

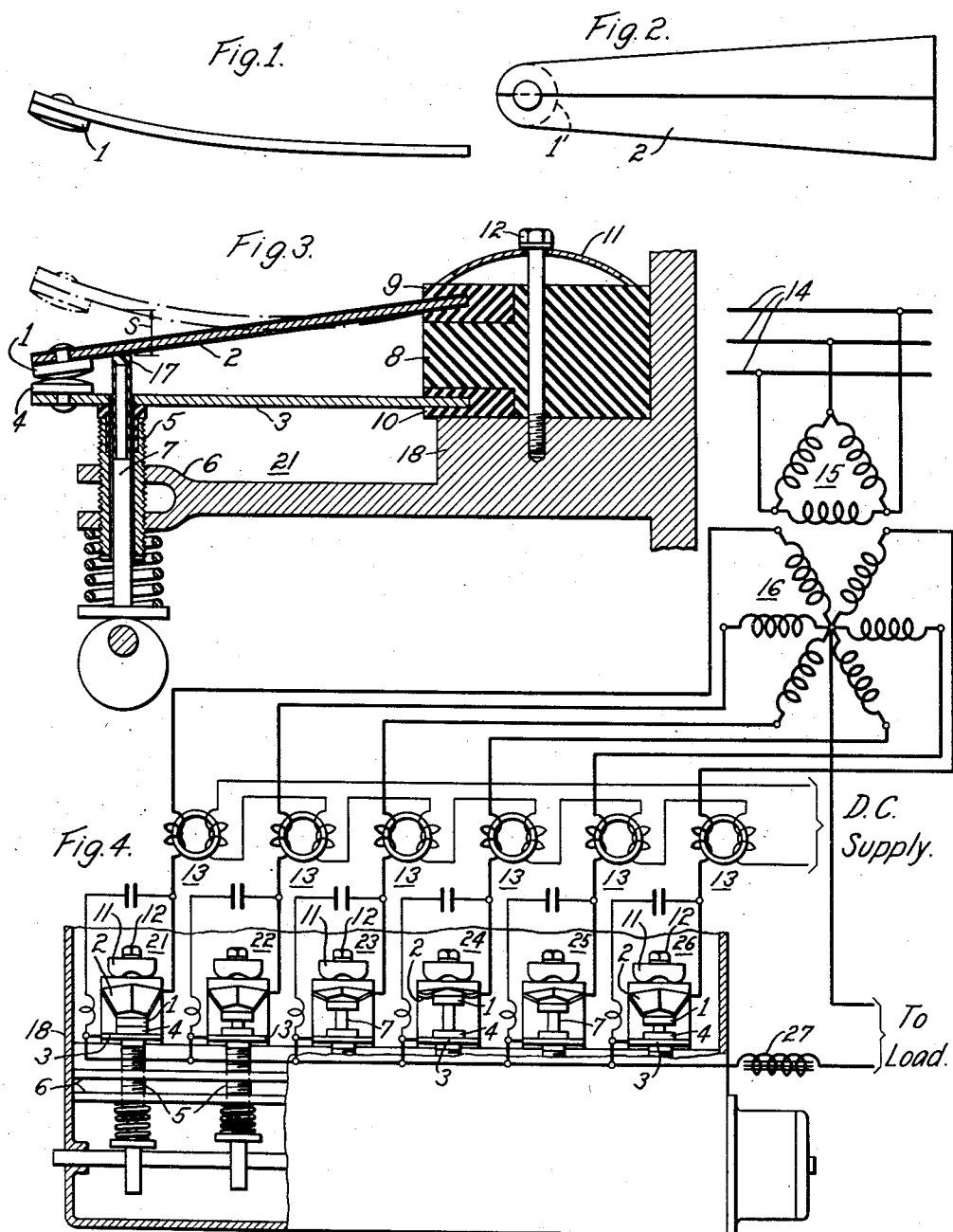
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CONVERTER

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WITNESSES:

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CONVERTER

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many; vested in the Alien Property Custo-
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13 Claims. (Cl. 175—364)

This invention relates to an apparatus for converting alternating current to direct current or vice versa, or alternating current of a given frequency to alternating current of another frequency with the aid of contact converters whose moved contacts are mechanically operated, for instance, by cams, eccentrics, cranks or the like. The main object of the invention is to reduce to a considerable extent or to prevent damages of the circuit breaker contacts.

If cantilever springs are employed as carriers for the moved contact in order to reduce the moved masses, difficulties are presented when employing a rectangular (strip) shape of the springs which have an equal cross-section throughout their entire length, since it has been found that such springs fixed at one end, provided at their free ends with contacts and which have a parabolic curve as shown in Fig. 1 tend to vibrate owing to the relatively great mass so that the contacts when in operation for a considerable period may be damaged or even rendered useless by arcing.

With the invention it is possible to attain not only an approximately circular, i. e., a throughout uniform curve but also to design the contacts with a small mass in the neighborhood of the contact point without the use of additional current leads, for instance, flexible flat conductors in such a manner that no vibrations occur despite an intimate contact. Owing to the manner how the contacts are arranged and designed, arcs which may, for instance, result in cases of trouble may be effectively blown out.

The essence of the invention consists in the fact that a substantially triangular plate spring which is fixed at the enlarged end and carries the contact at its narrow end serves as a carrier for each moved contact and at the same time as a current lead for the same. Also the cross-section of the cantilever spring may be given a substantially triangular shape. By giving the spring such a form a sufficient cross-section is at the same time available for the passage of the current to the contact so that the danger of an undue heating is prevented and therefore a reduction of the spring tension.

Such a contact spring is shown diagrammatically in Fig. 2, while Fig. 3 shows the manner how it is arranged and Fig. 4 a switching arrangement, whereby further improvements may be attained so as to avoid damages of contacts caused by arcing.

The moved contact 1 is secured to a substantially triangular plate spring 2 serving at the

same time as a current supply lead. The spring may consist of steel or spring bronze and may be coated with a highly conductive layer so as to improve the conductivity. An outer coating of silver with an intermediate layer of copper has proved particularly advantageous. The contact 1 which may be, for instance, provided with a silver coating may be designed or employed to advantage as a lifting contact. The corresponding stationary counter-contact 4 may also be rigidly secured to a strip-like plate spring 3 which may at the same time serve as a current-supply lead. The counter-contact may consist of a copper alloy, such as bronze or the like. The counter-contact 4 may be adjusted with the aid of an adjusting screw 5 which passes through the threaded bores of a stationary stirrup-shaped member 6. A push rod 7 may pass through a bore provided in the carrier 3 of the contact 4. It is advantageous to arrange the abutment or the adjusting screw 5 of the plate spring (contact reed) 3 as close as possible to the contact point in order to prevent the natural vibrations of the contact reed 3. To this end, the adjusting screw may, for instance, be made hollow and centrally arranged to the axis of the push rod.

To insulate the push rod from the plate spring and to reduce the tear and wear at the contact point between the push rod 7 and the contact spring 2 to a minimum the push rod 7 is preferably provided with an end portion 17 consisting of insulating material (for instance, of artificial resin).

By the displacement of the counter-contact 4 the position of closure of the triangular plate spring 2 secured under a predetermined, for instance, an obtuse angle to the axis of the push rod 7 to a basic body 18 consisting of the driving device and guide devices for the push rod is varied and the desired bias as well as the contact strokes for a given path of motion of the push rod are thereby adjusted. The plate spring 2 may be preferably so adjusted that the push rod axis is perpendicular to the tangent to the curve, passing through the contact point between the push rod and the plate spring 2 when the plate spring 2 is approximately in the central position of the stroke. In this manner the friction between the plate spring and the point of the push rod is reduced. If the contact surface of the push rod 7 is flat the friction is reduced to a further extent, i. e., to a minimum as a result of the rolling of the contact surface of the push rod on the plate spring 2. Owing to the particular design and arrangement of the con-

tacts and contact carriers a current loop is formed whose magnetic field exerts a blow-out action on the arc or supports the same. To increase the blow-out action to a further extent a magnet with a blow-out coil provided, for instance, in the shunt to the contacts is arranged in the neighborhood of the contacts.

Each of the plate springs 2 and 3 is held between an insulating spacer 8 and each of the fork-shaped holding pieces 9 and 10 respectively consisting of insulating material. The plate springs 2, 3 are firmly held together in position with the insulating pieces 8 to 10 by means of a rotatable claw 11 so that the parts 2, 3, 9 and 10 form an interchangeable unit which is secured with the aid of a single screw 12 of the claw 11.

As already mentioned the triangular contact spring 2 is operated by means of the spring-biased push rod 7 displaceable in the opposite direction which is reciprocated, for instance, by an eccentric shaft. To this end, as disclosed in the copending application Serial No. 239,918, a common (single) eccentric may be provided around which are radially arranged the contact sets. Instead of an eccentric an eccentric shaft, cam shaft or crank shaft may be employed which, as described in the copending application Serial No. 290,476, is driven through one or more levers, a connecting rod or the like. At all events the drive may be effected by means of a rotary engine, a compressed air piston or the like.

To prevent as far as possible the contacts from being damaged by arcing the apparatus according to the invention (Fig. 4) may be designed in such a manner that in each phase a switching reactor with a highly saturated magnet core is provided, by means of the desaturation of which a current-weak pause is brought about which facilitates the interruption.

As will be seen from Fig. 4 the apparatus may comprise, for instance, six contact devices 21 to 26, each of which may be connected in parallel relation with a preferably capacitive current path in order to retard the increase in voltage when the contacts are being opened. The converter is connected to an alternating-current supply circuit 14 to the primary winding 15 through a transformer. The secondary winding 16 may be star or delta connected. In the alternating-current supply conductors are arranged three switching reactors 13. The magnet cores of these switching reactors consist preferably of a flat wound ribbon of a magnetically high grade steel whose magnetization curve is as little as possible inclined to the flux axis in the unsaturated zone, presents at each transition point in the saturated zone as sharp a bend as possible and runs in the saturated zone in the case of the greatest possible induction substantially in parallel relation to the axis of the magnetic excitation. The number of turns and the core cross-section of the core reactors are preferably so chosen that the magnet core is unsaturated in the neighborhood of the zero value only for very small instantaneous values of the current.

Instead of three switching reactors six switching reactors may be provided, each of which may lie in the branch conductors immediately in front of a contact device.

The switching reactors may further be provided with additional auxiliary windings, for instance, for the magnetic bias, which are supplied with controllable direct current or alternating current and which may serve for the magnetic control of

the switching reactor cores for adapting the same to the different load conditions, or to control the direct voltage by varying the biasing current. As will be seen from Fig. 4 a reactance coil 27 may be arranged in one of the direct-current conductors.

The above-described contact arrangement may not only be employed for periodical current interruptions in contact converters but also in any control arrangements, for instance, for carrying out single switching operations.

The above-mentioned measures may be employed in any combination, for instance, in connection with the subject matter described in the copending application Serial No. 114,965.

What is claimed is:

1. A device as set forth in claim 10, characterized in that the fixed end of the triangular spring forms an obtuse angle with the push rod axis in such a manner that the push rod axis is substantially perpendicular to the tangent to the curve, passing through the contact point between the push rod and the triangular spring when the triangular spring is approximately in the central position of the stroke.
2. A device as set forth in claim 10, characterized in that the moved contact together with the stationary counter-contact, the respective carriers and insulating holding pieces forms an interchangeable unit.
3. A device as set forth in claim 10, characterized in that the contact set is held together by means of a rotatable claw and is secured to a basic body with the aid of a single screw.
4. A device as set forth in claim 11, characterized in that the metal coating of the triangular spring consists of a copper intermediate layer and of a silver outer layer.
5. A device as set forth in claim 10, characterized in that the moved contact has a silver coating, whereas the counter-contact consists of copper alloy or the like.
6. A device as set forth in claim 10, characterized in that the contacts and the contact carriers are so designed and arranged that a current loop is formed whose magnetic field exerts a blow-out action.
7. A device as set forth in claim 10, characterized in that the contact surface of the push rod is flat.
8. A device as set forth in claim 10, characterized in that the push rod is provided at the end opposite to its contact point with an end portion of insulating material.
9. A device as set forth in claim 10, characterized in that a switching reactor with a highly saturated magnet core, by means of the desaturation of which a current-weak pause is brought about which facilitates the interruption is series connected to the contacts.
10. In a contactor device, a contactor comprising a movable contact, a substantially fixed counter-contact, a substantially triangular spring anchored at the base and carrying the movable contact adjacent the tip, a plate spring carrying the counter-contact, a base member, insulating means for securing said plate spring and said triangular spring on said base, a substantially tubular adjusting screw secured in said base and contacting the plate spring adjacent the counter-contact, there being an opening in said plate spring coinciding with the opening in the adjusting screw and an insulated push rod extending through said adjusting screw and said opening for actuating said movable contact.
11. In a contactor device, a contactor compris-

ing a movable contact, a substantially fixed counter-contact, a substantially triangular spring anchored at the base and carrying the movable contact adjacent the tip, a plate spring carrying the counter-contact, a base member, insulating means 5 for securing said plate spring and said triangular spring on said base, a substantially tubular adjusting screw secured in said base and contacting the plate spring adjacent the counter-contact, there being an opening in said plate spring coinciding with the opening in the adjusting screw 10 and an insulated push rod extending through said adjusting screw and said opening for actuating said movable contact, said triangular spring being composed of spring material and a coating of 15 a highly conductive metal.

12. A switching device comprising a substantially fixed contact, a spring arm carrying said fixed contact, means for anchoring the spring arm at a point remote from the fixed contact, a support for the spring arm adjacent the fixed 20 contact, a movable contact cooperating with the fixed contact, a cantilever beam carrying said

movable contact, means for anchoring the end of the cantilever beam remote from the contact, said cantilever beam tapering from the anchored end to the contact to provide a cantilever beam of uniform strength, and means contacting said beam adjacent the movable contact for determining the position of the movable contact.

13. In a switching device, a contactor comprising a substantially fixed contact, a plate spring carrying said fixed contact, a movable contact cooperating with said fixed contact, a cantilever beam of spring material supporting said movable contact, said cantilever beam diminishing in cross-sectional area from the base to the tip carrying the contact, means for anchoring the base of said beam, there being an opening in said plate spring and a push rod extending through said opening and contacting the beam adjacent the tip for actuating said movable contact.

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