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(54) **ELECTRIC SWITCH PROVIDED WITH AN ARC-BLASTING UNIT**

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Description

[0001] The present invention relates to an electric switching unit provided with an arc-blasting unit.

[0002] It may find use particularly, but not exclusively, in earthing switches for medium or high voltages, located in enclosures which may or not be filled by an insulating gas like SF₆.

[0003] When the contacts of switches are disconnected at such voltages, an electric arc tends to appear and opposes the cutoff of the electric current. The arcs may remain permanent even when the contacts are fully separated apart, and their spontaneous extinction occurs randomly. They are less likely to appear when the contacts are immersed in an insulating fluid, but the gas-impervious enclosures that must be provided for enclosing the contacts are more expensive, and caution must be taken against leaks of the fluid, especially for the usual SF₆ gas which is toxic and deleterious to the environment. It must be remarked that this otherwise efficient gas has being less and less used over the recent years because of these drawbacks, and switches working without SF₆ as an insulating gas, i.e. with mixtures of gases of low environmental impact, are becoming more widespread.

[0004] The arcs extinguish more often when the contacts are separated at high speed and their gap at the open position of the switch is greater, but the extinction will nevertheless not be certain.

[0005] Systems for actively blasting the arcs with a gas flow are thus frequent in electric switches. They typically comprise a chamber aside the cavity containing the contacts, in which the gas is compressed during the separation of the contacts by the displacement of a piston connected to the mobile contact. When a pressure build-up has been obtained, a valve opens and releases the compressed gas out of the chamber. The gas is blown into the cavity and blasts the arc.

[0006] The arc-blasting unit of the invention is based on a new system in which a gas flow extinguishing the arcs is created during the separation of the contacts. Owing to original characteristics, its structure can be made compact, and a high extinguishing efficiency of the gas flow is observed. Finally, the invention dampens the movements of the contacts at the end of their opening and closing stroke, respectively.

[0007] EP 0 744 759 A1 discloses a high tension circuit breaker with a fixed heating chamber.

[0008] While the invention is defined in claim 1, further aspects of the invention are set forth in the dependent claims, the drawings and the following description.

[0009] The most remarkable characteristic of this arrangement is that the piston is stationary now, but the enclosure surrounding it is mobile. The conventional piston rod is converted into the blowpipe, which can direct the gas flow accurately and in a concentrated beam to the even place where the arc appears, so that a much greater part of the flow energy is actually used to blast

the arc, without allowing the flow to spread prematurely in the contacts cavity like in known arrangements.

[0010] The compression chamber may advantageously be provided with one or more valves being best present on the piston that open at a negative pressure of advantageously less than one bar inside the compression chamber. That enables an easier filling of the chamber, thus less effort on the driving system, when the switch returns to the closed position and no gas flow through the blowpipe takes place.

[0011] According to another advantageous characteristic of the invention, the piston may have an elongated shape, and the enclosure, a corresponding elongated cross-section. This shape or section may be rectangular. A greater compactness may be obtained then; this is true especially for multiple phase switches in which a plurality of pairs of contacts is present, the mobile contacts being arranged in a row: the enclosure may extend with a flat shape just above the row of mobile contacts, as wide as the row but with a reduced height for a same volume of compressed gas. Also, a single enclosure and a single piston are preferred even for such multiphase switches despite a plurality of blowpipes may be present, each associated to a respective pair of contacts: the gas compressed in the enclosure is shared between the blowpipes, and the arrangement remains simple because only a single enclosure needs to be moved.

[0012] This simplicity of arrangement is further enhanced if the enclosure is fastened to the carriage that also displaces the mobile contacts. Also, a good compactness may be reached if the enclosure and the blowpipe are both arranged with overlaps with the mobile contact along the movement direction.

[0013] These and other aspects, characteristics and advantages of the invention will now be exposed in greater detail with the comment of the following figures, which disclose a particular embodiment of the invention in a purely illustrative way:

- figure 1 shows a cutaway view through one pair of contacts with corresponding blowpipe, the switch being at the closed position;
- figure 2 shows the same view for the open position of the switch;
- figure 3 particularly shows the inside of the compression system during a closing operation with open valves; and
- figure 4 shows the compression system again, but in an opening operation with closed valves.

[0014] Figures 1 and 2 partly illustrate an earthing switch comprising at least one pair of contacts comprising a fixed contact 1 and a mobile contact 2, a front end of which can penetrate into the fixed contact 1.

[0015] The mobile contact 2 is reversibly moved in a movement direction X-X (figure 1). The invention can be implemented independently on the number, kind and layout of contact pairs. For instance, the switch can be three-

phase and the fixed and mobile contacts are aligned in straight rows perpendicular to the movement direction X-X.

[0016] The arrangement also comprises blowpipes 9 located aside the pairs of fixed contacts 1 and mobile contacts 2. Front ends of the blowpipes 9 are equipped with nozzles 10.

[0017] The figures show that the blowpipes 9 are straight, continuously hollow tubes, and the nozzles 10 are provided with a curved or elbowed drilling 11 that is directed towards places 12 at which the mobile contacts 2 separate from the fixed contact 1 and electric arcs will thus be present. The blowpipes 9 are in the same number as the pairs of fixed and mobile contacts, are also arranged in a straight row and extend at a short distance above respective ones of the mobile contacts. Rear ends of the blowpipes 9 are connected to a piston 13 which is common to all the blowpipes 9, as illustrated by figures 3 and 4. The walls of the blowpipes 9 have openings 14 just before the piston 13.

[0018] The mobile contacts 2 slide in mobile contact tulips. The mobile contact tulips are supported by tubular contact units 16 in the extension of the mobile contacts 2. A carriage 17 is supported by the contact units 16 and slides on them. It comprises axes 18 which are articulated to rear parts of the mobile contacts 2 and extend through the contact units 16 through longitudinal slots 19 machined at the upper and lower surfaces of the contact units 16. The switch operation consists in movements of the carriage 17, displacing the axes 18 between opposite ends of the slots 19 and the mobile contacts 2 between the closed position of the contacts of figure 1, in which the mobile contacts 2 extend in the front cavity 6, and the open position of figure 2, in which the mobile contacts 2 are completely retracted into the mobile contact tulips and central bores 20 of the contact units 16. The carriage 17 is displaced by a driving mechanism (not shown).

[0019] An enclosure in the shape of a compression cylinder 25 is fastened to the carriage 17 and displaced with it. It comprises openings 26 at the front face, through which the blowpipes 9 extend. The piston 13 is contained in the compression cylinder 25. The piston 13 has an elongated rectangular shape, and the compression cylinder 25 a similarly elongated rectangular cross-section, so that they extend over the entire width of the row of mobile contacts but with a reduced height and can thus be accommodated easily in usual housings. Seals are provided at the openings 26 and around the piston 13 so that a compression chamber 27 defined by the compression cylinder 25 and the piston 13 generally communicates with the outside only through the nozzles 10. However, valves 28 are present on the piston 13. They are generally closed by sets of compression springs 29, but are able to open slots 32, and establish a supplementary communication of the compression chamber 27 with the outside, when a threshold of negative pressure is reached in the compression chamber 27.

[0020] When the switch must open, the carriage 17 is

slid rearwards, the mobile contacts 2 separate from the fixed contact tulips 1, and an electric arc appears between them at the separation places 12. The compression cylinder 25 is slid on the blowpipes 9, and the compression chamber 27 shrinks. The gas contained therein is compressed and flows outside at the nozzles 10, which deflect it towards the separation places 12. The flows remain concentrated in thin beams directed precisely by the nozzles 10. Most of the blast energy therefore contributes to the arc extinction, in contrast with known devices in which the gas flow would be spread in the front cavity 6 comprising the contacts so that the overall efficiency would be lower. The valves 28 remain closed.

[0021] And when the switch returns to the closed state, a reverse movement is made, and the compression chamber 27 expands. A negative pressure buildup appears inside so that the valves 28 open by uncovering slots 32 punched through the piston 13 for facilitating a gas ingress into the compression chamber 27 until the pressure has increased to a degree allowing the springs sets 29 to bring the valves 28 back on the piston 13.

[0022] An originality of the invention is that the piston 13 is stationary but the enclosure surrounding it -the compression cylinder 25- is mobile, in contrast to known devices in which a piston depends on the mobile contacts and the enclosure in which the piston slides is a part of the housing or another stationary structure. The inventive arrangement enables a compact layout in which the piston 13 and compression cylinder 25 are not a longitudinal extension of the mobile contacts but are located aside them. The driving mechanism is simple and lightweight, the compression cylinder 25 and the mobile contacts being moved together by the same mechanism (the carriage 17). The piston rods -the blowpipes 9- can be made up with bores for channeling the gas flow and directing it accurately towards the even places -the separation places 12-where it is needed. Also, the pressure variations in the compression chamber 27 during the swift connecting and disconnecting movements develop opposing forces that dampen these movements at the end of their respective stroke.

[0023] The separation place 12 to which the gas flow is directed is not necessarily adjacent to the fixed contacts as in these drawings, but can be present at any location between the fixed contacts and the mobile contacts at the open position, in which the arc could be present.

[0024] While the detailed description concerned an earthing switch, the invention could be implemented in other kinds of electric switches.

[0025] There is no condition on the gas filling the housing, which may be an insulating gas like SF₆ or not.

Claims

1. An electric switch comprising:

- at least one fixed contact (1);
 at least one mobile contact (2) sliding in front of the fixed contact (1) in a movement direction between a closed position at which it is joined with the fixed contact (1) and an open position at which it is separated from the fixed contact (1);
 at least one blowpipe (9) fixed with respect to the fixed contact (1) and extending on one side of and at a short distance above the mobile contact (2) and parallel to the movement direction, the blowpipe (9) comprising a nozzle (10) at a front end, the nozzle (10) being directed towards a place (12) at which the mobile contact (2) separates from the fixed contact (1), and a piston (13) at a rear end;
characterized in that,
 the number of blowpipes (9) and pairs of fixed contacts (1) and mobile contacts (2) is the same, the blowpipe (9) and the fixed and mobile contacts (1, 2) are being arranged to blow an arc in only one direction roughly perpendicular to the arc, and
 a mobile enclosure (25) is connected to the mobile contact (2) and sliding around the blowpipe (9) and around the piston (13), a compression chamber (27), which communicates with the nozzle (10), being defined by the enclosure (25), the piston (13) and the blowpipe (9).
2. An electric switch according to claim 1, wherein the compression chamber (27) is provided with a valve (28) that opens at a negative pressure of less than 1 bar inside the compression chamber (27).
 3. An electric switch according to claim 2, wherein the valve (28) is provided on the piston (13).
 4. An electric switch according to any of claims 1 to 3, wherein the piston (13) has an elongated shape, and the enclosure (25) has a corresponding elongated cross-section.
 5. An electric switch according to any of claims 1 to 4, wherein it comprises a plurality of the fixed contacts (1) and the mobile contacts (2), the mobile contacts (2) being mobile together, and a plurality of the blowpipes (9), each of the blowpipes (9) being associated to a respective one of the fixed contacts (1) and of the mobile contacts (2), but the piston (13) is single and common to all the blowpipes (9), and the enclosure (25) is single too.
 6. An electric switch according to claims 4 and 5, wherein the blowpipes (9) are arranged in a row along the piston (13), and the fixed contacts (1) and the mobile contacts (2) are arranged in rows parallel to said row of blowpipes (9).
 7. An electric switch according to any of claims 1 to 6, wherein the enclosure (25) is fastened to a carriage (17) that also displaces the mobile contact (2).
 8. An electric switch according to any of claims 1 to 7, wherein the enclosure (25) and the blowpipe (9) are both arranged with overlaps with the mobile contact (2) along the movement direction.
- ### Patentansprüche
1. Elektrischer Schalter, umfassend:
 wenigstens einen festen Kontakt (1);
 wenigstens einen mobilen Kontakt (2), der vor dem festen Kontakt (1) in einer Bewegungsrichtung zwischen einer geschlossen Position, an der er mit dem festen Kontakt (1) verbunden ist, und einer offenen Position, an der er von dem festen Kontakt (1) getrennt ist, verschiebbar ist;
 wenigstens einen Brenner (9), der in Bezug auf den festen Kontakt (1) fest ist und sich auf einer Seite von und in einem geringen Abstand über dem mobilen Kontakt (2) und parallel zu der Bewegungsrichtung erstreckt, wobei der Brenner (9) eine Düse (10) an einem vorderen Ende umfasst, wobei die Düse (10) hin zu einem Ort (12) gerichtet ist, an dem der mobile Kontakt (2) sich von dem festen Kontakt (1) trennt,
 und einen Kolben (13) an einem hinteren Ende;
dadurch gekennzeichnet, dass
 die Anzahl von Brennern (9) und Paaren von festen Kontakten (1) und mobilen Kontakten (2) dieselbe ist,
 wobei der Brenner (9) und die festen und mobilen Kontakte (1, 2) angeordnet werden, um einen Lichtbogen lediglich in einer Richtung ungefähr senkrecht zu dem Lichtbogen zu blasen, und
 ein mobiles Gehäuse (25) mit dem mobilen Kontakt (2) verbunden ist und um den Brenner (9) herum und um den Kolben (13) herum verschiebbar ist, wobei eine Verdichterkammer (27), die mit der Düse (10) in Kommunikation steht, von dem Gehäuse (25), dem Kolben (13) und dem Brenner (9) definiert ist.
 2. Elektrischer Schalter nach Anspruch 1, wobei die Verdichterkammer (27) mit einem Ventil (28) versehen ist, das sich bei einem negativen Druck von weniger als 1 bar innerhalb der Verdichterkammer (27) öffnet.
 3. Elektrischer Schalter nach Anspruch 2, wobei das Ventil (28) auf dem Kolben (13) bereitgestellt ist.
 4. Elektrischer Schalter nach einem der Ansprüche 1

bis 3, wobei der Kolben (13) eine längliche Form aufweist und das Gehäuse (25) einen entsprechenden länglichen Querschnitt aufweist.

5. Elektrischer Schalter nach einem der Ansprüche 1 bis 4, wobei dieser eine Vielzahl von den festen Kontakten (1) und den mobilen Kontakten (2), wobei die mobilen Kontakte (2) zusammen mobil sind, und eine Vielzahl von den Brennern (9) aufweist, wobei jeder der Brenner (9) zu einem jeweiligen einen von den festen Kontakten (1) und den mobilen Kontakten (2) zugehörig ist, der Kolben (13) jedoch einzeln und allen Brennern (9) gemein ist, und das Gehäuse (25) ebenfalls einzeln ist.
6. Elektrischer Schalter nach den Ansprüchen 4 und 5, wobei die Brenner (9) in einer Reihe entlang des Kolbens (13) angeordnet sind, und die festen Kontakte (1) und die mobilen Kontakte (2) in Reihen parallel zu der Reihe von Brennern (9) angeordnet sind.
7. Elektrischer Schalter nach einem der Ansprüche 1 bis 6, wobei das Gehäuse (25) an einem Schlitten (17) befestigt ist, der ebenfalls den mobilen Kontakt (2) verschiebt.
8. Elektrischer Schalter nach einem der Ansprüche 1 bis 7, wobei das Gehäuse (25) und der Brenner (9) beide mit Überlappungen mit dem mobilen Kontakt (2) entlang der Bewegungsrichtung angeordnet sind.

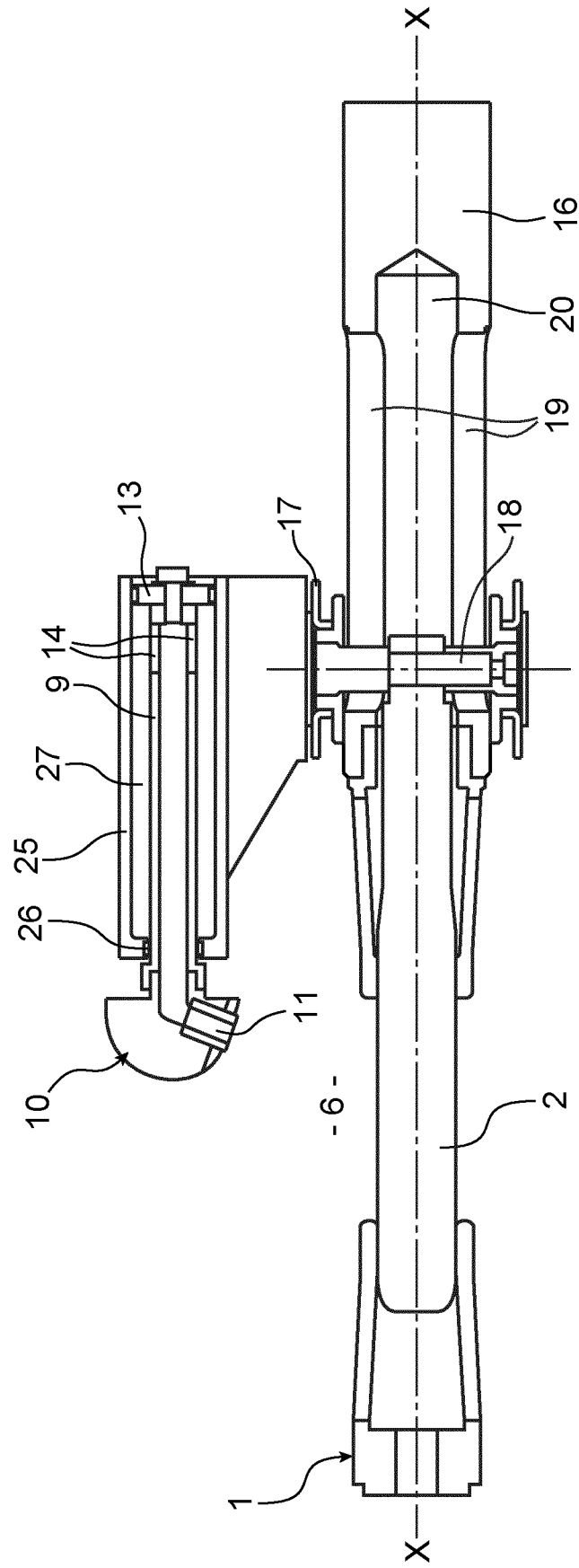
Revendications

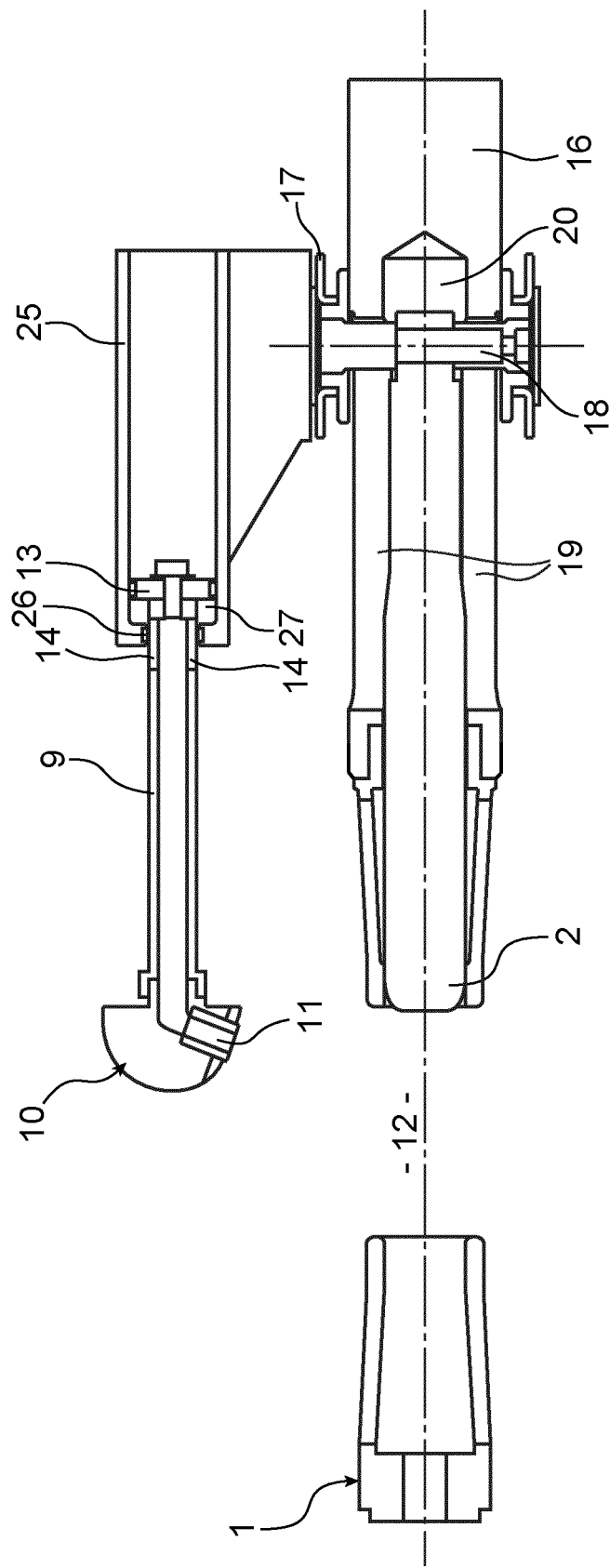
1. Interrupteur électrique comprenant :

au moins un contact fixe (1) ;
 au moins un contact mobile (2) glissant en face du contact fixe (1) dans une direction de mouvement entre une position fermée dans laquelle il est joint au contact fixe (1) et une position ouverte à laquelle il est séparé du contact fixe (1) ;
 au moins un tuyau de soufflage (9) fixe par rapport au contact fixe (1) et s'étendant sur un côté de et à une courte distance au-dessus du contact mobile (2) et parallèle à la direction de mouvement, le tuyau de soufflage (9) comprenant une buse (10) à une extrémité avant, la buse (10) étant dirigée vers un endroit (12) auquel le contact mobile (2) se sépare du contact fixe (1), et un piston (13) à une extrémité arrière ;
caractérisé en ce que,
 le nombre de tuyaux de soufflage (9) et les paires de contacts fixes (1) et de contacts mobiles (2) sont les mêmes,
 le tuyau de soufflage (9) et les contacts fixe et

mobile (1, 2) sont agencés pour souffler un arc dans uniquement une direction approximativement perpendiculaire à l'arc, et une enceinte mobile (25) est raccordée au contact mobile (2) et glissant autour du tuyau de soufflage (9) et autour du piston (13), une chambre de compression (27), qui communique avec la buse (10), étant définie par l'enceinte (25), le piston (13) et le tuyau de soufflage (9).

2. Interrupteur électrique selon la revendication 1, dans lequel la chambre de compression (27) est pourvue d'une soupape (28) qui s'ouvre à une pression négative de moins de 1 bar à l'intérieur de la chambre de compression (27).
3. Interrupteur électrique selon la revendication 2, dans lequel la soupape (28) est ménagée sur le piston (13).
4. Interrupteur électrique selon l'une quelconque des revendications 1 à 3, dans lequel le piston (13) a une forme allongée, et l'enceinte (25) a une section en coupe allongée correspondante.
5. Interrupteur électrique selon l'une quelconque des revendications 1 à 4, dans lequel il comprend une pluralité des contacts fixes (1) et des contacts mobiles (2), les contacts mobiles (2) étant mobiles ensemble, et une pluralité des tuyaux de soufflage (9), chacun des tuyaux de soufflage (9) étant associés à l'un respectif des contacts fixes (1) et des contacts mobiles (2), mais le piston (13) est unique et commun à tous les tuyaux de soufflage (9), et l'enceinte (25) est elle aussi unique.
6. Interrupteur électrique selon les revendications 4 et 5, dans lequel les tuyaux de soufflage (9) sont agencés selon une rangée le long du piston (13), et les contacts fixes (1) et les contacts mobiles (2) sont agencés en rangées parallèles à ladite rangée de tuyaux de soufflage (9).
7. Interrupteur électrique selon l'une quelconque des revendications 1 à 6, dans lequel l'enceinte (25) est assujettie à un chariot (17) qui déplace également le contact mobile (2).
8. Interrupteur électrique selon l'une quelconque des revendications 1 à 7, dans lequel l'enceinte (25) et le tuyau de soufflage (9) sont tous deux agencés avec des chevauchements avec le contact mobile (2) le long de la direction de mouvement.





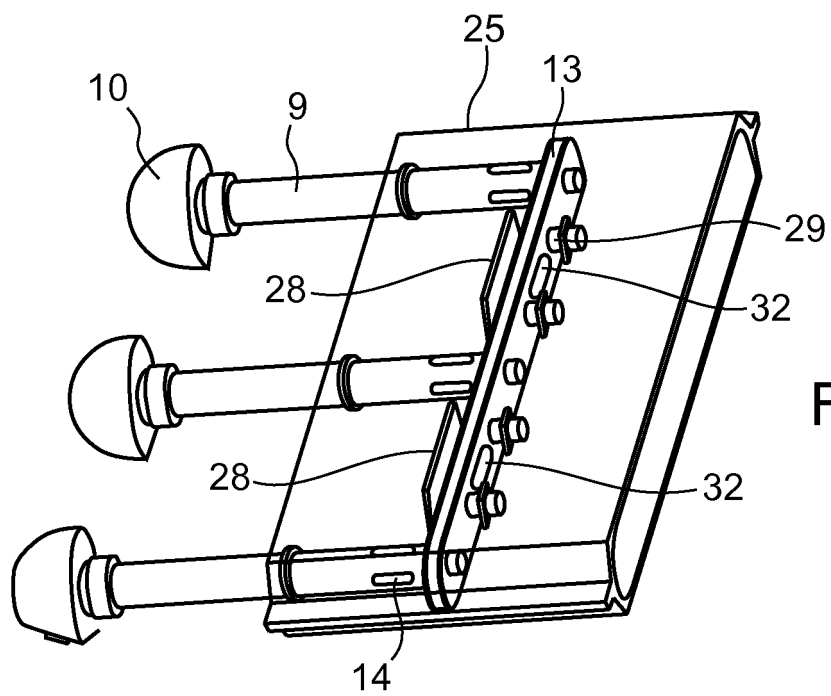


FIG.3

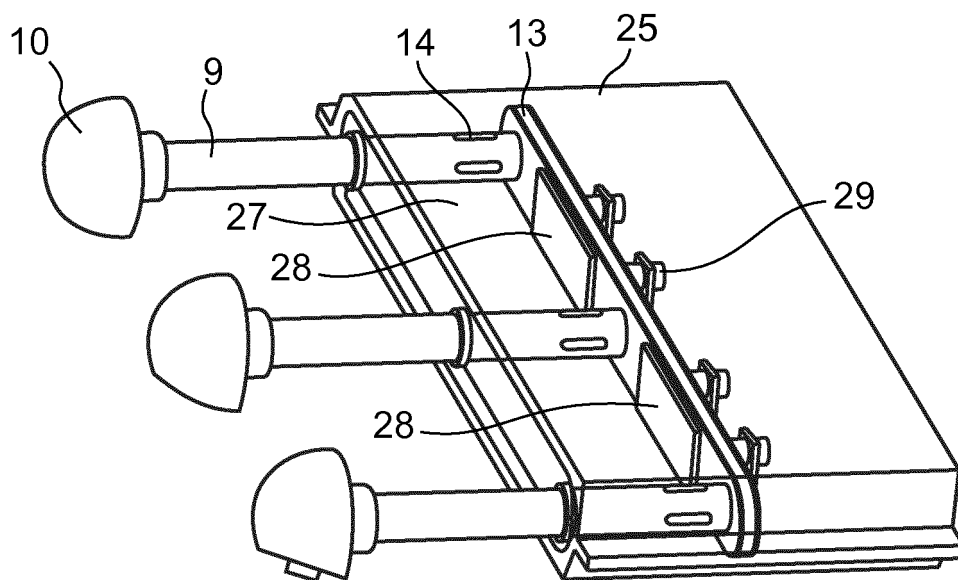


FIG.4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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