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(54) A switch and use thereof

(57) An electric switch comprises two main contact electrodes (1, 2) arranged in a first current path (3) through the switch and an auxiliary contact electrode (4) configured to be arranged in said current path in a location between the two main contact electrodes in a closed state of the switch and conduct the entire current flowing between the main contact electrodes in this state. The auxiliary contact electrode (4) is movable with respect to the main contact electrodes, and the switch comprises an arrangement configured to open and close said current path and having means (9) configured to move the auxiliary contact electrode (4) so as to obtain transfer of the switch between an open state and a closed state and conversely.

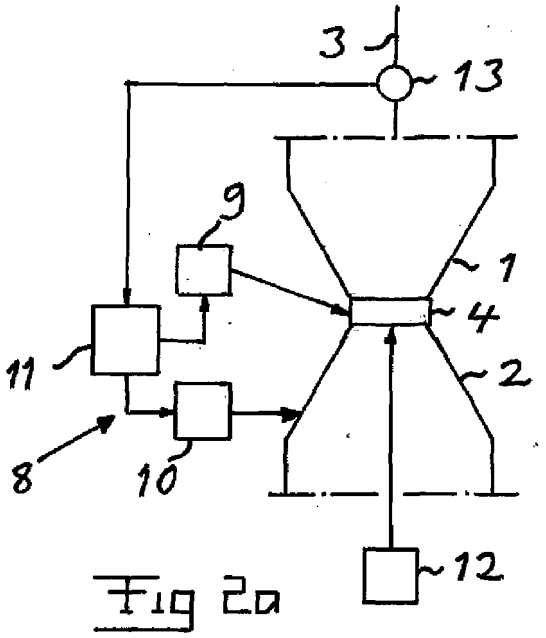


Fig 2a

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Description

TECHNICAL FIELD OF THE INVENTION AND BACKGROUND ART

[0001] The present invention relates to an electric switch comprising

- two main contact electrodes arranged in a first current path through the switch, and
- an arrangement configured to open and close said first current path through said electrodes for transferring the switch from a closed state in which current may flow in said first current path and an open state in which current, when flowing in said first current path, is diverted to another current path and conversely, as well as use of such an electric switch.

[0002] An electric switch of this type is normally used to commutate an alternating current between different said current paths and has then normally to be fast, but the invention is not restricted thereto and does also cover electric switches which may operate slowly and/or which are intended to be controlled to change between said closed and open state without any current flowing in said first current path.

[0003] Typical uses of such an electric switch are in equipment for reactive power compensation for switching in and out for instance capacitors, such as in Static Var Compensation (SVC) or in Controlled Series Capacitors (CSC), in plants for transmitting electric power or in equipment for controlling tap changers connected to transformers for adapting the voltage tapped therefrom to the magnitude of the load (power consumption) connected to the transformer. However, also other uses are conceivable.

[0004] Furthermore, it appears from above that the invention is not restricted to any level of current or voltages to be handled by the electric switch, although it may be particularly interesting for currents above 1 kA and voltages above 1 kV.

SUMMARY OF THE INVENTION

[0005] The object of the present invention is to provide an electric switch of the type defined in the introduction being improved in at least some aspect with respect to such electric switches already known.

[0006] This object is according to the invention obtained by providing such a switch that further comprises at least one auxiliary contact electrode configured to be arranged in said first current path in a location between said two main contact electrodes in said closed state of the switch and conduct the entire current flowing between said main contact electrodes in that state, said at least one auxiliary contact electrode is movable with respect to said main contact electrodes, and said arrangement comprises first means configured to move said at least one auxiliary contact electrode so as to obtain said transfer of the switch between said two states.

[0007] This new approach to obtain the electric contact between said two main contact electrodes solely by an auxiliary contact electrode in the closed state of the switch and utilizing the movability of this auxiliary contact electrode for transferring the switch between said two states results in a possibility to obtain preferred features of such a switch of great importance in different types of applications of a said switch. One such feature is low contact resistance between the main contact electrodes here through said auxiliary contact electrode, possibility to withstand high currents, high operation reliability and low wear when switching state and by that a long lifetime of the contact electrodes.

[0008] According to an embodiment of the invention said main contact electrodes are movable with respect to each other, and said arrangement comprises second means configured to move said main contact electrodes apart from and towards each other and a control unit configured to control said first and second means for co-ordinating the movement of said main contact electrodes with respect to each other and the movement of said auxiliary contact electrode when performing said transfer of state of the switch. Both main contact electrodes may be movable or one of them may be stationary. The movability of the contact electrodes with respect to each other and the co-ordination of the movements obtained through the control unit facilitate the achievement of advantageous characteristics of the transfer of the switch between said two states.

[0009] According to another embodiment of the invention said control unit is configured to synchronize said movements so as to first move said main contact electrodes apart with respect to each other and then with a determined delay move said auxiliary contact electrode when transferring the switch to the open state and move said auxiliary contact electrode and with a certain delay then move said main contact electrodes towards each other when transferring the switch to said closed state. When the switch is transferred to the closed state it may be started to move the auxiliary contact electrode and when this has moved a part of the distance for this movement move the two main contact electrodes slightly apart before said auxiliary contact electrode is moved in therebetween by being introduced into a gap between the main contact electrodes.

[0010] According to another embodiment of the invention the switch comprises third means configured to measure a time varying current in said first current path in a closed state of the switch and calculate the instant of time for a future zero-crossing of the current and send information thereabout to said control unit configured to use this information for synchronising said movements when transferring the switch from a closed state to an open state. This makes it possible to synchronize the movements of the main contact electrodes and the auxiliary contact electrode with the status of the current so as to obtain transfer of state exactly when most suited,

which normally will be very close to said zero-crossing.

[0011] According to another embodiment of the invention the switch comprises means configured to apply a pressure urging said main contact electrodes towards each other in the closed state of the switch, so that a low contact resistance of the switch may be obtained in that state.

[0012] According to another embodiment of the invention said first means configured to move said at least one auxiliary contact electrode is physically separated from this electrode. This makes it possible to obtain a low weight of the auxiliary contact electrode, since it has only to conduct current, and the switch may thanks to this be made very fast, which is of great importance in some applications.

[0013] According to another embodiment of the invention constituting a further development of the embodiment last mentioned said first means comprises an apparatus configured to accelerate a member to hit a part in the form of the auxiliary contact electrode or a carrier of that electrode for transferring kinetic energy to this part so as to obtain said movement thereof for transfer of the switch between said two states. This constitutes an advantageous way of obtaining a very distinct and rapid movement of the auxiliary contact electrode, and this feature is further improved when said member has substantially the same mass as said part with the auxiliary contact electrode caused to move by said hit, which will then result in a transfer of substantially all the kinetic energy of said member to said part as a consequence of substantially the same mechanical impedance of said member and part. "Substantially" here means a mass differing not more than 50 %, in which the two masses have to be determined while also considering the material of the surfaces of the member and the part hitting each other for obtaining a maximum transfer of kinetic energy and by that a distinct movement of said part with the auxiliary contact electrode.

[0014] According to another embodiment of the invention said auxiliary contact electrode is arranged on a slide movable along a predetermined path, which results in a controlled movement of the auxiliary contact electrode. The extension of said part may have any shape, such as rectilinear or circular.

[0015] According to another embodiment of the invention said apparatus has two said members arranged on opposite sides of said part with said auxiliary contact electrode with respect to the direction of said movement of said part, and one of said two members is configured to be hit by the part carrying said auxiliary contact electrode when this has been caused to move by being hit by the other of said two members and by this stop this part for defining a new state of the switch by transferring kinetic energy to said one of the two members. Said part carrying the auxiliary contact electrode and by this the auxiliary contact electrode may thanks to this be brought from one well defined position to another well defined position when the switch is transferred from one of said two states to the other.

[0016] According to another embodiment of the invention the switch comprises a piece configured to be hit by said one of the two members for transfer of kinetic energy thereto and stop this member in a predetermined ready position ready to be accelerated in the opposite direction for hitting said part for changing state of the switch back again. This means that the switch after having been transferred to one of said states with a very short notice is ready to be transferred back to the first state if that is desired.

[0017] According to another embodiment of the invention the switch comprises means configured to brake said piece when hit by said second member for stopping this piece. This means is according to an embodiment of the invention an eddy current brake, which results in a minimum of wear upon said piece.

[0018] According to another embodiment of the invention the switch is symmetric with respect to said two members and with respect to the function of said apparatus, and said one member is configured to assume the role of said other member and conversely once the switch has changed from one of said closed and open state to the other, which is favourable for the rapidness and easiness of the function of the switch.

[0019] According to another embodiment of the invention said apparatus comprises Thomson coils close to or in said member to be accelerated and means configured to control a current flow through these coils for accelerating said member. Such an apparatus makes it possible to obtain a high and well defined acceleration of said member and by that cause the auxiliary contact electrode to move with a minimum of delay after said apparatus has been trigged.

[0020] According to another embodiment of the invention the switch comprises a first said main contact electrode in common to said first and second current paths and two second main contact electrodes configured to be arranged in one of said first and second current paths each, and said first means is configured to close one of said current paths when opening the other by moving at least one said auxiliary contact electrode.

[0021] The invention also relates to a device for commutating an alternating current from at least one first current path to at least another second current path, and this device comprises a switch according to the present invention arranged in at least said first current path. The advantages of such a device appear clearly from the above discussion of the different embodiments of the switch according to the invention.

[0022] According to an embodiment of the invention said device comprises at least one semiconductor device of turn-on type arranged in said second current path and a control apparatus configured to synchronize opening and closing of said switch with control of said semiconductor device.

[0023] The invention also relates to use of a switch according to the invention for commutating an alternating

current from one current path to another current path resulting in the advantages appearing from the above discussion.

[0024] Uses according to embodiments of the present invention are in a tap changer or a current limiter or in an equipment for reactive power compensation, such as in a Static Var Compensation (SVC) or in Controlled Series Capacitors (CSC).

[0025] Further advantages as well as advantageous features of the invention will appear from the following description of embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] With reference to the appended drawings, below follows a specific description of embodiments of the invention cited as examples.

[0027] In the drawings:

Fig 1 is a very simplified view illustrating a general structure and function of an electric switch according to an embodiment of the invention,

Figs 2a-2c are simplified views illustrating how an electric switch according to the invention may be brought from a closed state to an open state,

Figs 3a-3c illustrate very schematically how said electric switch may be brought from an open state to a closed state,

Figs 4-5 are simplified views illustrating two possible embodiments of an auxiliary contact electrode and means configured to move it in a switch according to the present invention,

Figs 6-8 are partially exploded perspective views illustrating more in detail the structure of an electric switch according to an embodiment of the invention,

Fig 9 is a very simplified view illustrating an electric switch according to Figs 6-8,

Fig 10 is a view from above of a part of the switch shown in Fig 9,

Fig 11 is a view from one end of the part shown in Fig 10 used to explain the function of an eddy current brake acting upon a piece moved when changing state of the switch,

Fig 12 is a graph showing the position of a first member XP, the velocity of this member XV and the acceleration of this member XA versus time when triggering an apparatus of the electric switch for changing state of the switch according to the invention,

Fig 13 is a graph showing the velocity of said first member XV, the velocity of a part carrying the auxiliary contact electrode YV and the interaction force F between said first member and said part versus time when said part is hit by said first member during the process of changing state in an electric switch according to the present invention,

Fig 14 is a very simplified view illustrating an alternative way of moving said auxiliary contact electrode in an electric switch according to the present invention, and

Fig 15 is a very simplified view illustrating an electric switch according to a further possible embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0028] Explained herein are embodiments of the invention, describing the electric switch of the invention and uses thereof. The invention may, however, be embodied in many different forms and should not be construed as being limited to the exemplary embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to those skilled in the art.

[0029] Fig 1 is a very schematic view illustrating an electric switch according to an embodiment of the present invention having two main contact electrodes 1, 2 arranged in a first current path 3 through the switch and an auxiliary contact electrode 4 configured to be arranged in said first current path in a location between said two main contact electrodes in a closed state of the switch (as indicated by a continuous line) and then conduct the entire current that may possibly flow between said main contact electrodes. It is further through the arrow 5 and dashed lines illustrated that the auxiliary contact electrode 4 is movable with respect to the main contact electrodes so as to obtain transfer of the switch between the closed state and an open state in which current, when flowing in the first current path, is diverted to another, second current path 6. It is shown how this second current path may have a semiconductor device 7 of turn-on type, such as a thyristor, which may be appropriately controlled for obtaining desired characteristics of said transfer. It is pointed out that Fig 1 is strongly simplified and that the first current path in fact normally is formed by conductor rails.

[0030] How an electric switch according to the present

invention may be transferred from one of said states to the other will now be explained while referring to Figs 2a-2c and Figs 3a-3c. The electric switch has an arrangement 8 configured to open and close said first current path 3 and comprises for that sake on one hand first means 9 configured to move said auxiliary contact electrode 4 so as to obtain said transfer and on the other second means 10 configured to move the main contact electrodes 1, 2 apart from and towards each other. In the embodiment shown the main contact electrode 1 is fixed and the main contact electrode 2 is movably arranged. The arrangement 8 further comprises a control unit 11 configured to control the first and second means for coordinating the movement of said main contact electrode 2 and the movement of the auxiliary contact electrode 4 when performing a transfer of state of the switch. It is also indicated that the switch comprises means 12 configured to apply a pressure urging the main contact electrode 2 towards the auxiliary contact electrode 4 and by that towards the main contact electrode 1 in the closed state of the switch. Furthermore, the switch comprises third means 13 configured to measure a time varying current in the first current path 3 in a closed state of the switch and calculate the instant of time for a future zero-crossing of that current and send information thereabout to the control unit 11 configured to use this information for synchronising said movements when transferring the switch from the closed state to an open state. It is known that in the case of an alternating current said transfer should preferably take place at or very close to said instant of time for a zero-crossing, which however may be located several periods ahead.

[0031] It is schematically illustrated in Fig 2b how said second means is controlled by the control unit to move the main contact electrode 2 apart from the main contact electrode 1 at an instant determined to be appropriate for said transfer. Said first means 9 will then with a determined delay, such as in the order of 0.1-5 ms, move the auxiliary contact electrode 4 as shown in Fig 2c for transferring the switch to an open state with a sufficient insulation between the main contact electrodes.

[0032] It is shown in Fig 3a how a transfer of the switch from an open state to a closed state may be started by moving the main contact electrodes 1, 2 slightly apart, whereupon the auxiliary contact electrode 4 is moved in between the main contact electrodes, whereupon these are moved towards each other while obtaining a sufficient pressure upon the auxiliary contact electrode located therebetween for obtaining a good contact with a low contact resistance and which may take a high current, such as in the order of some kA.

[0033] Figs 4 and 5 illustrate two possible ways of obtaining the required movability of the auxiliary contact electrode for transferring the switch between said two states by moving this contact electrode. Fig 4 shows how the auxiliary contact electrode 4' may be connected to an axle 14, which may be rotated for moving the auxiliary contact electrode. Fig 5 shows how the auxiliary contact electrode 4" may have an elliptical shape and be rotated when the switch is to be transferred between said two states.

[0034] An electric switch according to an embodiment of the present invention will now be more in detail described while making reference to Figs 6-11. It is shown in the exploded view in Fig 6 how the switch has two parallel first main contact electrodes 1 formed by conductor rails and accordingly also two second main contact electrodes 2 in the form of contact arms, which may be moved towards and away from the first contact electrodes by displacing a pull rod 15 connected to one end 16 of the respective contact arm. A torsion spring 17 is connected to the other end 18 of the respective contact arm while biasing this towards the first main contact electrodes for applying a contact pressure to auxiliary contact electrodes located between the main contact electrodes in the closed state of the switch. The tension of the torsion springs will be increased when the pull rod 15 is controlled for opening the switch. It is shown in Fig 6 how the two auxiliary contact electrodes 4 are arranged on a slid 19 movable along a substantially rectilinear path defined by guiding plates 20, 21. How this movement of the auxiliary contact electrodes is achieved will now be explained while making reference mainly to Fig 8 showing this more in detail.

[0035] The auxiliary electrode contact slid 19 is provided with armature plates 22 on one end thereof, so that the slid may be fixed by means of permanent magnets 23 (see Fig 9) in the end position thereof assumed in the open state of the switch. The slid is accelerated from a first of these bi-stable end positions by being hit by a member 24 in the form of a hammer brought to be accelerated by sending a current through a Thomson coil 25 indicated in Fig 9 and for which only the seat 26 is shown in Fig 8. The hammer 24 has substantially the same mass and by that the same mechanical impedance as the slid 19, so that substantially all the kinetic energy thereof is transferred to the slid when this is hit by the hammer. When the slid 19 then has nearly reached its second bi-stable end position defined by said permanent magnets 23 it will hit another member 27 being identical to the member 24, so that substantially all the kinetic energy of the slid will be transferred to the hammer 27, which through a spring loaded bracket 28 is located in one of the bi-stable end positions of the members 24, 27, namely a waiting position for stopping or braking the movement of the slid 19. This means that the slid 19 will without bumping stop in the second end position with the end surface thereof against the corresponding permanent magnets 23. No such permanent magnets are needed for keeping the slid in the end position corresponding to the closed state, since the main contact electrodes will clamp the auxiliary contact electrodes in that position.

[0036] Means are also provided for braking the member 24, 27 once hit by the slid and this comprises a piece 29 loaded by springs 30 in a position shown in Fig 9 for being hit by the member 27. Also the piece 29 has sub-

stantially the same mechanical impedance as the respective member 24, 27, so that substantially all the kinetic energy thereof will be transferred to the piece 29. The piece 29 is in the form of an electrically conducting plate located in the pole gap between permanent magnets 31, 32, so that a magnet flux is directed substantially perpendicularly to the flat large surfaces thereof. This means that eddy currents will be induced in the plate 29 as soon as it starts to move, so that these eddy currents and said magnetic flux will interact and result in a braking force applied on the plate 29 being proportional to the velocity of the plate 29. Thus, the kinetic energy is absorbed by resistive heating of the plate 29 and by that completely without any mechanical wear, which would result if friction or the like was used instead. Moreover, it appears that the switch is symmetric with respect to the members 24, 27, the function of said apparatus and the pieces 29 with brakes, so that the members are always in opposite bi-stable positions.

[0037] It is shown in the Figures how the members 24, 27 are provided with bumping layers 33 on opposite sides thereof. These layers shall be of a material showing low inner energy losses and at the same time a high mechanical strength.

[0038] A very fast electric switch is obtained by having the means for obtaining the movement of the auxiliary contact electrodes completely separated therefrom, so that the mass of these conduct electrodes with the slid 19 may be low and by that be given a very high acceleration. This means in practice that such an electric switch according to an embodiment of the invention may be transferred from one of the states to the other in less than 2 ms, and thanks to the braking of the eddy current brake the switch may be triggered to a state transfer again after about 10 ms.

[0039] A simulated acceleration of a hammer of the electric switch shown in Figs 6-11 versus time is shown in Fig 12, in which XA is the acceleration, XV is the velocity and XP is the position of the hammer.

[0040] Fig 13 illustrates a simulation of the velocity of the hammer XV, the velocity of the auxiliary conduct electrode slid YV when hit by the hammer at the instant 0 and F is the interaction force between the hammer and the slid versus time.

[0041] Some of many possibilities to obtaining alternative embodiments of the invention are shown in Figs 14 and 15. Fig 14 illustrates schematically how a hammer 40 may be connected to a rotatable rod 41, which may be brought to rotate for transfer of state of the switch by striking the hammer 40 against the auxiliary contact electrode 4. Several such hammers 40 may be connected to the same rotatable rod 41 for controlling a plurality of electric switches.

[0042] Fig 15 illustrates very schematically an embodiment of an electric switch according to the invention, which has a first main contact electrode 1' in common to said first and second current paths and two second main contact electrodes 2', 2" configured to be arranged in one of said first and second current paths each. This embodiment comprises said first means configured to close one of said current paths when opening the other by moving the two auxiliary contact electrodes 4''', 4"" as shown in Fig 15.

[0043] Preferred uses of an electric switch according to the present invention is in tap changers, such as in on-load tap changers, in current limiters and in equipment for reactive power compensation, such as in Static Var Compensation (SVC) or in Controlled Series Capacitors (CSC).

[0044] It may in such uses of an electric switch benefit from the possibility to obtain a very fast and accurately controlled and synchronized switching.

[0045] $AgSnO_2$ and/or Ag are advantageous materials for the contact electrodes, since they are very resistant to welding at the voltages normally occurring when an electric switch of this type is controlled to switch.

[0046] The invention is of course not in any way restricted to the embodiments described above, but many possibilities to modifications thereof will be apparent to a person with skill in the art without departing from the scope of the invention as defined in the appended claims.

[0047] Said first means may be of other types than described above, such as utilizing magnetostriction or even explosives if it is a one way switch.

[0048] The eddy current brake may be replaced by any other suitable brake, such as a pneumatic brake.

Claims

1. An electric switch comprising

- two main contact electrodes (1, 2) arranged in a first current path (3) through the switch, and
- an arrangement (8) configured to open and close said first current path through said electrodes for transferring the switch from a closed state in which current may flow in said first current path and an open state in which current, when flowing in said first current path, is diverted to another current path (6) and conversely,

characterized **in that** the switch further comprises at least one auxiliary contact electrode (4) configured to be arranged in said first current path in a location between said two main contact electrodes in said closed state of the switch and conduct the entire current flowing between said main contact electrodes **in that** state,

that said at least one auxiliary contact electrode (4) is movable with respect to said main contact electrodes, and

that said arrangement comprises first means (9) configured to move said at least one auxiliary contact electrode so as to obtain said transfer of the switch between said two states.

2. A switch according to claim 1, ***characterized*** **in that** said main contact electrodes (1, 2) are movable with respect to each other, and that said arrangement (8) comprises second means (10) configured to move said main contact electrodes apart from and towards each other and a control unit (11) configured to control said first (9) and second (10) means for co-ordinating the movement of said main contact electrodes (1, 2) with respect to each other and the movement of said auxiliary contact electrode (4) when performing said transfer of state of the switch.

3. A switch according to claim 2, ***characterized*** **in that** said control unit (11) is configured to synchronise said movements so as to first move said main contact electrodes (1, 2) apart with respect to each other and then with a determined delay move said auxiliary contact electrode (4) when transferring the switch to the open state and move said auxiliary contact electrode (4) and with a certain delay then move said main contact electrodes (1, 2) towards each other when transferring the switch to said closed state.

4. A switch according to claim 3, ***characterized*** **in that** it comprises third means (13) configured to measure a time varying current in said first current path (3) in a closed state of the switch and calculate the instant of time for a future zero-crossing of the current and send information thereabout to said control unit (11) configured to use this information for synchronising said movements when transferring the switch from a closed state to an open state.

5. A switch according to claim 2, ***characterized*** **in that** it comprises means (12) configured to apply a pressure urging said main contact electrodes (1, 2) towards each other in the closed state of the switch.

6. A switch according to any of the preceding claims, ***characterized*** **in that** said first means (9) configured to move said at least one auxiliary contact electrode (4) is physically separated from this electrode.

7. A switch according to claim 6, ***characterized*** **in that** said first means (9) comprises an apparatus configured to accelerate a member (24, 27) to hit a part (19) in the form of the auxiliary contact electrode (4) or a carrier of that electrode for transferring kinetic energy to this part so as to obtain said movement thereof for transfer of the switch between said two states.

8. A switch according to claim 7, ***characterized*** **in that** said member (24, 27) has substantially the same mass as said part (19) with the auxiliary contact electrode (4) caused to move by said hit.

9. A switch according to claim 7 or 8, ***characterized*** **in that** said auxiliary contact electrode (4) is arranged on a slide (19) movable along a predetermined path.

10. A switch according to any of claims 7-9, ***characterized*** **in that** said apparatus has two said members (24, 27) arranged on opposite sides of said part (19) with said auxiliary contact electrode (4) with respect to the direction of said movement of said part, and that one of said two members is configured to be hit by the part carrying said auxiliary contact electrode when this has been caused to move by being hit by the other of said two members and by this stop this part for defining a new state of the switch by transferring kinetic energy to said one of the two members.

11. A switch according to claim 10, ***characterized*** **in that** it comprises a piece (29) configured to be hit by said one (24, 27) of the two members for transfer of kinetic energy thereto and stop this member in a predetermined ready position ready to be accelerated in the opposite direction for hitting said part (19) for changing state of the switch back again.

12. A switch according to claim 11, ***characterized*** **in that** it comprises means (30-32) configured to brake said piece (29) when hit by said second member (24, 27) for stopping this piece.

13. A switch according to any of claims 10-12, ***characterized*** **in that** it is symmetric with respect to said two members (24, 27) and with respect to the function of said apparatus, and said one member is configured to assume the role of said other member and conversely once the switch has changed from one of said closed and open state to the other.

14. A switch according to any of claims 7-13, ***characterized*** **in that** said apparatus comprises Thomson coils (25) close to and/or in said member (24, 27) to be accelerated and means configured to control a current flow through these coils for accelerating said member.

15. A switch according to any of the preceding claims, ***characterized*** **in that** it comprises a first said main contact electrode (1') in common to said first and second current paths and two second main contact electrodes (2', 2") configured to be arranged in one of said first and second current paths each, and that said first means (9) is configured to close one of said current paths when opening the other by moving at least one said auxiliary contact electrode.

16. A device for commutating an alternating current from at least one first current path (3) to at least another second current path (6), ***characterized*** **in that** it comprises a switch according to any of the preceding

claims arranged in at least said first current path.

17. A device according to claim 16, ***characterized*** **in that** it comprises at least one semiconductor device (7) of turn-on type arranged in said second current path and a control apparatus configured to synchronise opening and closing of said switch with control of said semiconductor device.

18. Use of a switch according to any of claims 1-15 for commutating an alternating current from one current path to another current path.

19. Use according to claim 18, in which the switch is used in a tap changer or a current limiter.

20. Use according to claim 18, in which the switch is used in equipment for reactive power compensation, such as in Static Var Compensation (SVC) or in Controlled Series Capacitors (CSC).

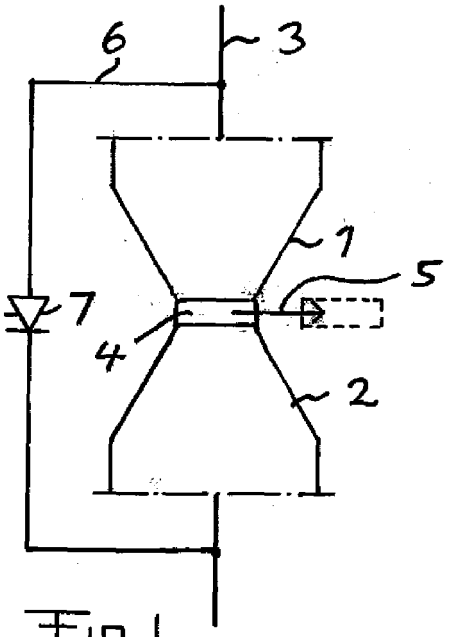


Fig 1

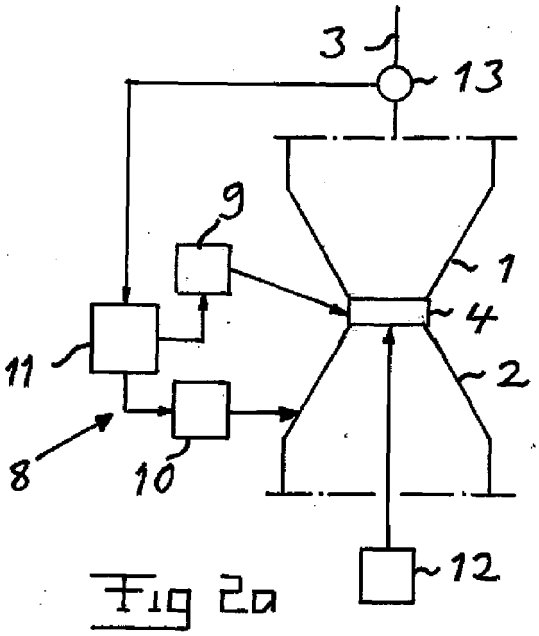


Fig 2a

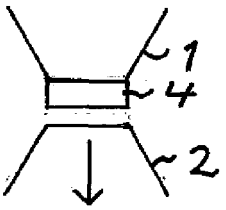


Fig 2b

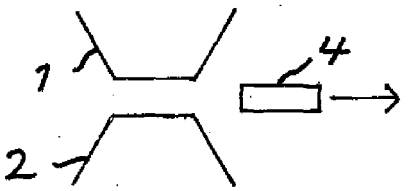


Fig 2c

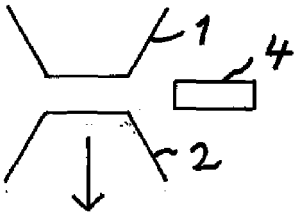


Fig 3a

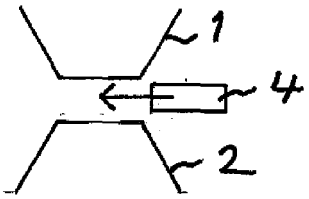


Fig 3b

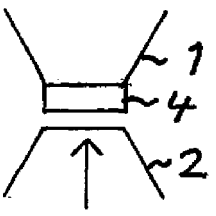


Fig 3c

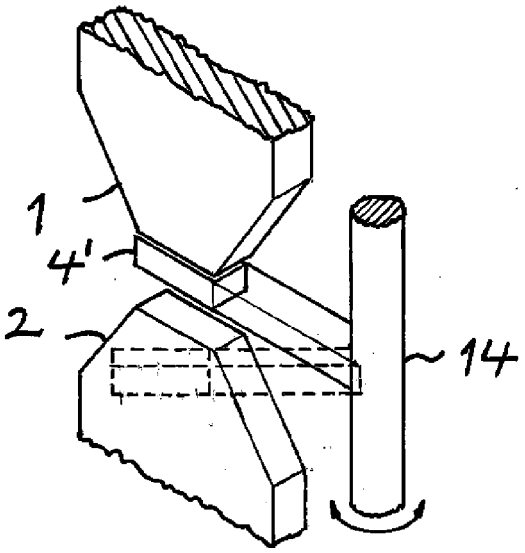


Fig 4

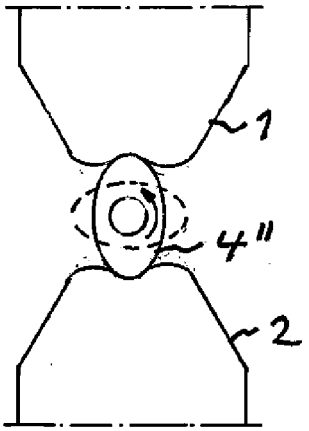


Fig 5

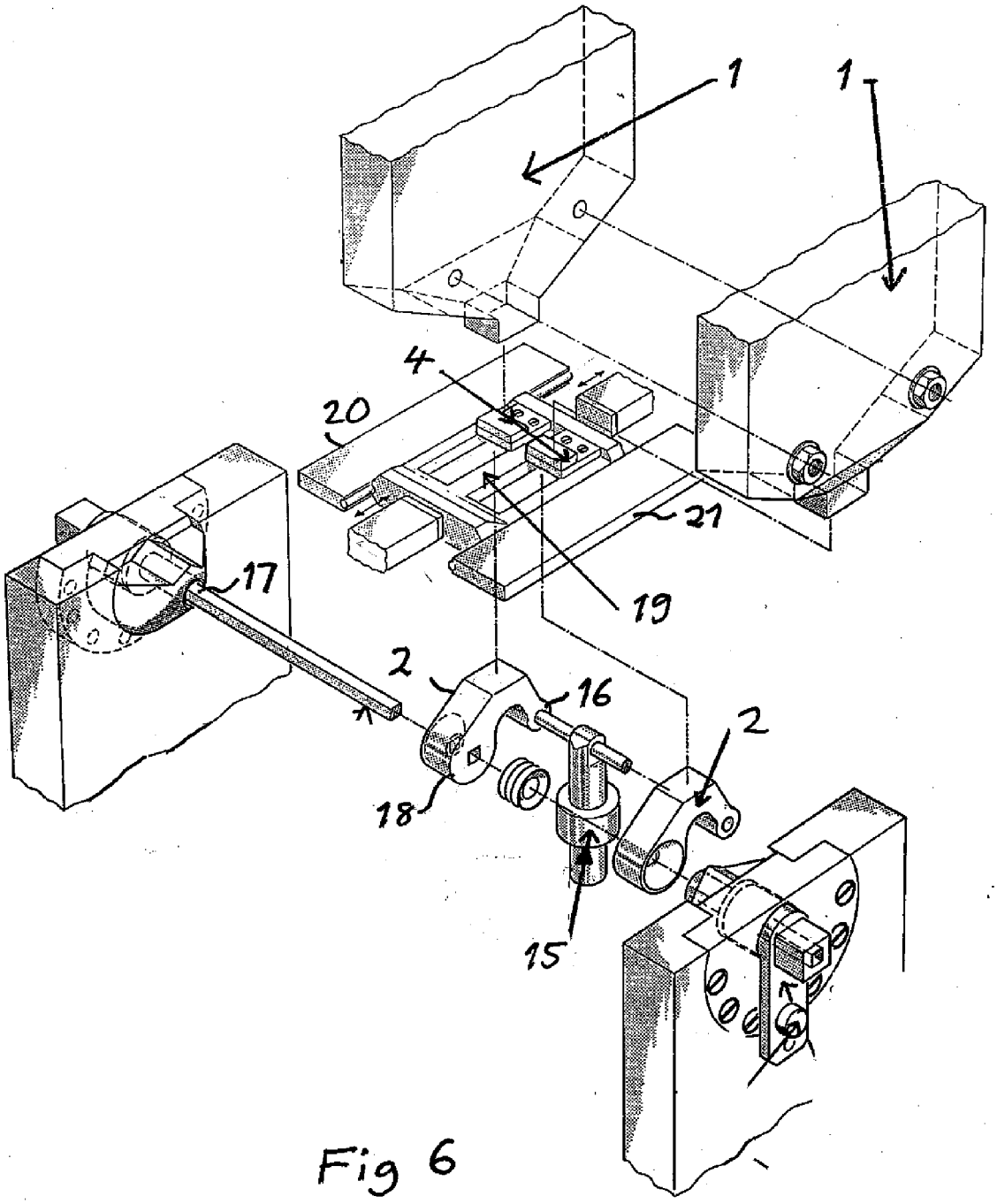


Fig 6

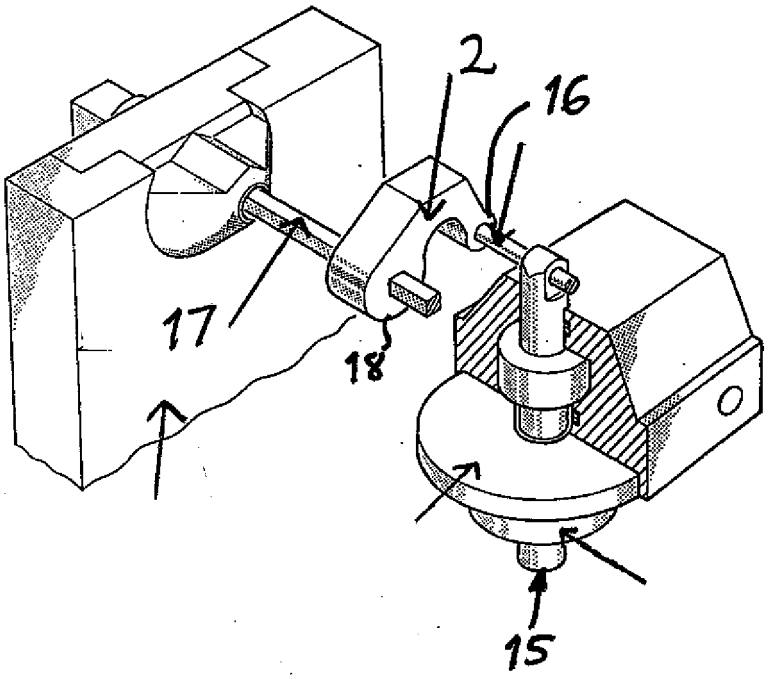


Fig 7

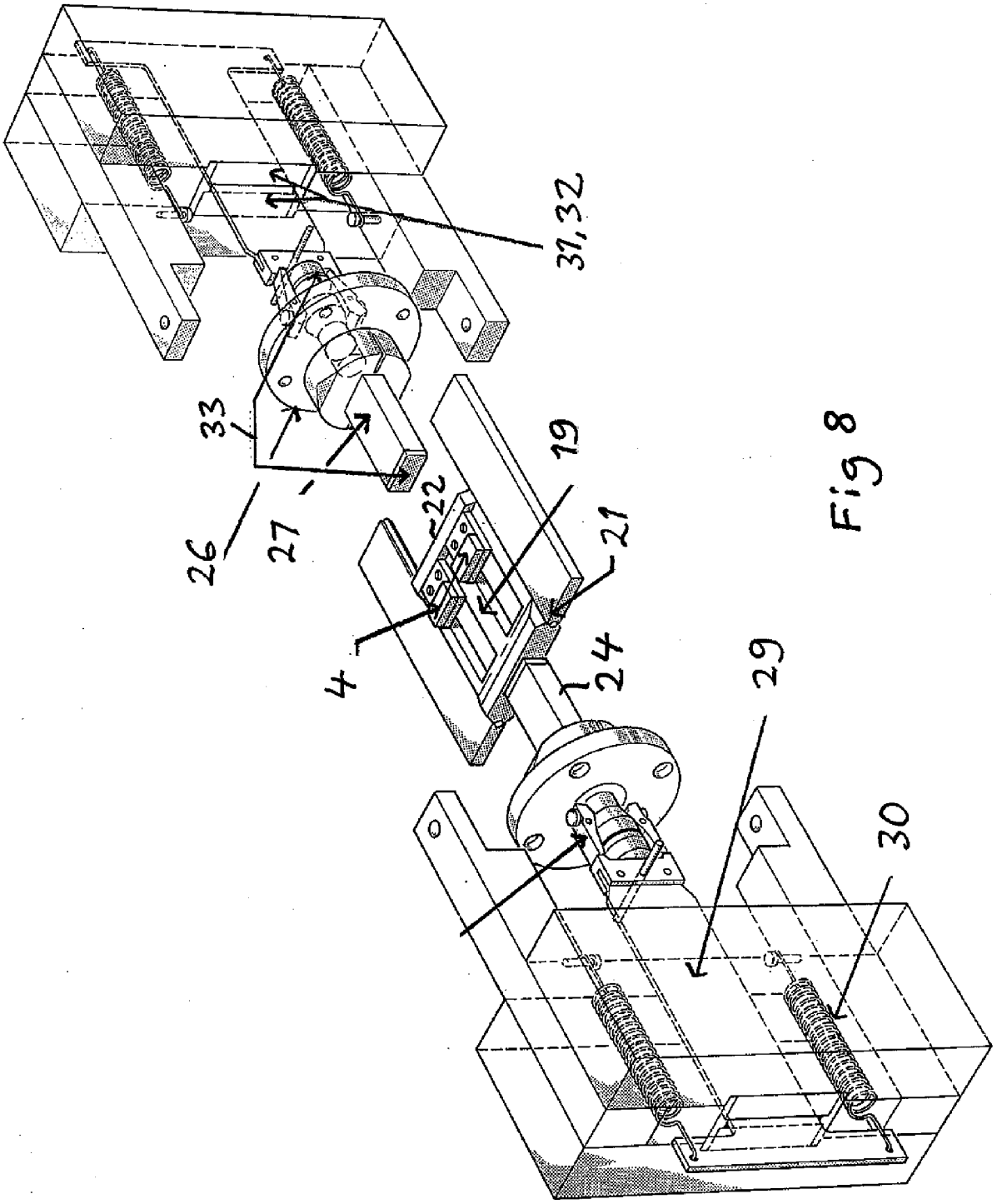


Fig 8

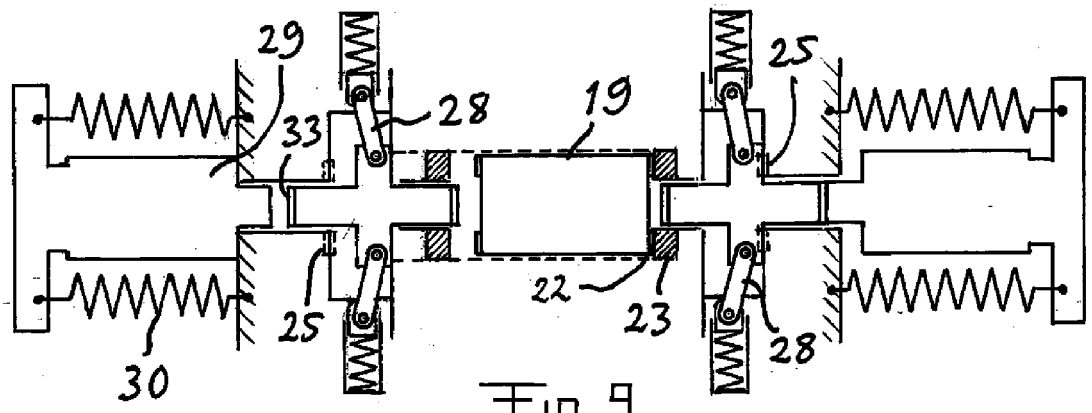


Fig 9

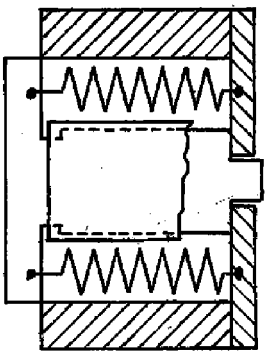


Fig 10

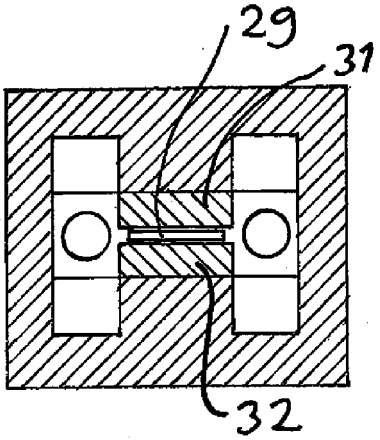


Fig 11

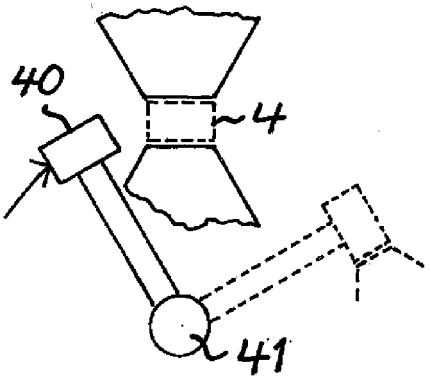


Fig 14

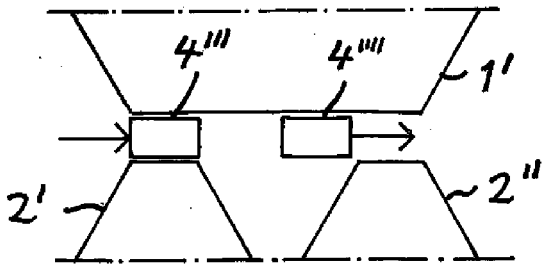


Fig 15

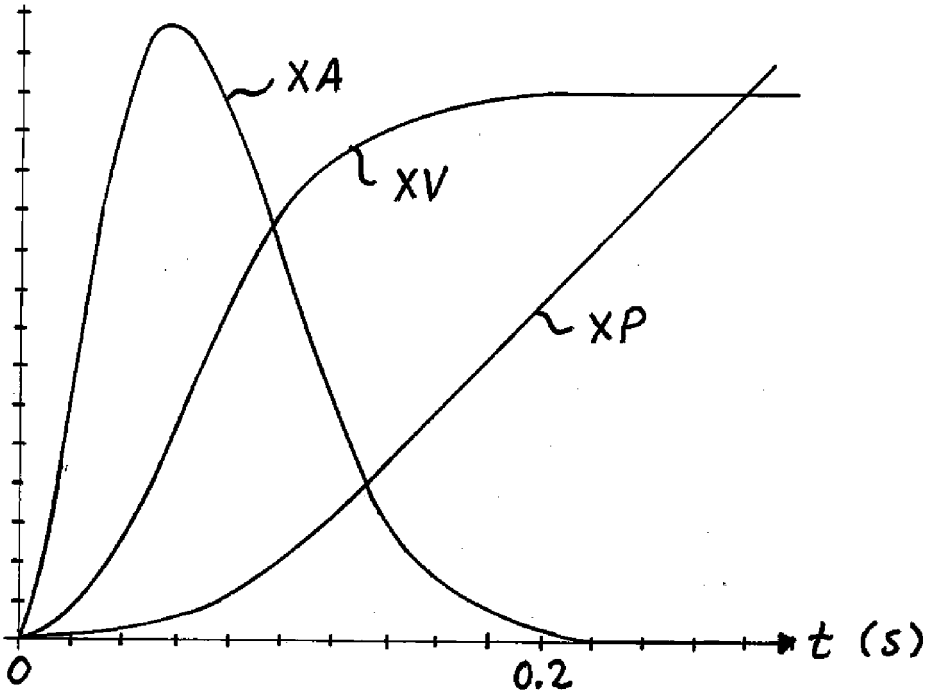


Fig 12

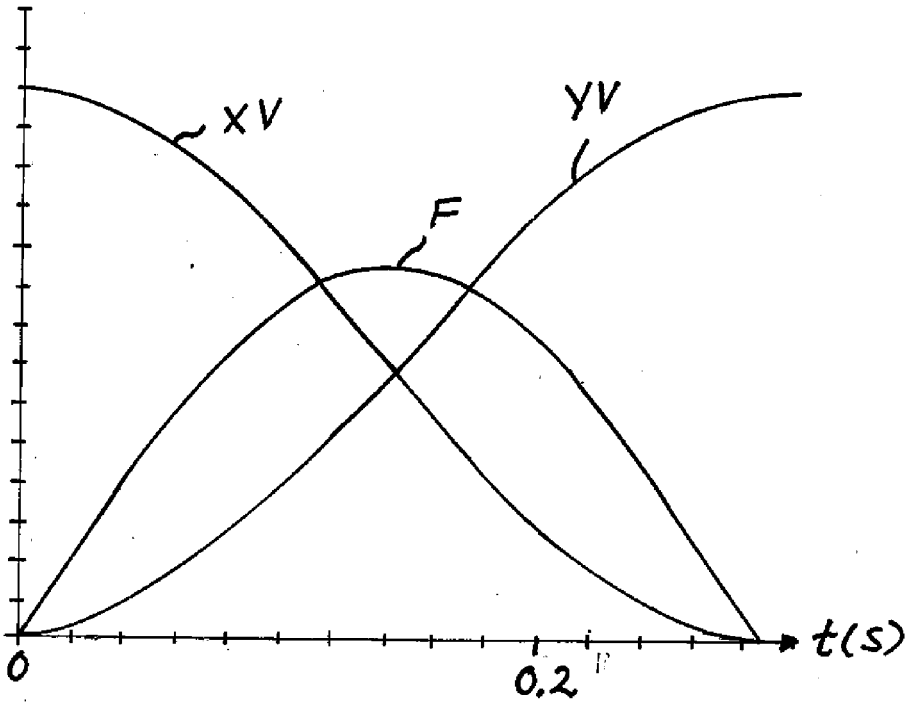


Fig 13

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EUROPEAN SEARCH REPORT

Application Number
EP 09 18 0362

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 April 2010	Starck, Thierry

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EUROPEAN SEARCH REPORT

Application Number
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The Hague	21 April 2010	Starck, Thierry

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