It will be appreciated that while the example non-limiting embodiment shown and described herein includes a single movable contact arm assembly 100 and a single pair of separable contacts 6,8, any known or suitable alternative number and/or configuration of movable contact arms (e.g., 100) and corresponding sets of separable contacts (e.g., 6,8) could be employed, without departing from the scope of the disclosed concept.

Continuing to refer to Figures 1-3, and also to Figures 4A and 4B, the example movable contact arm assembly 100 includes a first member 102 and a separate second member 104, which is attached to the first member 102, as will be described in greater detail hereinbelow. Specifically, the first member 102 is made

from a first material and the second member 104 is made from a second, different material.

In one non-limiting embodiment, in accordance with the disclosed concept, the first member 102 and the second member 104 combined to form a  
5 bimetallic movable contact arm 100. The term “bimetallic” as used herein refers to an assembly of a plurality (e.g., at least two) of metal parts attached or otherwise suitably joined together (see, for example and without limitation, bimetallic movable contact arm 100, best shown in Figure 4B). For example and without limitation, preferably the first material of the first member 102 is steel, and the second material of the  
10 second member 104 is copper. In this manner, the amount of copper required for the movable contact arm assembly 100 is reduced. In other words, in accordance with the disclosed concept, rather than a single unitary piece of copper being used for the entire movable contact arm, in accordance with conventional designs, a substantial reduction in the amount of copper used is achieved by replacing copper with steel or  
15 another suitable material in the non-conducting portion of the movable contact arm assembly 100.

As shown in Figures 1-3, the aforementioned movable contact 8  
(shown in hidden line drawing in Figures 2 and 3) is disposed on the second member 104. Specifically, the first and second members 102,104 each include first ends  
20 106,110 and second ends 108,112, respectively. The first end 106 of first member 102 cooperates with the operating mechanism 10 (e.g., without limitation, opening handle). The first end 110 of the second member 104 is attached to the second end 108 of the first member 102. The movable contact 8 is disposed on the second end 112 of the second member 104, as shown. It will be appreciated, however, that the  
25 movable contact 8 could alternatively comprise an integral portion or segment of the second member 104. In other words, it is not a requirement of the disclosed concept for the separable contact 8 to be a separate part that is attached to the second member 104. It is anticipated that it could alternatively comprise an integral portion or segment of the second member 104.

30 Referring again to Figures 4A and 4B, the second end 108 of the first member 102 has a first shape, and the first end 110 of the second member 104 has a second shape. The first shape of the first member 110 compliments the second shape of the second member 104, as shown. Specifically, as used herein, the term “compliments” refers to two opposing shapes, surfaces or configurations of two

separate parts that are structured to be attached together such that the opposing surfaces abut and correspond to one another so as to provide a precise interface between the two parts. This relationship will be appreciated, for example and without limitation, with reference to the non-limiting embodiment shown and described with respect to Figures 4A and 4B. In the example shown and described, the second end 108 of the first member 102 includes a recess 114, and the first end 110 of the second member 104 includes a protrusion 116. As shown in Figure 4B the protrusion 116 is disposed within the recess 114 to complete the movable contact arm assembly 100.

More specifically, the second end 108 of the example first member 102 preferably includes first and second opposing legs 118,120, wherein the recess 114 is formed between such legs 118,120, as best shown in Figure 4A. Accordingly, the protrusion 116 is disposed within the recess 114 between the first and second legs 118,120 to complete the assembly 100, as shown in Figure 4B. Preferably, the first and second legs 118,120, which are made, for example and without limitation from steel, are compressed inwardly against the protrusion 116, which is made, for example and without limitation from copper, in order to further secure the copper second member 104 to the steel first member 102.

Referring again to Figures 1-3, the example circuit breaker 2 further includes a bimetal structure 12 and a flexible shunt 14. The flexible shunt 14 preferably extends between and electrically connects the second member 104 of the movable contact arm assembly 100 to the bimetal structure 12, as shown. It will, however, be appreciated that any known or suitable alternative type and/or configuration of electrical connection (not shown) could be employed, without departing from the scope of the disclosed concept.

In addition to the aforementioned movable contact arm assembly 100, the example circuit breaker 2 includes a conductor assembly 200 (Figures 1-3, 5A, 5B and 5C), which also functions to advantageously further reduce the amount of copper required to be used in the circuit breaker 2.

As best shown in Figures 5A-5C, the disclosed conductor assembly 200 includes a first conductor member 202, a second conductor member 204, and a plurality of fasteners 206,208 for mechanically fastening and electrically connecting the first conductor member 202 to the second conductor 204. The first conductor member 202 is made from a first material, such as for example and without limitation, copper, and the second conductor member 204 is made from a second, different

material, such as for example and without limitation, aluminum. Accordingly, the first and second conductor members 202,204 combine to form a bimetallic conductor assembly 200, which substantially reduces the amount of copper required.

As shown in Figures 1-3, the first conductor member 202 is structured  
5 to extend from the exterior 22 of the circuit breaker housing 4 into the interior 20.  
The fasteners, which in the example shown and described herein are rivets 206, fasten  
(e.g., rivet) the second conductor member 204 to the first conductor member 202  
within the interior 20 of the housing 4. More specifically, the first conductor member  
202 includes a terminal portion 210, which is accessible from the exterior 22 of the  
10 circuit breaker housing 4, and a mounting portion 212. The example mounting  
portion 212 is an upturned flange (best shown in Figures 5A and 5C), wherein the  
second conductor member 204 includes opposing first and second ends 214,216, and a  
first pair 206 of the aforementioned rivets 206,208 fastens the first end 214 of the  
second conductor member 204 to the upturned flange 212 of the first conductor  
15 member 202, within the interior 20 of the circuit breaker housing 4, as shown. In the  
example shown and described herein, the second conductor member 204 further  
includes first and second opposing sides 222,224, wherein the second side 224 of the  
first end 214 of the second conductor member 204 is riveted to the upturned flange  
212 using the first pair of rivets 206, as best shown in Figures 5A-5C. It will,  
20 however, be appreciated that any known or suitable alternative number, type and/or  
configuration of fastener could be employed, without departing from the scope of the  
disclosed concept.

Referring to Figures 5A-5C, the second conductor member 204  
preferably further includes a bend 218 disposed between the first and second ends  
25 214,216. Accordingly, as shown in Figure 5B, the second end 216 of the second  
member 204 is disposed at an angle 220 with respect to the first end 214 of the second  
conductor member 204. As shown in Figures 1-3, this configuration of the second  
end 216 being disposed at an angle 220 (Figure 5B) with respect to the first end 214,  
functions to position the second end 216 of the second conductor member 204 of the  
30 conductor assembly 200 in the desired orientation with respect to other internal  
electrically conductive components, such as for example and without limitation, the  
bimetallic structure 12.

In the example of Figures 1-3, the second end 216 of the second  
conductor member 204 is electrically connected to the bimetal structure 12 by a

flexible shunt 16, as shown. The example second conductor member 204 includes a second pair of rivets 208 disposed at or about the second end 216 of the second conductor member 204. In one non-limiting embodiment, the flexible shunt 16 is mechanically fastened and electrically connected to the second end 216 of the second conductor member 204 by a corresponding one of the rivets 208. It will, however, be appreciated that any known or suitable alternative configuration and/or mechanism for electrically connecting the conductor assembly 200 to other circuit breaker components (e.g., without limitation, bimetal structure 12) could be employed, without departing from the scope of the disclosed concept.

10                   It will further be appreciated that the aforementioned conductor assembly 200 could be employed independently within any known or suitable electrical switching apparatus (e.g., without limitation, circuit breaker 2 of Figures 1-3) with, or without, the aforementioned movable contact arm assembly 100 (Figures 1-4C).

15                   Accordingly, the disclosed concept provides a number of assemblies (e.g., without limitation, movable contact arm assembly 100; conductor assembly 200) that utilize a unique bimetal structure that, among other benefits, serves to reduce the amount of copper required to be used within the circuit breaker 2 (Figures 1-3).

20                   While specific embodiments of the disclosed concept have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the disclosed concept which is to be given the full breadth of the claims appended and  
25 any and all equivalents thereof.

What is claimed is:

1. A conductor assembly for an electrical switching apparatus, said electrical switching apparatus including a housing having an interior and an exterior, and a bimetal structure disposed on the interior, said conductor assembly comprising:
  - a first conductor member;
  - a second conductor member including a first end, a second end, a bend between the first end and the second end, and a flexible shunt, the second end being structured to extend toward said bimetal structure at an angle with respect to the first end, said flexible shunt being structured to electrically connect said second conductor member to said bimetal structure; and
  - a plurality of fasteners mechanically fastening and electrically connecting said first conductor member to said second conductor member,wherein said first conductor member is made from a first material and said second conductor member is made from a second different material, and
  - wherein said first conductor member includes a terminal portion and a mounting portion; and
  - wherein said fasteners fasten the first end of said second conductor member to the mounting portion of said first conductor member.
2. The conductor assembly of claim 1 wherein said first conductor member and said second conductor member combine to form a bimetallic conductor assembly.
3. The conductor arm assembly of claim 2 wherein the first material of said first conductor member is copper; and wherein the second material of said second conductor member is aluminum.
4. The conductor assembly of claim 1 wherein said first conductor member is structured to extend from the exterior of said housing into the interior of said housing; and wherein said fasteners are structured to fasten said second conductor member to said first conductor member within the interior of said housing.
5. The conductor assembly of claim 1 wherein said mounting portion comprises an upturned flange; wherein said second conductor member further comprises a first side and a second side disposed opposite the first side; and wherein the second side of first end of said second conductor member is fastened to said upturned flange.

6. The conductor assembly of claim 5 wherein said plurality of fasteners is a plurality of rivets; and wherein a number of said rivets fasten the first end of said second conductor member to the upturned flange of said first conductor member.

7. The conductor assembly of claim 6 wherein said plurality of rivets is four rivets; wherein a first pair of said rivets fastens said second conductor member to said first conductor member; and wherein a second pair of said rivets is disposed at the second end of said second conductor member.

8. An electrical switching apparatus comprising:  
a housing including an interior and an exterior;  
a bimetal structure disposed on the interior;  
separable contacts enclosed by the housing;  
an operating mechanism for opening and closing said separable contacts; and  
a conductor assembly comprising:  
a first conductor member,  
a second conductor member including a first end, a second end, a bend between the first end and the second end, and a flexible shunt, the second end extending toward said bimetal structure at an angle with respect to the first end, said flexible shunt electrically connecting said second conductor member to said bimetal structure, and  
a plurality of fasteners mechanically fastening and electrically connecting said first conductor member to said second conductor member,  
wherein said first conductor member is made from a first material and said second conductor member is made from a second different material, and  
wherein said first conductor member extends from the exterior of said housing into the interior of said housing; and wherein said fasteners fasten said second conductor member to said first conductor member within the interior of said housing.

9. The electrical switching apparatus of claim 8 wherein said first conductor member and said second conductor member combine to form a bimetallic conductor assembly.

10. The electrical switching apparatus of claim 9 wherein the first material of said first conductor member is copper; and wherein the second material of said second conductor member is aluminum.

11. The electrical switching apparatus of claim 8 wherein said first conductor member includes a terminal portion and a mounting portion; and wherein said fasteners fasten the first end of said second conductor member to the mounting portion of said first conductor member.

12. The electrical switching apparatus of claim 11 wherein said mounting portion comprises an upturned flange; wherein said second conductor member further comprises a first side and a second side disposed opposite the first side; and wherein the second side of first end of said second conductor member is fastened to said upturned flange.

13. The electrical switching apparatus of claim 12 wherein said plurality of fasteners is a plurality of rivets; and wherein a number of said rivets fasten the first end of said second conductor member to the upturned flange of said first conductor member.

14. The electrical switching apparatus of claim 13 wherein said plurality of rivets is four rivets; wherein a first pair of said rivets fastens said second conductor member to said first conductor member; and wherein a second pair of said rivets is disposed at the second end of said second conductor member.

15. The electrical switching apparatus of claim 8 wherein said electrical switching apparatus is a circuit breaker.

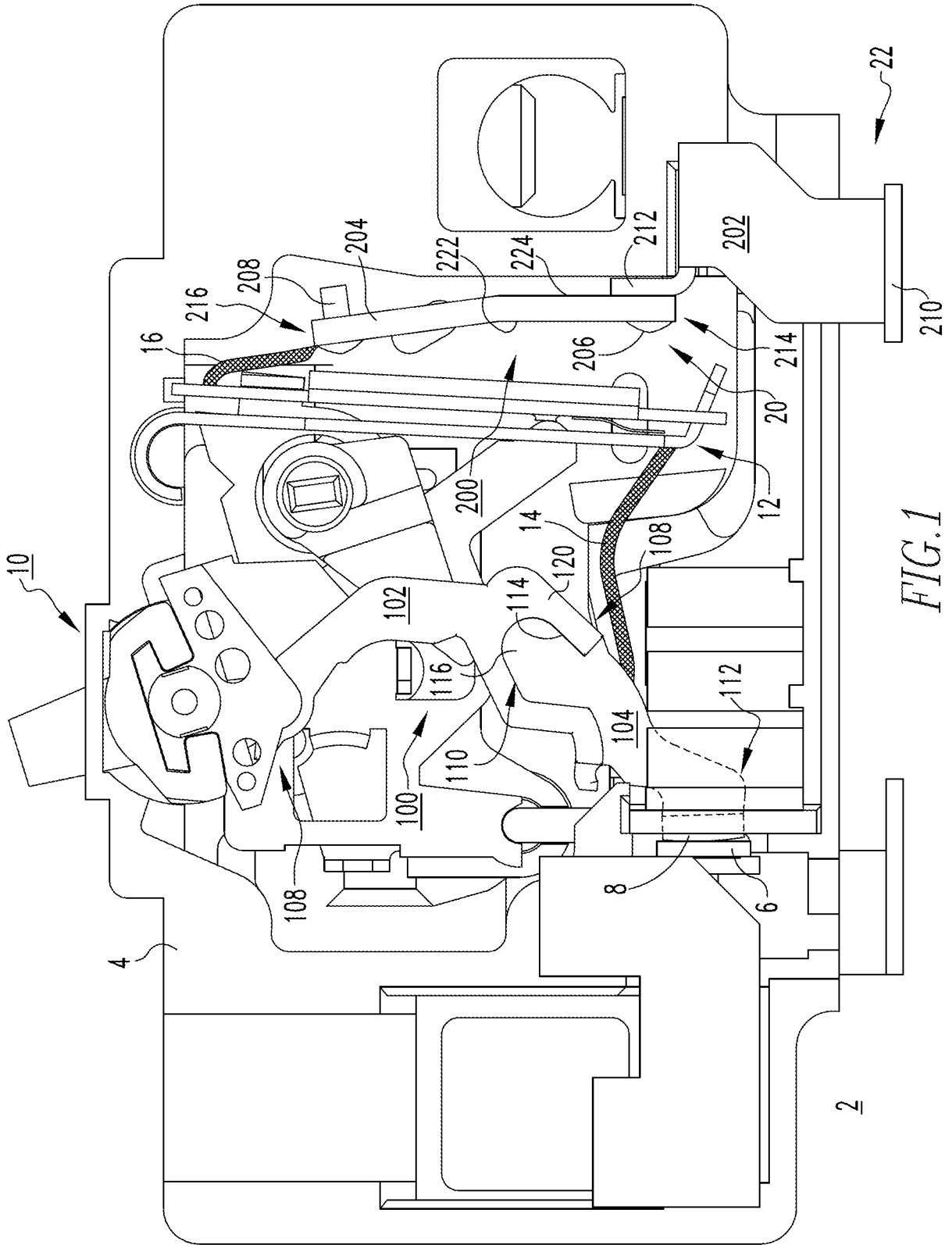


FIG. 1

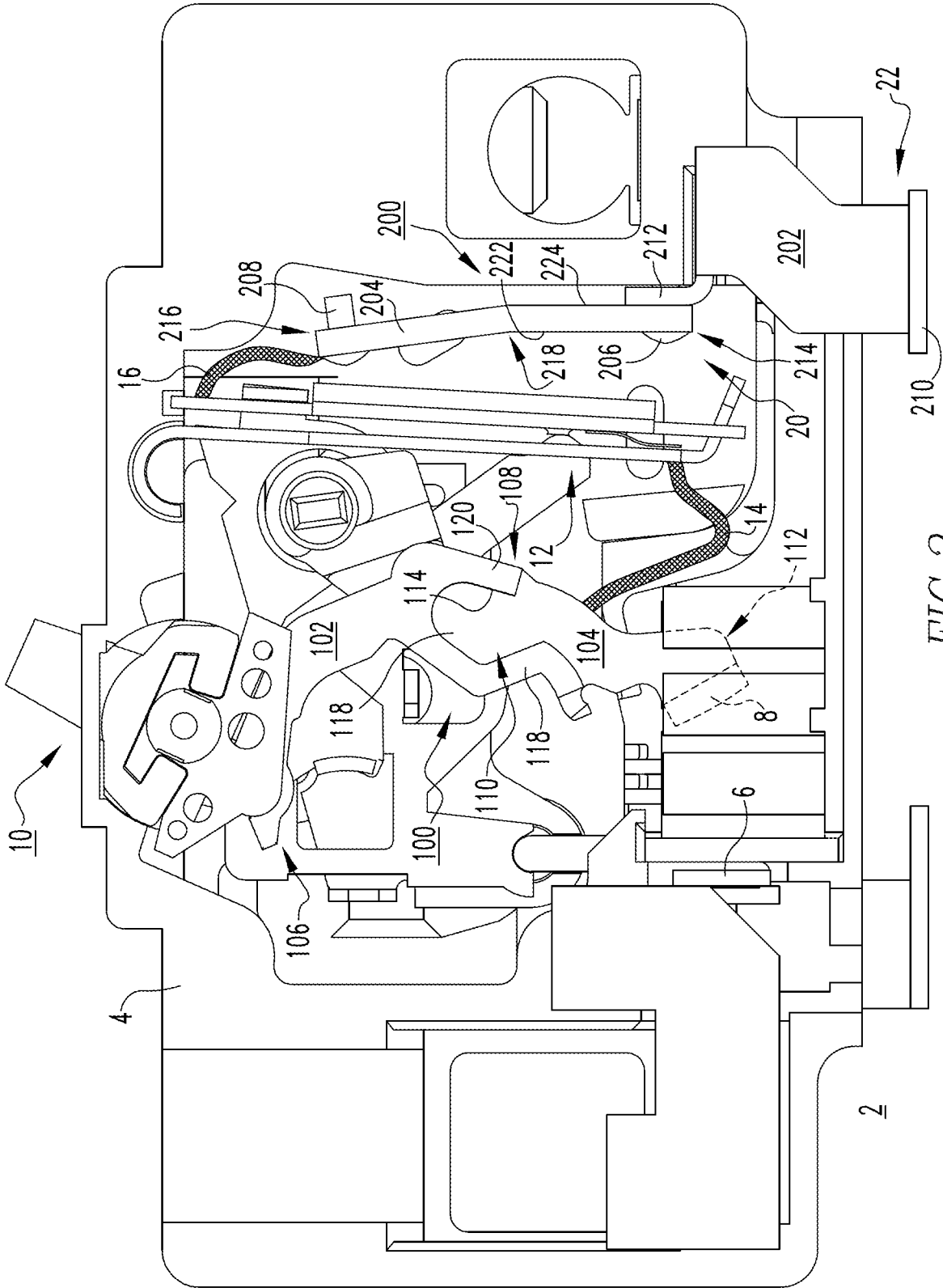


FIG. 2

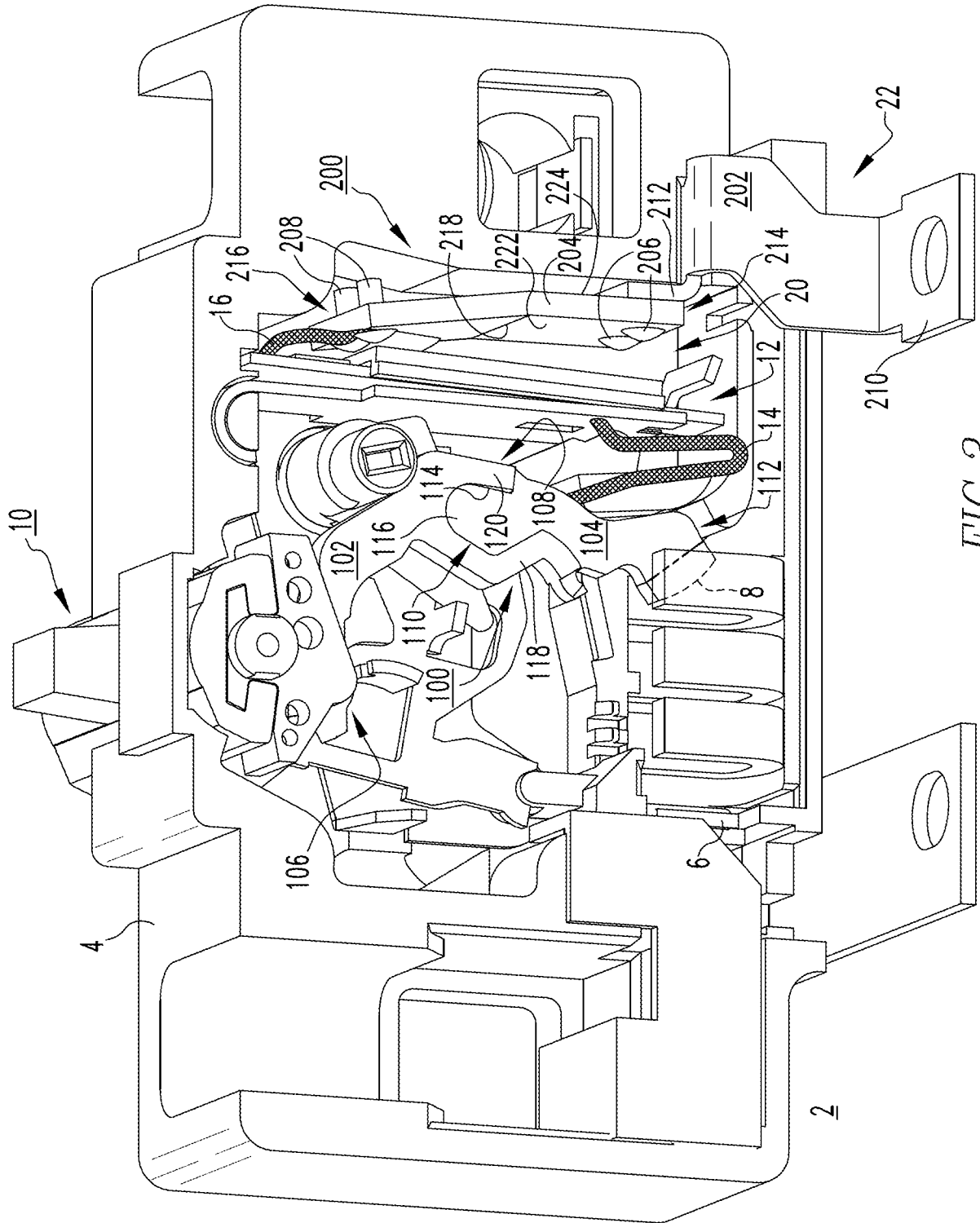


FIG. 3

