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(54) **HIGH-VOLTAGE CIRCUIT BREAKER**

HOCHSPANNUNGSLASTSCHALTER

DISJONCTEUR A HAUTE TENSION

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(73) Proprietor: **ABB AB**
721 83 Västeras (SE)

(72) Inventors:
- **SKOGH, Kerstin**
  S-771 43 Ludvika (SE)
- **STENGARD, Peter**
  S-771 43 Ludvika (SE)
- **AKESSON, Ulf**
  S-771 42 Ludvika (SE)

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Description

TECHNICAL FIELD

[0001] The present invention relates to a high-voltage circuit breaker of the kind described in the preamble to claim 1.

[0002] The invention is primarily intended for circuit breakers with rated operating voltages of the order of magnitude of 100-300 kV, but it may also be used to advantage in circuit breakers for voltages both above and below this range, for example in medium-voltage circuit breakers.

BACKGROUND ART

[0003] Circuit breakers of the above-mentioned kind are previously known, for example from the ABB pamphlet SESWG/B 2330 E "SF_6 Circuit-Breaker Type LTB", published in 1990. In the circuit breaker shown in this publication, the blast piston and an annular guide means for the operating rod are fixed to the lower connection flange of the circuit breaker via rods arranged parallel to the operating rod. The other components included in the circuit breaker, such as the movable arcing contact, the intermediate flange between the compression space (the puffer volume) and the pressure-collecting space (the self-blasting volume) etc., are fixed to the respective current path section (metal tube) by means of screw joints.

SUMMARY OF THE INVENTION

[0004] The invention aims to provide a circuit breaker of the above-mentioned kind which is simpler to manufacture, contains a smaller number of components, and has a lower contact resistance between the current path sections of the circuit breaker than comparable prior art circuit breakers. This is achieved according to the invention with a design which exhibits the characteristic features described in the claims.

[0005] By integrating the blast nozzle, the guides, the intermediate flange, the arcing contact etc. by means of a pressing operation into the respective current path section, a simplified design is obtained, which results in lower manufacturing cost because of less mounting work. At the same time, the reliability of the function is increased because the number of components are reduced and the screw joints previously used are omitted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The invention will be explained in greater detail by description of embodiments with reference to the accompanying drawings, wherein

Figure 1 shows in axial section the central part of a first embodiment of a high-voltage circuit breaker designed according to the invention, in the open contact position,

Figures 2 shows in axial section a current path section which is included in the circuit breaker according to Figure 1,

Figure 3 shows in axial section the central part of a second embodiment of a high-voltage circuit breaker designed according to the invention, wherein the part of the figure to the left of the centre line shows the circuit breaker in the closed position, and the part of the figure to the right of the centre line shows the circuit breaker in the open position, and

Figure 4 shows, in the same way as Figure 3, a third embodiment of a circuit breaker according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] The circuit breaker shown in Figure 1 has an elongated casing 10 which is made of insulating material and which is provided with an upper and a lower connection flange 11 and 12, respectively. The casing contains insulating gas, for example SF_6. The contact device of the circuit breaker comprises a fixed main contact 13 which cooperates with an axially movable main contact 14, as well as a fixed plug-shaped arcing contact 15 which cooperates with an axially movable sleeve-shaped arcing contact 16.

[0008] At the upper connection flange 11 the circuit breaker has a stationary upper current path section 17 in the form of a copper tube with a thickness of one or a few millimetres. The lower end portion of the tube is compression-moulded and slotted so as to form a large number of contact fingers which are integrated with the tube and which constitute the fixed main contact 13 of the circuit breaker. The fixed arcing contact 15 of the circuit breaker is arranged coaxially in the tube 17 and is electrically and mechanically connected thereto by means of a holder 18.

[0009] The movable main contact 14 of the circuit breaker consists of the upper end portion of a hollow cylinder 19 (puffer-type cylinder) in the form of a copper tube, which may have the same cross-section dimension as the copper tube 17. The movable arcing contact 16 is arranged coaxially in the cylinder 19 and is electrically and mechanically connected thereto. The hollow cylinder 19 encloses a pressure-collecting space 20 (the self-blasting volume), the volume of which is constant, and a compression space 21 (the puffer volume). The spaces 20 and 21 are separated by an intermediate flange 22 with openings which are covered by an annular plate serving as a nonreturn valve. At its upper end,

the hollow cylinder 19 supports an electrically insulating blast nozzle 23 with an annular channel 24, which connects the pressure-collecting space 20 to the area where the arc is burning during an opening operation. The hollow cylinder 19 with the movable contacts 14, 16 is connected, via an operating rod 25, to an operating device and can be displaced by means of this device between a closed position and the open position shown in Figure 1.

[0010] The hollow cylinder 19 surrounds the upper portion of a lower current path section 26 which is secured to the lower connection flange 12 and which consists of a copper tube with substantially the same cross-section dimension as the copper tube 17. Via sliding contact means 27, for example in the form of spiral springs of contact material, the hollow cylinder 19 is electrically connected to the lower current path section 26.

[0011] The compression space 21 is limited downwards by an annular blast piston 28 which surrounds the operating rod 25. This piston is fixed by being pressed to the upper end portion of the copper tube 26. In the same way, an annular guide washer for the operating rod 25 is pressed to the tube 26.

[0012] The circuit breaker according to Figure 1 operates as follows:

[0013] During a breaking operation, the operating rod 25 is pulled downwards with the aid of the operating device, whereby the main contacts 13 and 14 are first separated. The current thereby commutates over to the arcing contacts 15, 16 which, when separated, generate an arc between them. The arc heats the gas in the arcing region, whereby the gas pressure increases and a gas flow through the channel 24 into the pressure-collecting space 20 is started. As a result of this flow, the pressure in the pressure-collecting space 20 increases. The arc current follows the power-frequency sine curve, and when the current value approaches the zero crossing, the pressure in the arc region starts decreasing. The contact movement has now proceeded so far that the plug contact 15 has exposed the nozzle outlet, where the pressure is now lower than in the pressure-collecting space 20. This gives rise to a gas flow from the pressure-collecting space 20 through the channel 24 and the nozzle 23 to a surrounding expansion space 30. The arc is cooled through this flow and is extinguished during the next current zero-crossing.

[0014] When breaking relatively small currents, the pressure increase in the pressure-collecting space 20, generated by the arc, is insufficient to achieve an efficient flow of arc-extinguishing gas. In such cases, the arc extinction is performed with the aid of the compression space 21, in which a pressure build-up takes place during the opening process because of the downward movement of the intermediate flange 22. The pressure in the compression space 21 then becomes higher than in the pressure-collecting space 20, which causes the nonreturn valve in the intermediate flange to open and cold arc-extinguishing gas to flow from the compression space 21 via the pressure-collecting space 20 and the channel 24 to the blast nozzle 23, where the arc is cooled and extinguished.

[0015] Figure 2 shows separately the lower current path section 26 with a piston 28 and a guide washer 29 pressed to the section 26. The pressing has been accomplished by pressing the plastically machinable material in the tube 26, for example by so-called pressure turning, into prepared grooves 31 and 32, respectively, in the piston 28 and the guide washer 29. The piston 28 is also provided with grooves 33 into which tube material is pressed for forming a seat for the sliding contact means 27.

[0016] Figures 3 and 4 show examples of puffer-type circuit breakers where the blast piston 28 is directly integrated into the tubular lower current path 26. The blast piston is here formed by inwardly arching the upper end portion of the tube 26 so as to create an annular bottom with a U-shaped profile, which may be semicircular according to Figure 3 or substantially perpendicular according to Figure 4. The arched curvature imparts enormous mechanical strength to the end portion of the tube. This is particularly true of the embodiment according to Figure 3, which may be used at high pressures in the compression chamber 21. The embodiment according to Figure 4 has lower strength and is therefore intended for circuit breakers dimensioned for medium-high pressures in the chamber 21. The blast piston 28 is provided with openings 34 covered by an annular washer 35 which serves as a nonreturn valve and has a profile adapted to the shape of the blast piston 28. Through this nonreturn valve, the compression chamber 21 is refilled with arc-extinguishing gas from the expansion space 30 during a circuit-breaker closing. The end portion of the tube is also shaped with grooves for seals 36 and 37 against the hollow cylinder 19 and the operating rod 25, respectively.

[0017] The embodiment of the blast piston shown in Figures 3 and 4 is not limited to use only in connection with puffer-type circuit breakers, but may be used for all types of SF_6 circuit breakers.

Claims

1. A high-voltage circuit breaker comprising an elongated casing (10) which is filled with a gaseous arc-extinguishing medium and provided with connection flanges (11, 12), said casing comprising a contact device with cooperating fixed and movable main and arcing contacts (13-16), the fixed contacts (13, 15) being arranged at one end portion of a first metal tube (17) secured to one connection flange (11) of the circuit breaker, whereas the movable contacts (14, 16) are arranged at one end portion of a second metal tube (19), which is connected via an operating rod (25) to an operating device and

with the aid of this device is axially displaceable in the casing between a closed and an open position, wherein the second metal tube (19), via a sliding contact means (27), is permanently connected to a third metal tube (26) secured to the other connection flange (12) of the circuit breaker, and wherein the second metal tube (19) together with a blast piston (28) defines a compression space (21), **characterized** in that the metal tubes (17, 19, 26) are made of plastically machinable sheet material and that the blast piston (28) is integrated into the third metal tube (26) by plastic machining thereof.

2. A circuit breaker according to claim 1, **characterized** in that the blast piston (28) consists of a substantially rotationally symmetrical body, which is provided with at least one groove (31) arranged around the periphery of the body and is fixed to one end portion of said third metal tube (26) by pressing the plastically machinable material in the tube into the groove.

3. A circuit breaker according to claim 1, **characterized** in that the blast piston (28) consists of an inward flanging of one end portion of said third metal tube (26), shaped by plastic machining.

4. A circuit breaker according to claim 1, 2 or 3, **characterized** in that an annular guide washer (29) for guiding the operating rod (25) is fixed to said third metal tube (26) by pressing the plastically machinable material in the tube into a prepared surrounding groove (32) in the washer (29).

5. A circuit breaker according to any of the preceding claims, **characterized** in that the movable arcing contact (16) of the circuit breaker is supported by an annular body which, together with a blast nozzle (23), is fixed to one end portion of said second metal tube (19) by pressing a portion of the tube wall into a prepared surrounding groove in the body.

6. A circuit breaker according to any of the preceding claims, **characterized** in that in said second metal tube (19) there is arranged an annular intermediate flange (22) between a pressure-collecting space (20) and said compression space (21), which intermediate flange is fixed to the tube (19) by pressing a portion of the tube wall into a prepared surrounding groove in the flange.

7. A circuit breaker according to any of the preceding claims, **characterized** in that the material in said metal tubes (17, 19, 26) is copper or a copper alloy.

8. A circuit breaker according to any of the preceding claims, **characterized** in that the metal tubes (17, 19, 26) are made of sheet with a thickness of at most 4 mm.

9. A method for manufacturing a circuit breaker according to any of the preceding claims, **characterized** in that the main current path of the circuit breaker is made of a number of plastically machinable, circular-cylindrical metal tubes (17, 19, 26), preferably of copper or a copper alloy, and that the blast piston (28) and any other components included in the circuit breaker are integrated into the respective metal tube by plastic machining thereof, for example by so-called pressure turning.

Patentansprüche

1. Hochspannungslastschalter mit länglichem Gehäuse (10), das mit einem gasförmigen bogenlöschenden Medium gefüllt und mit Anschlußflanschen (11, 12) versehen ist, wobei das Gehäuse eine Kontaktvorrichtung mit zusammenwirkenden, stillstehenden und beweglichen Haupt- und Bogenkontakten (13-16) umfaßt, wobei die stillstehenden Kontakte (13, 15) am einen Giebelbereich eines ersten, am einen Anschlußflansch (11) des Lastschalters befestigten Metallrohres (17) angeordnet sind, wogegen die beweglichen Kontakte (14, 16) an einem Giebelbereich eines zweiten Metallrohres angeordnet sind, das über eine Bedienungsstange (25) an die Bedienungsvorrichtung angeschlossen ist und mit Hilfe dieser Vorrichtung achsial im Gehäuse zwischen einer Anschluß- und einer Abschaltstellung verschiebbar ist, wobei das zweite Metallrohr (19) über eine Gleitkontaktvorrichtung (27) ständig an ein drittes, am anderen Anschlußflansch des Lastschalters befestigten Metallrohr (26) angeschlossen ist und wo das zweite Metallrohr (19) zusammen mit einem Löschkammerkolben (28) einen Druckraum (21) begrenzt, **dadurch gekennzeichnet**, daß die Metallrohre (17, 19, 26) aus plastisch verformbaren Plattenwerkstoff hergestellt sind und daß der Löschkammerkolben (28) in das dritte Metallrohr (26) durch plastische Bearbeitung desselben eingefügt ist.

2. Lastschalter gemäß Patentanspruch 1, **dadurch gekennzeichnet**, daß der Löschkammerkolben (28) aus einem im wesentlichen rotationssymmetrischen Körper besteht, der mit mindestens einer Nut (31) versehen ist, die den Umkreis des Körpers umgibt und an einem Giebelbereich dieses dritten Metallrohres (26) dadurch befestigt ist, daß plastisch verformbares Material des Rohres in die Nut gepresst wird.

3. Lastschalter gemäß Patentanspruch 1, **dadurch gekennzeichnet**, daß der Löschkammerkolben (28) aus einem inneren Anflanschen des einen Gie-

belbereiches dieses dritten Metallrohres (26) mit Hilfe plastischer Verformung besteht.

4. Lastschalter gemäß Patentanspruch 1, 2 oder 3, **dadurch gekennzeichnet**, daß eine rohrförmige Führungsscheibe (29) zum Führen der Bedienungsstange (25) an diesem dritten Metallrohr (26) befestigt ist, indem plastisch verformbarer Werkstoff des Rohres in eine bereitgestellte, umgebende Nut (32) in der Scheibe (29) gepresst wird.

5. Lastschalter gemäß irgendeinem der vorhergehenden Patentansprüche, **dadurch gekennzeichnet**, daß der bewegliche Bogenkontakt (16) des Lastschalters von einem ringförmigen Körper getragen wird, der zusammen mit einer Löschkammerdüse (23) am einen Giebelbereich dieses zweiten Metallrohres (19) befestigt ist, indem ein Teil der Rohrwand in eine bereitgestellte, umgebende Nut im Körper gepresst wird.

6. Lastschalter gemäß irgendeinem der vorhergehenden Patentansprüche, **dadurch gekennzeichnet**, daß in diesem zweiten Metallrohr (19) ein ringförmiger Zwischenflansch (22) zwischen einem druckaufnehmenden Raum (20) und diesem Druckraum (21) angeordnet ist, wobei der Zwischenflansch am Rohr (19) befestigt ist, indem ein Bereich der Rohrwand in eine bereitgestellte Nut im Flansch gepresst wird.

7. Lastschalter gemäß irgendeinem der vorhergehenden Patentansprüche, **dadurch gekennzeichnet**, daß das Material dieser Metallrohre (17, 19, 26) Kupfer oder eine Kupferlegierung ist.

8. Lastschalter gemäß irgendeinem der vorhergehenden Patentansprüche, **dadurch gekennzeichnet**, daß die Metallrohre (17, 19, 26) aus einer Platte einer Dicke von höchstens 4 mm hergestellt sind.

9. Herstellungsverfahren für einen Lastschalter gemäß irgendeinem der vorhergehenden Patentansprüche, **dadurch gekennzeichnet**, daß die Hauptstrombahn des Lastschalters aus einer Anzahl plastisch verformbarer, kreisrund-zylindrischer Metallrohre (17, 19, 26), vorzugsweise aus Kupfer oder einer Kupferlegierung, hergestellt ist und daß der Löschkammerkolben (28) und jedwede weitere Bestandteile des Lastschalters in das entsprechende Metallrohr durch dessen plastische Verformung, beispielsweise mit Hilfe von Drücken eingefügt sind.

Revendications

1. Disjoncteur à haute tension, comportant un boîtier (10) oblong qui est empli d'un fluide gazeux extincteur d'arc et qui est muni de rebords (11, 12) de connexion, le boîtier comportant un dispositif de contact ayant des contacts (13-16) coopérant fixes et mobiles de formation d'arcs et principaux, les contacts (13, 15) fixes étant disposés à une partie d'extrémité d'un premier tube (17) métallique fixé à un rebord (11) de connexion du disjoncteur, tandis que les contacts (14, 16) mobiles sont disposés à une partie d'extrémité d'un second tube (19) métallique, qui est connectée par l'intermédiaire d'une tige (25) d'actionnement à un dispositif d'actionnement et à l'aide de ce dispositif peut être déplacée axialement dans le boîtier entre une position fermée et une position ouverte, dans lequel le second tube (19) métallique, par l'intermédiaire de moyens (27) de contact coulissant, est relié de manière permanente à un troisième tube (26) métallique fixé à l'autre rebord (12) de connexion du disjoncteur, et dans lequel le second tube (19) métallique, définit ensemble avec un piston (28) de soufflage, un espace (21) de compression, caractérisé en ce que les tubes (17, 19, 26) métalliques sont réalisés en un matériau en feuille usinable plastiquement et en ce que le piston (28) de soufflage est intégré dans le troisième tube (26) métallique par usinage plastique de celui-ci.

2. Disjoncteur suivant la revendication 1, caractérisé en ce que le piston (28) d'échappement est constitué d'un corps sensiblement symétrique de révolution, qui est muni d'au moins une rainure (31) disposée à la périphérie du corps et qui est fixé à une partie d'extrémité du troisième tube (26) métallique par pressage du matériau usinable plastiquement du tube dans la rainure.

3. Disjoncteur suivant la revendication 1, caractérisé en ce que le piston (28) de soufflage est constitué d'un rebord dirigé vers l'intérieur d'une partie d'extrémité du troisième tube (26) métallique, formée par usinage plastique.

4. Disjoncteur suivant la revendication 1, 2 ou 3, caractérisé en ce qu'une rondelle (29) de guidage annulaire destinée à guider la tige (25) d'actionnement est fixée au troisième tube (26) métallique par pressage du matériau usinable plastiquement du tube dans une rainure (30) préparée et qui l'entoure de la rondelle (29).

5. Disjoncteur suivant l'une quelconque des revendications précédentes, caractérisé en ce que le contact (16) mobile de formation d'arc du disjoncteur est supporté par un corps annulaire qui, avec une buse (23) de soufflage, est fixé à une partie d'extrémité du second tube (19) métallique en pressant une partie de la paroi de tube dans une rainure l'en-

tourant et préparée du corps.

6. Disjoncteur suivant l'une quelconque des revendications précédentes, caractérisé en ce que dans le second tube (19) métallique, il est prévu un rebord (22) annulaire intermédiaire entre un espace (20) collecteur de pression et l'espace (21) de compression, le rebord intermédiaire étant fixé au tube (19) par pressage d'une partie de la paroi de tube dans une rainure entourante et préparée du rebord.

7. Disjoncteur suivant l'une quelconque des revendications précédentes, caractérisé en ce que le matériau des tubes (17, 19, 26) métalliques est du cuivre ou un alliage à base de cuivre.

8. Disjoncteur suivant l'une quelconque des revendications précédentes, caractérisé en ce que les tubes (17, 19, 26) métalliques sont réalisés à partir de feuille ayant une épaisseur d'au plus 4 mm.

9. Procédé pour fabriquer un disjoncteur suivant l'une quelconque des revendications précédentes, caractérisé en ce que le trajet de courant principal du disjoncteur est constitué d'un certain nombre de tubes (17,19, 26) métalliques cylindro-circulaires et usinables plastiquement, de préférence en cuivre ou en alliage à base de cuivre, et en ce que le piston (28) de soufflage et tous autres éléments inclus dans le disjoncteur sont intégrés dans le tube métallique respectif par l'usinage plastique de celui-ci, par exemple par ce que l'on appelle un usinage au tour sous pression.

Fig. 1

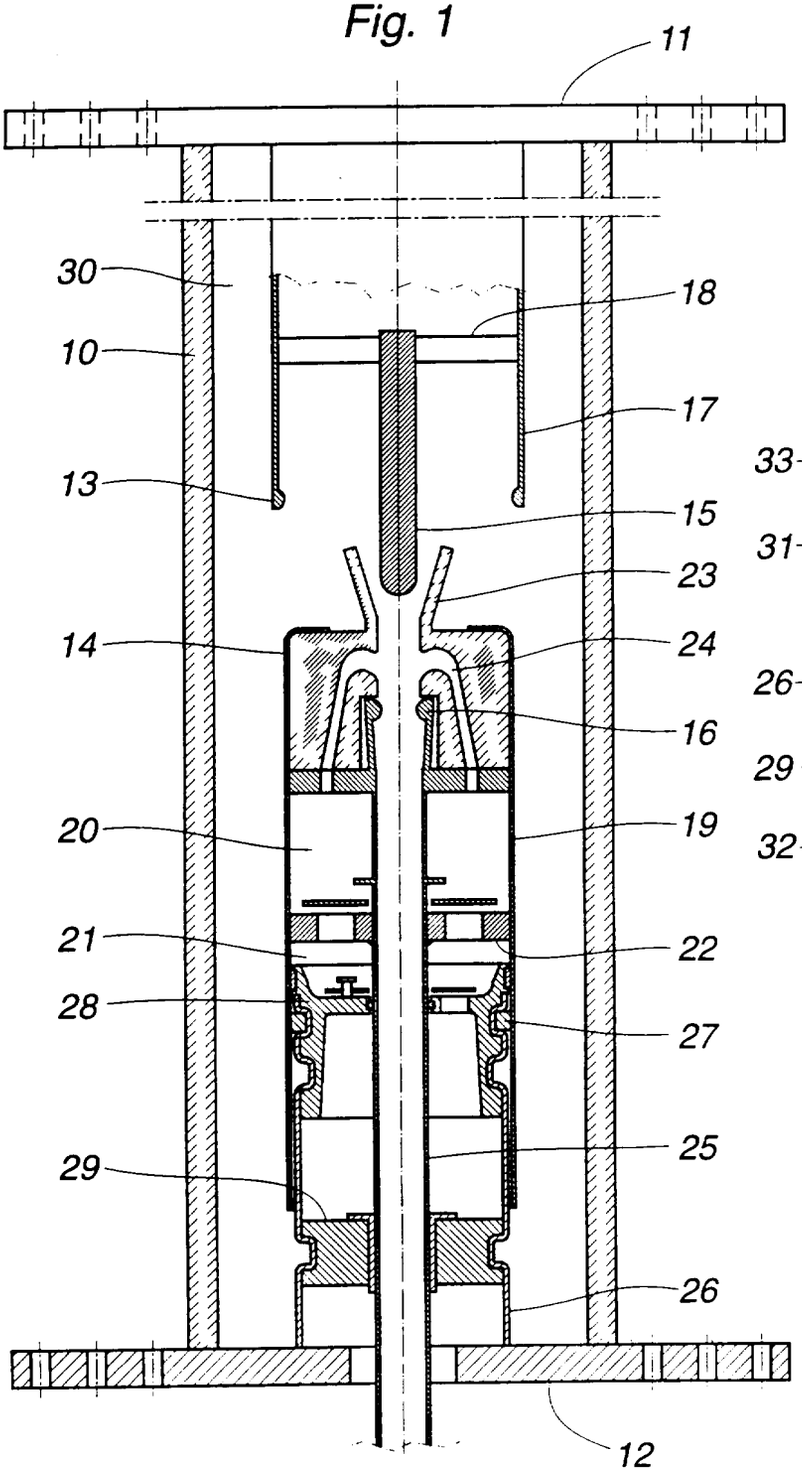
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Fig. 2

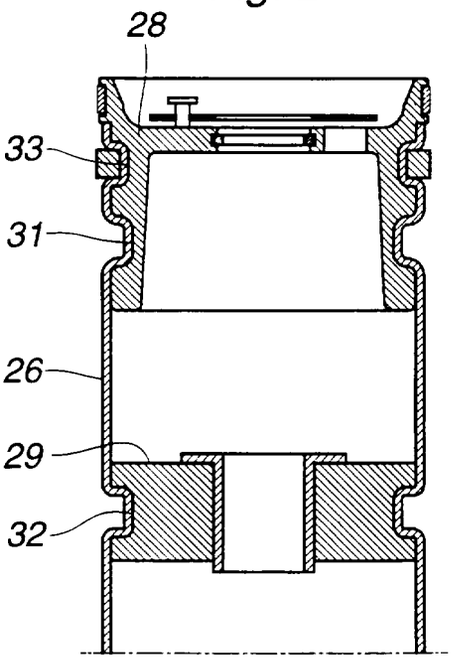
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FIG. 4

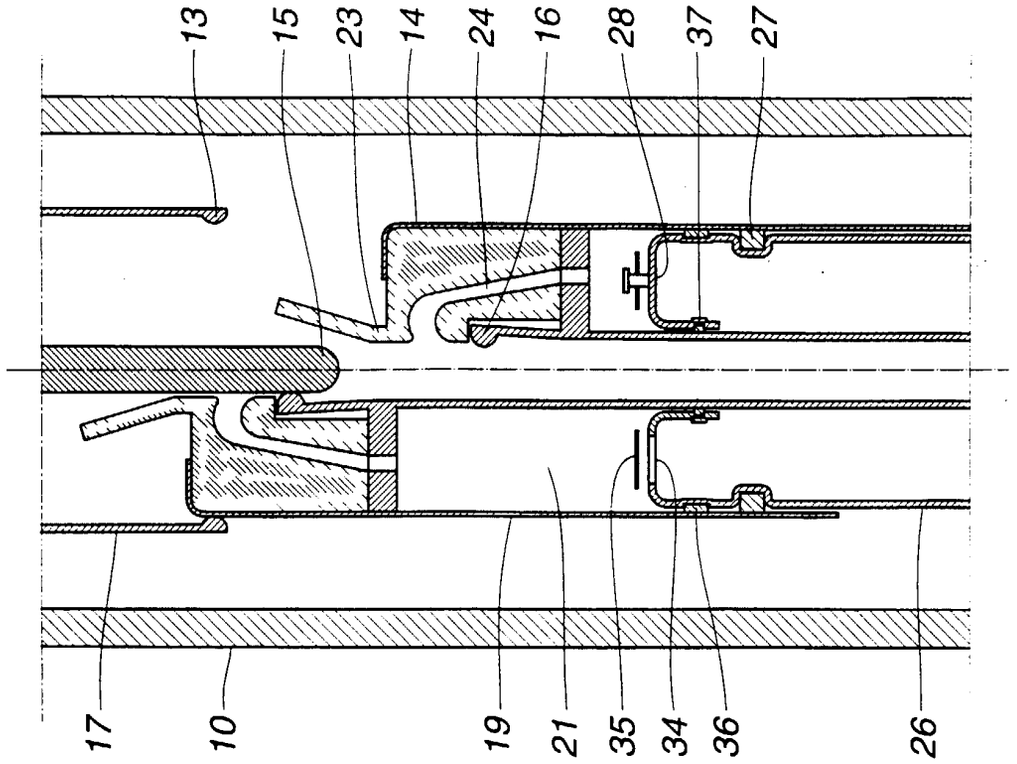
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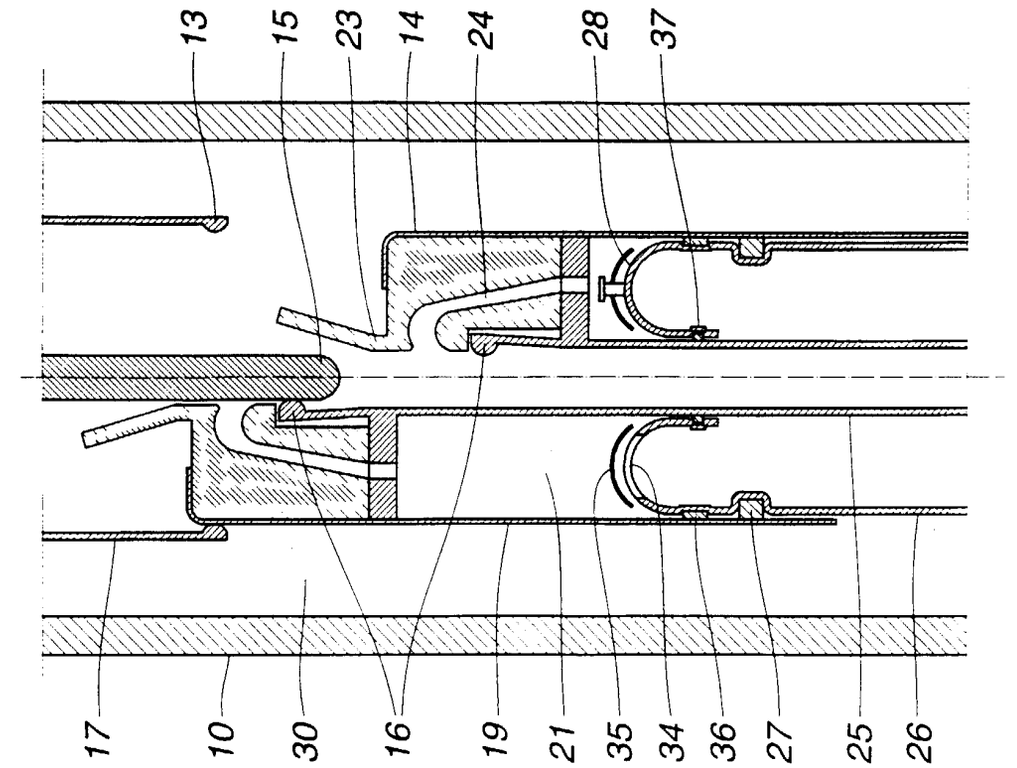
FIG. 3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