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(54) **VACUUM CIRCUIT BREAKER**

VAKUUM-UNTERBRECHERSCHALTER

COUPE-CIRCUIT A VIDE

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Description

Technical Field

[0001] The invention is related to electrical engineering, particularly to vacuum circuit breaker.

Background Art

[0002] The vacuum circuit breaker having vacuum interrupter, electromagnetic drive, opening springs and compression springs is known [1].

[0003] Its kinematic scheme comprises a large quantity of friction assemblies loaded, which results in low reliability and working life of the apparatus.

[0004] The closest in design is the vacuum circuit breaker of TEL line, having drives in segregated - phase arrangement with magnetic latch and synchronizing shaft [2].

[0005] Disadvantages of this design include considerable length of pulling insulator, relatively high resistance of movable conducting element (flexible current shunt), complexity of magnetic actuator, low rated current due to hindered natural cooling of contact terminals, difficulty in manual tripping and remote mechanical indication of main contact positions, difficulties in connecting up socket contacts and designing interlock mechanisms for various application projects.

[0006] The invention solves the problem of providing a vacuum circuit breaker having reduced dimensions and cost, while increasing main performance parameters.

[0007] The technical effect of applying the invention as claimed includes: reduction in traction insulator length, reduction in resistance of movable conducting element, simplification and cost reduction of the magnetic actuator, increase of rated current due to improvement in cooling contact terminals, reduction of the force required for manual tripping, solution of the problem of remote mechanical indication for main contacts, connecting up socket contacts and their simplified designs, facilitation of the task of hooking up interlock mechanisms.

Disclosure of Invention

[0008] The vacuum circuit breaker is characterized in that the traction insulation therein is embodied in such a way that component parts energized by different potentials are covered with insulation, immovable part of the insulation being embodied with a tubular fragment located coaxially inside the insulation sleeve, which is a part of the traction insulator, and resilient conductive spirals are used as movable conducting elements, having a possibility of rolling between surfaces, at least one of which possesses teeth, with the teeth oriented in the direction of motion, two convolutions of said spirals being located between the teeth, and drive magnetic systems constitute two bowl - shaped components made of high - coercivity material with a coil located inside, one bowl - shaped component being attached to the circuit breaker base, the other being attached to the traction insulator, and contact terminals are made of aluminium alloy using extrusion process followed by subsequent mechanical finishing, and the manual deenergization generator constitutes a closed magnetic system having a possibility of mechanical opening thereof, comprising permanent magnet and coil electrically connected with coils of circuit breaker drives, and the manual deenergization button is in a rigid connection with the magnetic system element in such a way that the operation direction coincides with the direction of magnetic system opening, the vacuum circuit breaker is equipped with remote indicator of main contact positions connected with the mechanism of the synchronizing shaft with the flexible link embodied as an encapsulated wire cable, and also equipped with socket contacts having separators made of aluminium alloy, manufactured using extrusion process, and equipped with an interlock shaft having a cam for mechanical opening and interlocking the drive in the deenergized state, and a lever for electrical interlocking.

[0009] The essence of the invention consists in the fact that the traction insulator and immovable insulation tubular fragment provide labyrinth air-gap between high potential and the earth in such a way that the breakdown path in the air has segments directed oppositely to the direction of the electrical field.

[0010] Spiral conducting elements rolling in the course of vacuum circuit breaker operation between movable and immovable surfaces provide a permanent multiple - point contact because each half - turn is a separate conductor, which makes it possible to reach low values of transient resistance.

[0011] The drive magnetic system consisting of two bowl - shaped component parts made of high - coercivity material makes it possible to implement a simple and reliable drive with magnetic latch.

[0012] Manufacturing the contact terminals by extrusion process followed by subsequent cutting the sections of required length from the profile considerably reduces the cost of the ready article in comparison with other processes of component manufacturing, for example, casting.

[0013] Employment of the manual deenergization generator facilitates designing distribution devices because the generator is not mechanically connected with the vacuum circuit breaker and may be mounted, similarly to the remote indicator of main contact position, in any convenient place.

[0014] Extrusion process of manufacturing followed by subsequent cutting the sections of required length considerably reduces the cost of socket contact separators. Employment of the interlock shaft makes it possible implement interlocking without mechanical loading of the synchronizing shaft in the course of operation of the vacuum circuit breaker.

Brief Drawings Description

[0015] The general layout of the vacuum circuit breaker is presented in Fig.1, the plane section for a module of one of the phases is presented for the vacuum circuit breaker in enabled position in Fig. 2, and for the vacuum circuit breaker in disabled position in Fig. 3, the contact terminals are shown in Fig. 4, the principle of contacting for the spiral current collector in cases of one and two toothed surfaces is presented in Fig. 5 and Fig. 6 accordingly, the plane section of the manual deenergization generator is provided in Fig. 7, the construction design of a socket contact is presented in Fig. 8.

Detailed Drawings Description

[0016] The vacuum circuit breaker comprises phase modules mounted on metal base 1, inside which drives with magnetic latch are situated, comprising stator 2, armature 3 and coil 4, opening spring 5, synchronizing 6 and interlock 7 shafts, block contacts. Cam 8 is situated at the end of interlock shaft 7. The phase modules comprise supporting insulators 9, with vacuum chambers 10 embedded in silicone rubber positioned inside, contact terminals 11, 12, compression spring 13 and traction insulators 14.

[0017] Drive stator 2 faced to contact terminal 11 is covered with hard insulation 15 with the tubular fragment 16. Spiral conducting elements 17 are situated in the clearance between contact terminal 11 I and movable contact bush 18. Indicator of contact positions 19 is connected with synchronizing shaft 6 with the encapsulated wire shaft. Manual deenergization generator 20 with armature 21 is electrically connected with windings of drive coils 4. Socket contacts 22 comprise separators 23, lamels 24 and plate springs 25.

The Best Mode for Carrying Out the Invention

[0018] The device operates in the following way. When a current pulse is provided to drive coils 4, closing stator 2 and armature 3 occurs, which is accompanied by compression of opening 5 and compression 13 springs, and closing contacts of vacuum chambers 10 occurs. Stator 2 and armature 3 may be in closed position infinitely, because they are made of high - coercivity material, retaining therein the residual magnetic flux. When a negative - sequence current pulse is provided to coils 4, "resetting" of the magnetic latch from the drive occurs, and by the action of springs 5 and 13, the drive returns to the position presented in Fig. 3, contacts of vacuum chambers 10 are disconnected. In the course of drive operation, the synchronizing shaft turns to a certain angle, moving the indicator 19 from one position to another. Furthermore, the shaft turn brings about actuation of block contacts (not shown in the Fig. 3). When movable contacts of vacuum chambers 10 and bushes 18 are moved, spiral conducting elements 17 roll between elements 18 and 11. ensuring permanent contact between them. Forces of contact pressures are shown by arrows in Fig. 5 and Fig. 6 for turns of resilient spiral conducting elements in cases of one (Fig. 5) or two (Fig. 6) toothed surfaces.

[0019] The principle of labyrinth insulation is shown in Fig. 2, wherein possible path of the breakdown in air between terminal 11 and component parts energized by the earth potential is indicated by arrows.

[0020] While working power is lacking, manual deenergization may be performed using manual deenergization generator 20 by moving its armature 21, resulting in opening the magnetic system enabling the permanent magnet, and inducing a current pulse in the coil of manual deenergization generator 20, fed to drive coils 4, leading to "resetting" of the latter from the magnetic latch.

[0021] Manual deenergization also may be performed by mechanical disconnection of stator 2 from armature 3 through turning interlock shaft 7, which detaches armature 3 from stator 2 with its cam. Turning of the interlock shaft 7 is performed by 90°, and its design is such that it may be situated only in one of two stable positions of Fig. 2 and Fig. 3.

[0022] Toggling of interlock shaft 7 with its latching from the position of Fig. 2 to the position of Fig. 3 is accompanied by disconnecting drive circuits (electrical interlocking, not shown in the Fig. 3), mechanical opening drives, if they are closed, mechanical interlocking drives to prevent its enabling, in case of incapacitation of the electrical interlocking.

Industrial Applicability

[0023] The extrusion process of manufacturing articles 11, 12, 23 of complicated spatial shape enables considerable reduction of the cost of the vacuum circuit breaker as claimed. Contact terminals 11 and 12 are also radiators of natural convective cooling of the vacuum circuit breaker, which enables increasing of the current rating.

[0024] Multiple contact spiral current collector 17 enables obtaining low values of transient resistance, unobtainable for other designs of similar dimensions.

[0025] Manual deenergization generator 20 and indicator of contact position 19 may be mounted in any convenient place because they are not in a rigid mechanical connection with the vacuum circuit breaker.

[0026] Application of the interlock shaft makes it possible to develop simple and reliable interlock systems for any type of factory - assembled distribution devices.

[0027] Information sources:

1. SU № 1552250, H 01 H 33/66, 1990.
2. RU № 2020631, H 01 H 33/66, 1992.

Claims

1. A vacuum circuit breaker comprising vacuum chambers (10), supporting (9) and traction insulation (14),

drives in segregated - phase arrangement with magnetic latches and common synchronizing shaft (6), **characterized in that**, with the purpose of decreasing dimensions, the traction insulation (14) is embodied in such a way that component parts energized by different potentials are covered with insulation, immovable part of the insulation (15) being made as having a tubular fragment (16) located coaxially inside insulation sleeve, which is a part of the traction insulator (14).

2. A vacuum circuit breaker according to claim 1, **characterized in that**, as a movable current - conducting element, resilient conductive spirals are used capable of rolling between surfaces, at least one of which possesses teeth, with the teeth oriented in the direction of motion, two turns of above-mentioned spirals being located between teeth.

3. A vacuum circuit breaker according to any of claims 1, 2, **characterized in that** drive magnetic systems constitute two bowls made of high - coercivity material with a coil located inside, one bowl being attached to the circuit breaker base, the other being attached to the traction insulator.

4. A vacuum circuit breaker according to any of claims 1, 2, 3, **characterized in that** contact terminals are made of aluminium alloy by extrusion process followed by subsequent mechanical finishing.

5. A vacuum circuit breaker according to any of claims 1, 2, 3, 4, **characterized in that** it is equipped with manual deenergization generator constituting a closed magnetic system capable of mechanical opening thereof, comprising a permanent magnet and a coil electrically connected with coils of circuit breaker drives, and the manual deenergization button is in a rigid connection with the magnetic system element in such a way that the operation direction coincides with the direction of magnetic system opening.

6. A vacuum circuit breaker according to any of claims 1 - 5, **characterized in that** it is equipped with remote indicator of main contact position, being connected with the mechanism of synchronizing shaft with the help of flexible connection in the form of encapsulated wire cable.

7. A vacuum circuit breaker according to any of claims 1 - 6, **characterized in that** it is equipped with socket contacts having separators made of aluminium alloy, manufactured using extrusion process.

8. A vacuum circuit breaker according to any of claims 1 - 7, **characterized in that** it is equipped with interlock shaft having a cam for mechanical opening and interlocking the drive in the deenergized state, and a lever for electrical interlocking.

Patentansprüche

1. Vakuum-Unterbrecherschalter, enthaltend Vakuumkessel, Bezugsun Schubisolierung, Antriebe mit getrennten Phasen und magnetischen Schnappern und eine gemeinsame Synchronisierwelle, **dadurch gekennzeichnet, daß** zwecks der Verkleinerung der Außenmaße die Schubisolierung so ausgebildet ist, daß die Schaltungselemente, die verschiedene Potenziale haben, mit der Isolierung verdeckt sind, wobei der unbewegliche Teil der Isolierung ein röhriges Fragment hat, das gleichachsig innerhalb des Isolierglases untergebracht ist, wobei das Isolierglas ein Teil des Schubisolators ist.

2. Vakuum-Unterbrecherschalter nach Anspruch 1, **dadurch gekennzeichnet, daß** als ein stromführendes Element elastische Spiralen genutzt sind, die zwischen den Flächen abrollen können, und wenigstens eine Spirale verzahnt ist, und die Zähne in der Richtung der Bewegung gerichtet sind, wobei zwei Windungen der genannten Spiralen zwischen den Zähnen liegen.

3. Vakuum-Unterbrecherschalter nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** die Magnetiksysteme der Antriebe zwei Schalen aus Dauermagnetwerkstoff mit einer innenliegenden Rolle vorstellen, wobei eine Schale zu der Gründung des Unterbrecherschalters befestigt ist und die andere zu dem Schubisolator befestigt ist.

4. Vakuum-Unterbrecherschalter nach einem der Ansprüche 1, 2, 3, **dadurch gekennzeichnet, daß** die Kontaktterminale aus einer Aluminiumlegierung mittels Strangpreßverfahrens mit anschließender mechanischen Bearbeitung hergestellt sind.

5. Vakuum-Unterbrecherschalter nach einem der Ansprüche 1, 2, 3, 4, **dadurch gekennzeichnet, daß** der Unterbrecherschalter einen Handauflösungsgenerator hat, der ein geschlossenes Magnetiksystem vorstellt, das mechanisch abgeschaltet werden kann und einen Dauermagnet und eine Spule hat, wobei die Spule mit den Spulen der Antriebe des Shalters elektrisch verbunden ist und die Handauflösungsdrucktaste fest mit dem Element des Magnetiksystems auf solche Weise verbunden ist, daß die Richtung der Betätigung der Öffnungsrichtung des Magnetiksystems entspricht.

6. Vakuum-Unterbrecherschalter nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, daß** der Unterbrecherschalter eine abgesetzte Schaltstel-

lungsanzeige hat, verbunden mit dem Mechanismus der Synchronisierwelle des Unterbrecherschalters mittels Zugmittel in Form eines ummantelten Seiles.

7. Vakuum-Unterbrecherschalter nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, daß** der Unterbrecherschalter Steckkontakte hat, umfassend Separatoren aus Aluminiumlegierung, die mittels Extrudieren hergestellt ist.

8. Vakuum-Unterbrecherschalter nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, daß** der Unterbrecherschalter eine Blockrolle mit einem Nokken für mechanische Unterbrechung und Antriebsblockierung im Abschaltzustand und einen Hebel für elektrische Verriegelung umfasst.

Revendications

1. Coupe-circuit à vide qui comporte une boite à vide, une isolation de soutien, un bloc d'entraînement unipolair avec des loquets magnétiques et un axe de synchronization uni **caractérisé en ce que** la réalisation de l'isolation de soutien dans laquelle les details de potentials différents sont couverts par l'isolation, une part immobile de laquelle est faite avec le fragment tubulaire, placé coaxialement dans un verre isolant qui est une part de l'isolation de soutien, ce que est fait pour la diminution des gabarits.

2. Coupe-circuit à vide selon la revendication 1, **caractérisé en ce que** l'élément conducteur mobile qui est représenté par des spirales élastiques conductrices avec la possibilité de rouler entre les surfaces, l'une de quelles est une surface dentée dont les dents sont orientée sur guidage du mouvement, et avec cela deux spires des spirales susmentionnées est situées entre les dents.

3. Coupe-circuit à vide selon la revendication 1 ou la revendication 2, **caractérisé en ce que** le système magnétique des blocs d'entraînement qui sont représentés par deux chambers faites de matériaux magnétique stable avec la bobine à intérieur, en cela une chamber est attaché sur l'embasement de l'interrupteur, une autre est fixé à l'isolation de soutien.

4. Coupe-circuit à vide selon l'une quelconque des revendications 1, 2, 3, **caractérisé en ce que** les terminaux de contact qui sont faits de l'alliage extrudé d'aluminium avec le traitement mécanique.

5. Coupe-circuit à vide selon l'une quelconque des revendications 1, 2, 3, 4, **caractérisé en ce que** le générateur de débranchement de mains qui représente le système magnétique fermé avec la possibilité de la rupture mécanique, en cela ce système comporte un aimant constant et une bobine qui est connectée avec les bobines des blocs d'entraînement, en cela le bouton de débranchement de mains est fixé à l'élément du système magnétique et le guidage du mouvement correspond au guidage de la rupture du système magnétique.

6. Coupe-circuit à vide selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** la présence de l'indicateur extérieur de position des contacts essentiels avec le mécanisme qui synchronise l'axe de l'interrupteur par l'agent de liaison flexible représenté par le câble armuré.

7. Coupe-circuit à vide selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** les contacts femelles avec les séparateurs qui sont faits de l'alliage extrudé d'aluminium.

8. Coupe-circuit à vide selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** l'axe de blocage avec le talon de rupture mécanique et de blocage de bloc d'entraînement en position de l'arrêt d'alimentation et par le levier de blocage électrique.

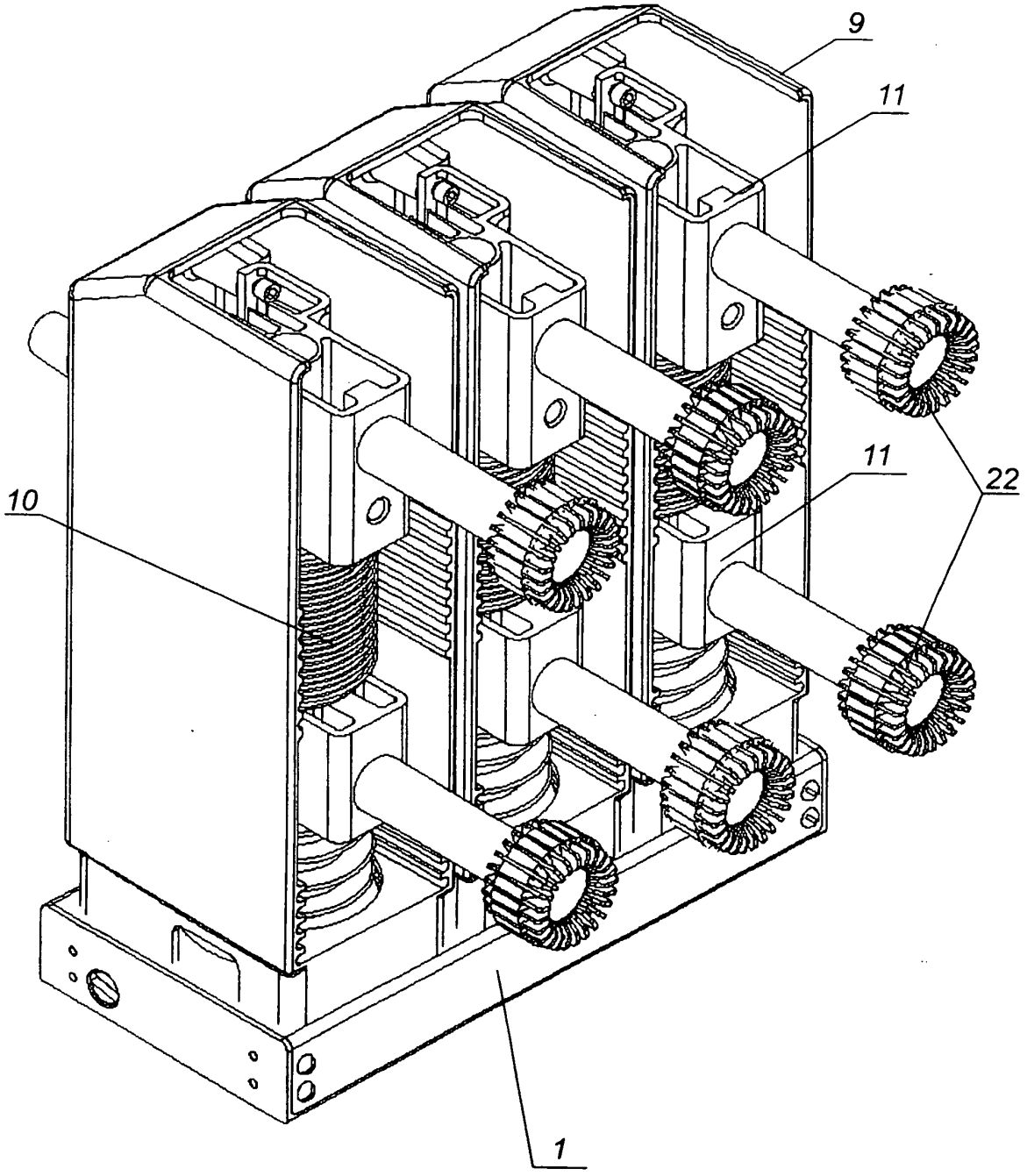

Fig.1

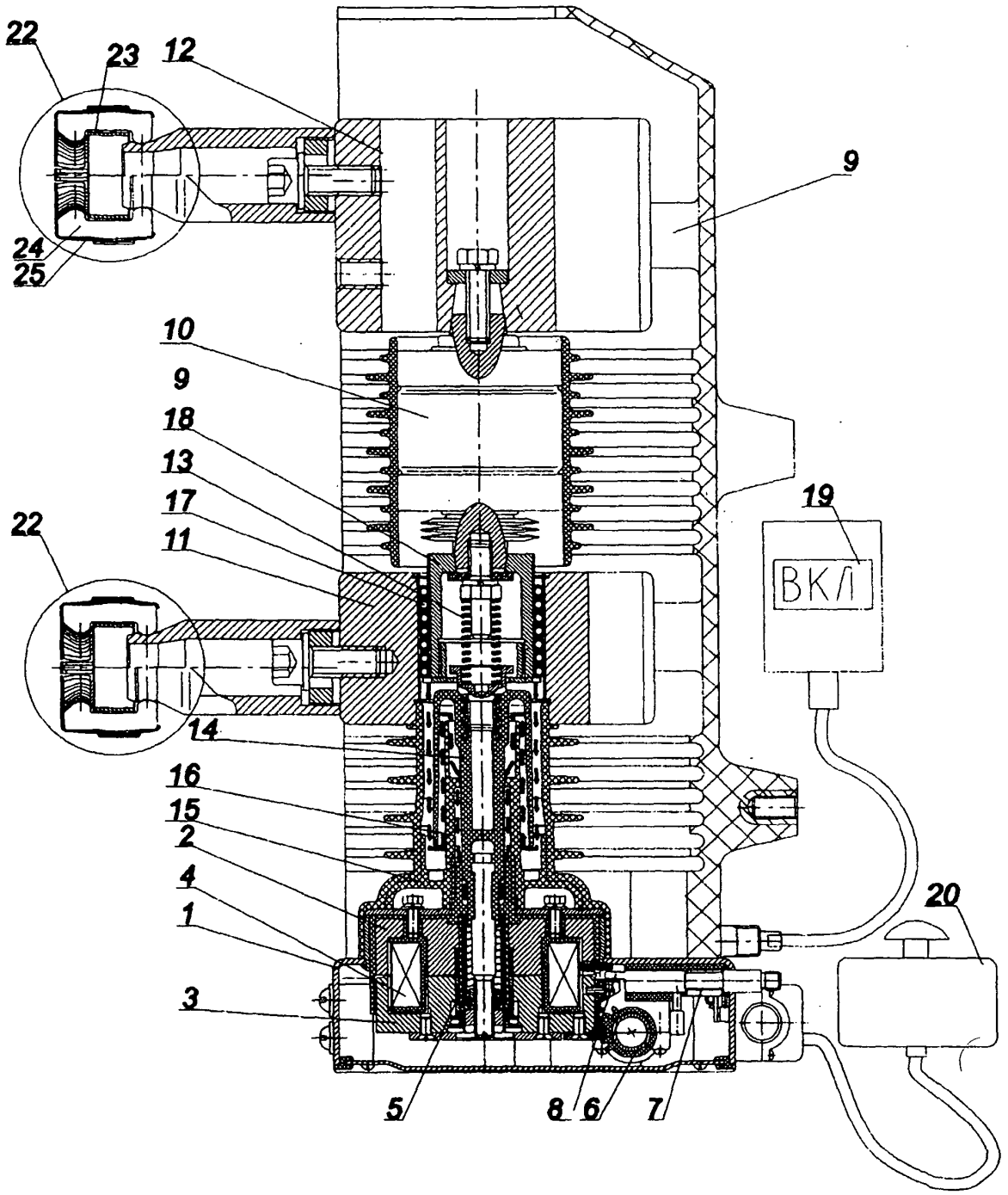

Fig.2

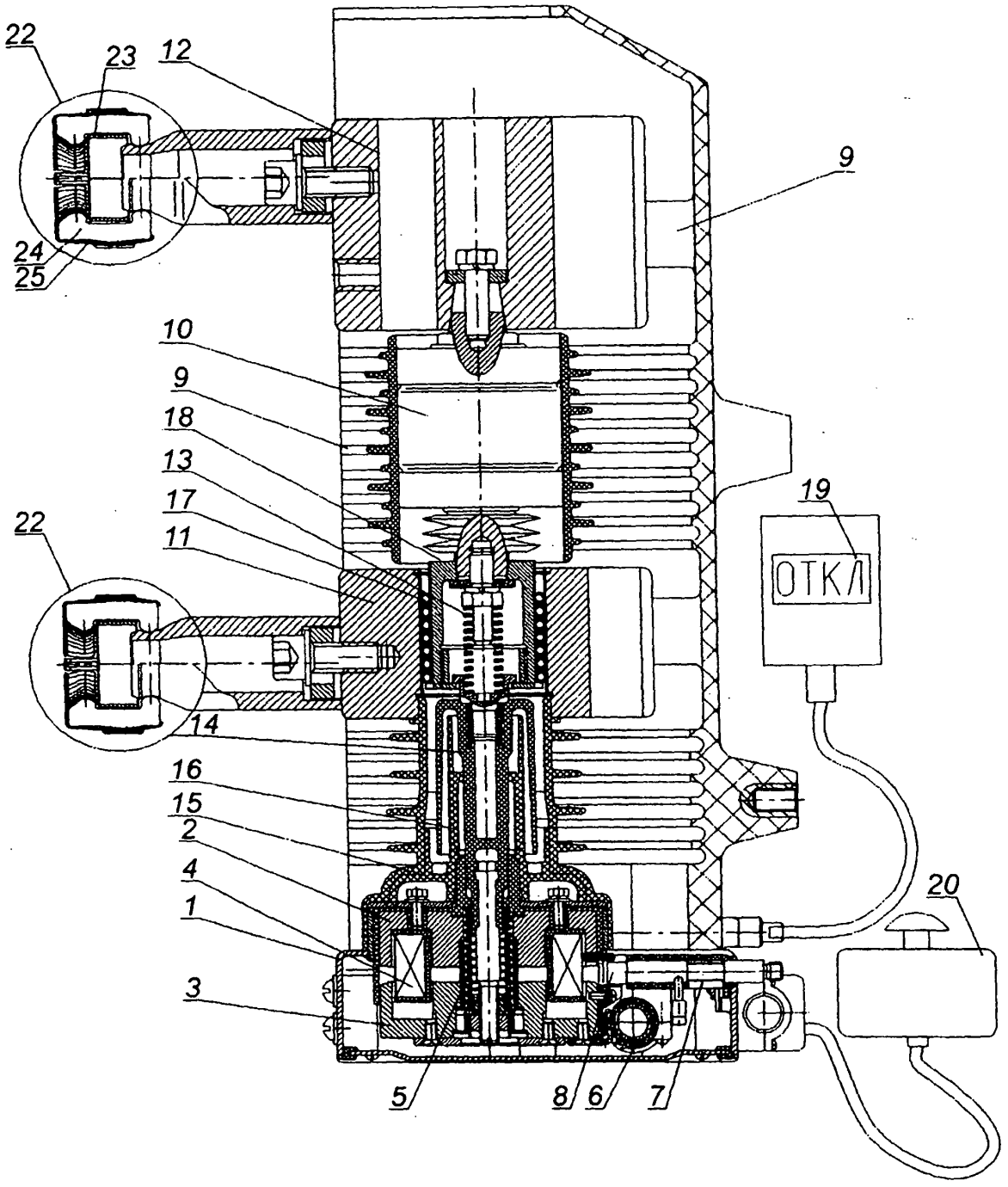

Fig.3

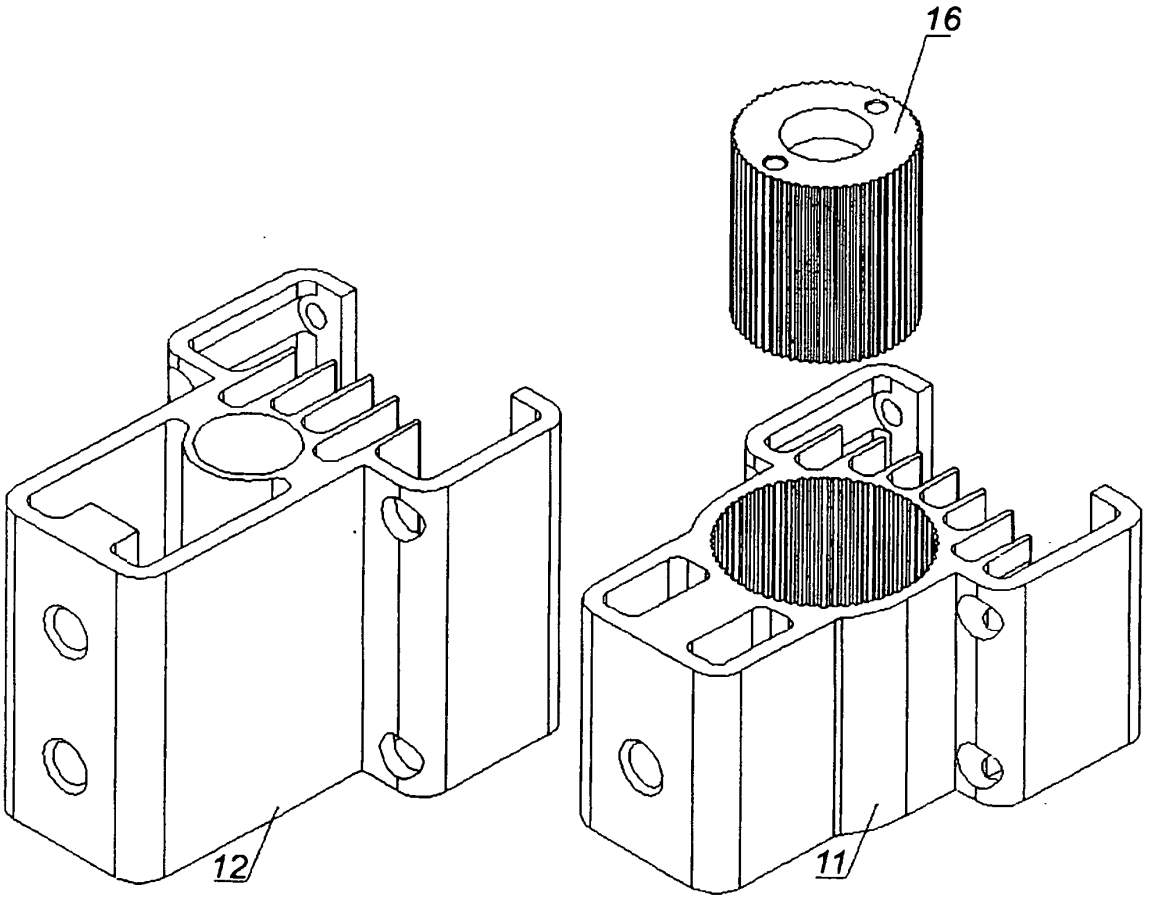

Fig.4

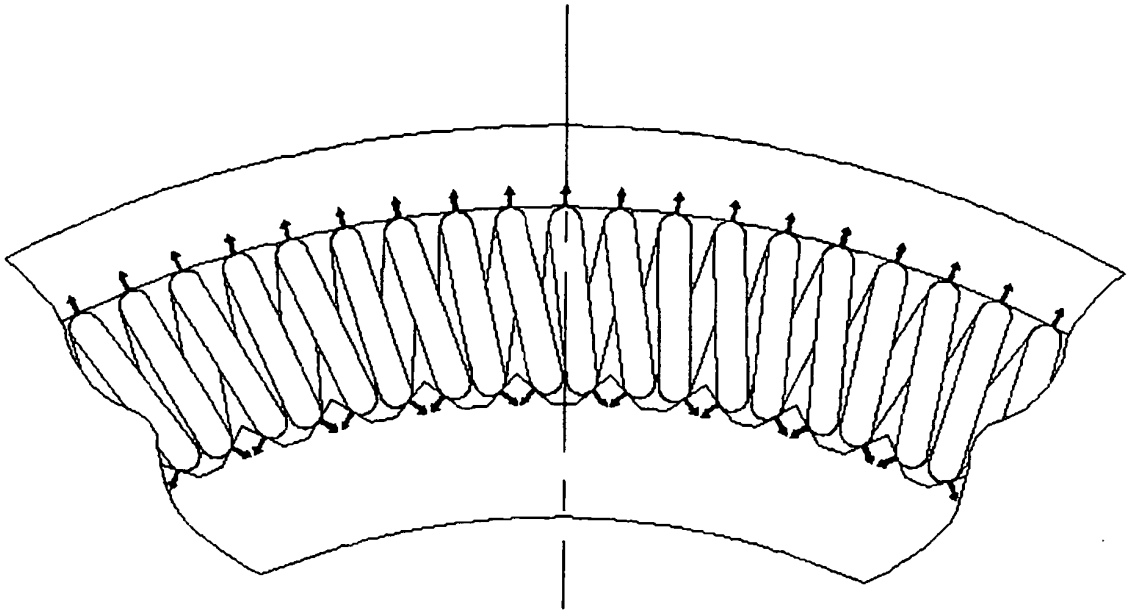

Fig.5

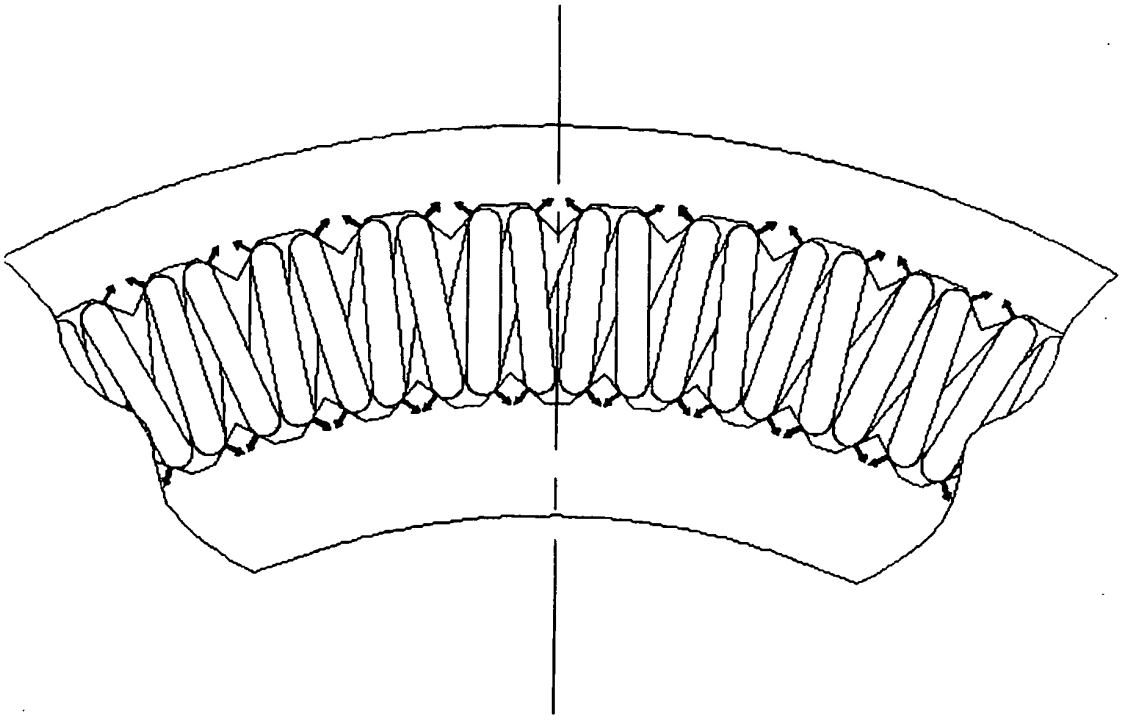

Fig.6

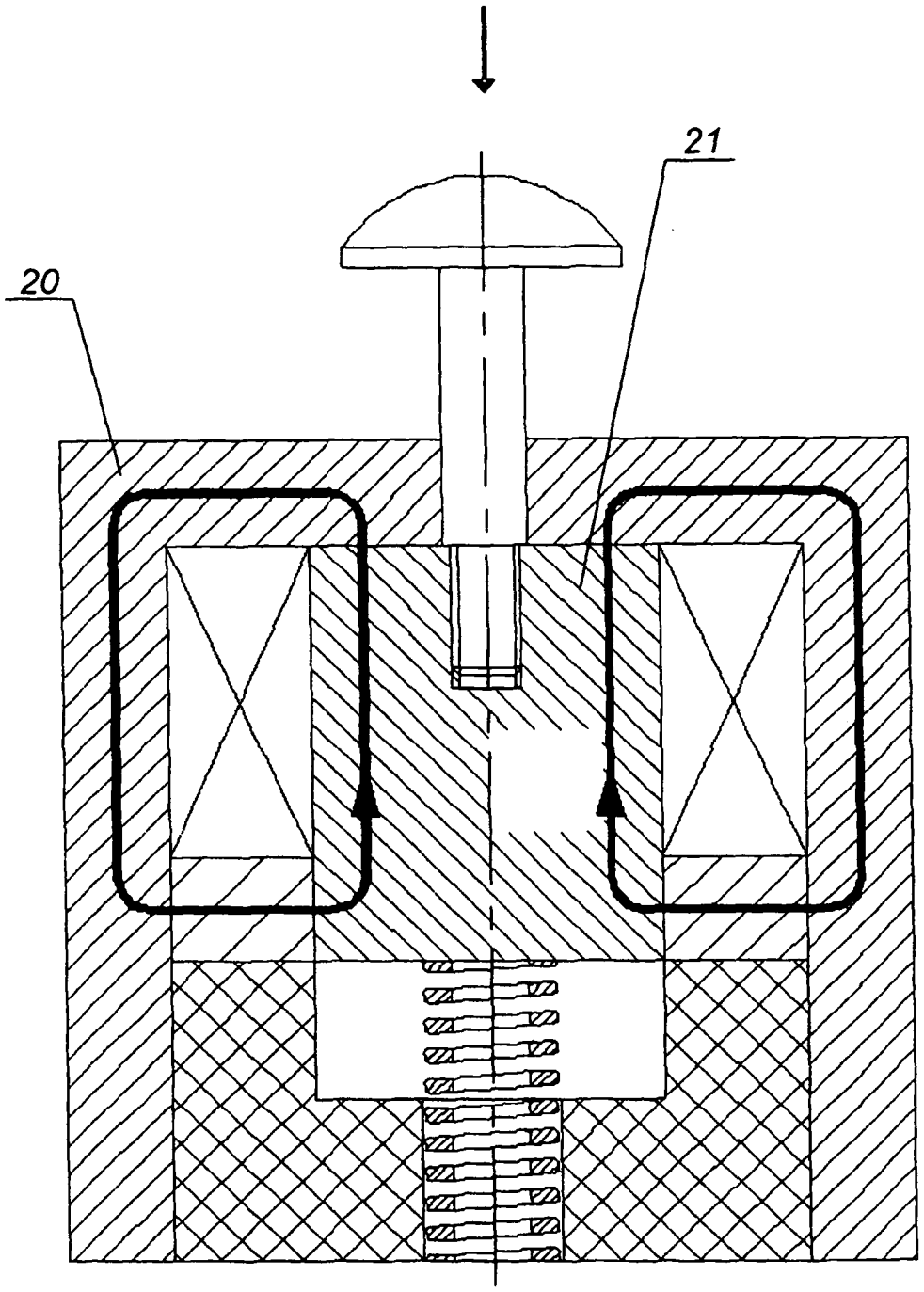

Fig.7

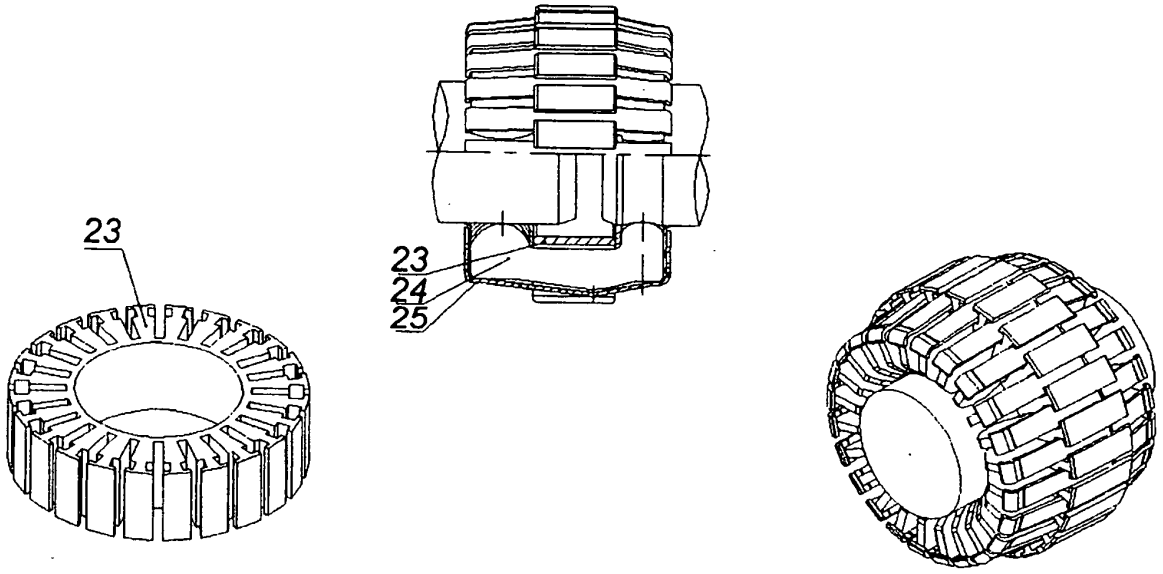

Fig.8