Aug. 24, 1943. H. J. BROWN 2,327,577

BALANCED INTERRUPTER SYSTEM

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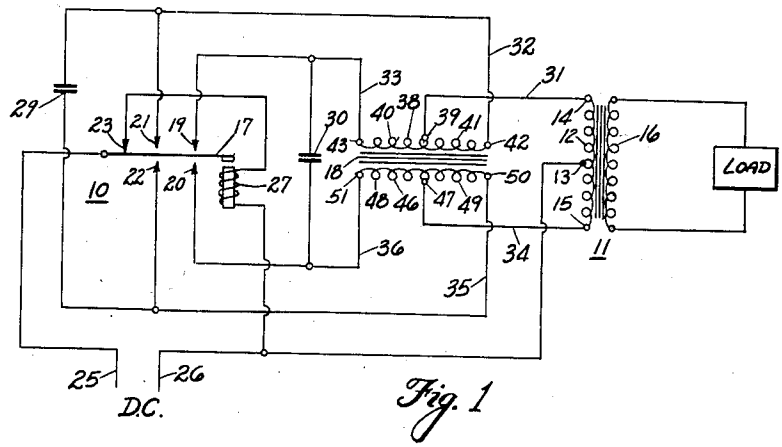


Fig. 1

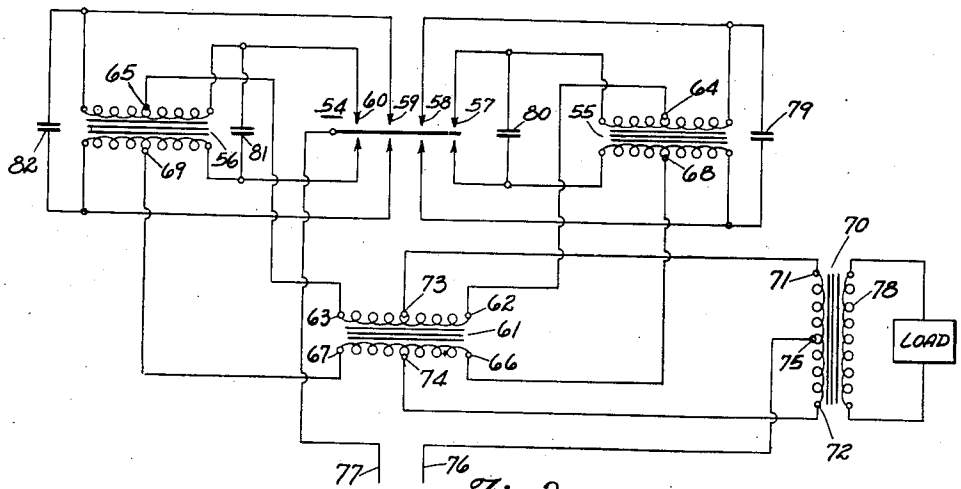


Fig. 2

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BALANCED INTERRUPTER SYSTEM

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14 Claims. (Cl. 175—365)

My invention relates in general to balanced interrupter systems and more particularly to an arrangement to prevent the damaging of the interrupting contact. This application relates to the subject matter of my Patent No. 2,286,842 and my pending applications Serial Nos. 429,074, 429,075 and 429,077.

In the design of vibratory converters, substantially no difficulty is encountered in building a vibrator that is immuned to mechanical wear on the contact points. The impacts on closing and the wear due to rubbing can be so reduced that the device will operate indefinitely, if at the same time, the stressed parts are properly strain-relieved and operated well below their endurance limit. With such a vibrator, the problem is primarily one of reducing the effects of the electric current and voltages on the contacts so that any required performance may be achieved. Experience shows that in a vibrator where the make-and-break operating cycles run into the billions, the life and performance is strictly determined by the ability of the contact points to withstand the pitting and erosion of the electrical current flowing at the instance of the make-and-break. Notwithstanding the fact that the most resistant materials available to the engineering art are used, the vibrator in many applications fails to meet the standards of reliability and life which are normally required. Also, there is need for increased power output capabilities for vibratory converters. By using larger transformers and larger vibrators, increased power has been obtained, but in general, a less satisfactory result is noted especially as regards vibrator life and reliability of the contact interrupting points. Vibrators with several sets of points in parallel have also been used in an effort to increase the power handling capacities, but here too the life and reliability of the contacts do not come up to expectations. The principle reason for the lack of satisfactory results lies in the character of the contacting materials when interrupting the current. Generally speaking, the current in a contact "necks" down to an extremely high current density prior to separation, even though large shunting capacities be used. For reasonable values of current relative to the material used, the contact is subject to melting and vaporization at the final tip, and if two or more contacts are in parallel, the final single trailing contact is subject to the attack of this high current density. Similar destructive effects take place when the contact engagement is made, as the condensers necessary to operate the equipment are then charged or discharged. One of the more noticeable effects is material transfer from one contact to the other, another is pitting and erosion, and in severe cases, there is arcing which is very destructive.

Contact point disintegration due to electrical current falls in two categories; namely, the disintegration resulting from making the contact and the disintegration resulting from breaking the contact. Both may be partially controlled by the proper handling of the circuit constants but it is unfortunately true that changes in the circuit which improve the performance at the "break" may harm the performance at the "make," and vice versa. Therefore, the design of a good and efficient converter circuit which will give long life and reliability against breakdowns presents a difficult problem to solve and a satisfactory circuit cannot be prescribed on the basis of a superficial examination. Furthermore, the absence of sparking is no criterion of a satisfactory circuit, as it is often true that the performance of mildly sparking contacts will be superior to dark ones. A further characteristic of contact points is that various thresholds of current exist below which material transfer and erosion do not occur at all or in small amounts.

An object of my invention is, therefore, the provision of reducing the electrical disintegration effect below the threshold value where material transfer and erosion do not occur at all or in small amounts.

Another object of my invention is to prevent the current flowing through one contact from diverting into another, as one contact is opened prior to another.

Another object of my invention is to forcibly prevent the current flowing in two or more vibrator contacts from re-establishing itself in a single final trailing contact tip during the short interval of time involved between the successive openings of the parallel contacts and to insure that the burden of interrupting the circuit is divided between the pair of parallel contacts.

Another object of my invention is the provision, in a circuit interrupter having a plurality of parallel interrupting paths, of preventing the current which is interrupted in an interrupted path incident to slight variations in the interruptions of the plurality of interrupting paths from suddenly re-establishing itself in a yet uninterrupted path during the short inter-

val of time involved between the successive interruptions of the parallel paths.

Another object of my invention is to keep the flow of the interrupting current in the interrupting contacts less than that certain threshold value below which material transfer and erosion of the contacts do not occur at all or in small amounts.

In a set of parallel contacts, the current will divide between the contacts according to Ohm's law. Since the contact resistance is small compared to the rest of the vibratory circuit, which is ordinarily the case, the opening of one of two parallel contacts will not effect the total current flow, and the total current will then flow through the remaining closed trailing contact. The time required for this diversion will be very small, perhaps less than 10^{-6} seconds, as indicated by the residual inductance and resistance of the closed loops through the two parallel contacts. In any practical vibrator, the differences in opening time may be a thousand times this value so the problem may be stated as one of increasing the diversion time perhaps a thousand or more times its ordinary value.

Therefore, another object of my invention is to provide for increasing the diversion time perhaps a thousand or more times its ordinary value.

Another object of my invention is to utilize the ordinary primary buffer condenser as a current-diverting condenser during the short interval of time involved between the successive openings of the contact members to avoid the use of by-pass condensers in the circuit.

Another object of my invention is to divide the primary buffer condenser into two parts and thus reduce the condenser effects on the "making" of the contacts.

Another object of my invention is to reduce the electrical damage to the contacts during both the "make" and "break" cycles thereof.

Another object of my invention is the provision of a balancing inductance taken in combination with a current-diverting impedance for preventing the current flowing in two or more vibratory contacts from re-establishing itself in a single final trailing contact tip during the short interval of time involved between the successive openings of the parallel contacts and to insure that the burden of interrupting the current is divided between the pair of parallel contacts.

Another object of my invention is to prevent the current flowing through one contact from diverting into another as one contact is open prior to the other without the liability of inductance in the vibratory load circuit.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a diagrammatic view of a vibratory converter circuit employing the features of my invention; and

Figure 2 is a view illustrating the manner in which the circuit of Figure 1 may be applied to four sets of parallel contacts instead of two sets as shown in Figure 1.

With reference to the Figure 1 of the drawing, my invention comprises, in general, a vibratory interrupter 10, a transformer 11, two capacitors 29 and 30, and a balancing inductance 18 having a winding 38 and a winding 46 mounted upon a common core. As illustrated, the vibratory interrupter 10 supplies an interrupted direct current to the primary winding 12 of the transformer 11 which in turn supplies an alternating current to the load from the secondary winding 16. The center tap 13 of the primary winding is connected to one side 26 of the direct current source and the other side 25 of the direct current source is connected to the vibratory reed 17 of the vibratory interrupter. As diagrammatically shown, the vibratory interrupter comprises two parallel sets of interrupting contacts, in which one set comprises the oppositely disposed contacts 19 and 20 with the vibratory reed 17 operating therebetween and in which the other set comprises the oppositely disposed contacts 21 and 22 with the vibrating reed 17 operating therebetween. The vibrating reed 17 is actuated by an electro-magnet 27 which is energized through an additional contact 23 engaging the vibrating reed 17. The capacitor 29 is connected across the oppositely disposed contacts 21 and 22 of one set of contacts and the capacitor 30 is connected across the oppositely disposed contacts 19 and 20 of the other set of contacts. The oppositely disposed contacts 19 and 20 on one side of the vibrating reed 17 are connected in parallel through a first circuit connection means comprising conductor 31 and two branch circuits 32 and 33. The right-hand end of the conductor 31 is connected to the end 14 of the primary winding 12 of the transformer and the left-hand end of the conductor 31 is connected to a center tap 39 upon the winding 38 of the inductance 18. The two branch circuits 32 and 33 are connected, respectively, to the ends 42 and 43 of the winding 38 of the balancing inductance 18. The center tap 39 divides the winding 38 into two halves 40 and 41 included in each of the branch circuits 32 and 33.

The two oppositely disposed contacts 20 and 22 on the other side of the vibrating reed 17 are connected in parallel through a second circuit connection means comprising a conductor 34 and two branch circuits 35 and 36. The right-hand end of the conductor 34 is connected to the end 15 of the primary winding 12 of the transformer and the left-hand end of the conductor 34 is connected to the center-tap 47 of the second winding 46 on the balancing inductance 18. The two branch circuits 35 and 36 are connected respectively to the ends 50 and 51 of the second winding 46 on the inductance 18. The center tap 47 divides the second winding 46 into two halves 48 and 49 with each half included in the two branch circuits 35 and 36.

In operation, the two halves 40 and 41 of the winding 38 and the two halves 48 and 49 of the winding 46 do not impede the flow of the current in the vibratory load circuit for the reason that the current which flows therethrough in opposite directions balances out the impedance so that the only effect of the windings of the inductance 18 in the vibratory load circuit is that of the IR drop. Consequently, I am able to achieve parallel operation of the two sets of contacts without liability of the inductance in the load circuit.

During the interruption of the parallel contacts, should the contact 19, for example, open slightly prior to the opening of the contact 21, then the combination of the balancing winding 38 and the current-diverting condenser 30 operates to prevent the current which is interrupted by the contact 19 from suddenly re-establishing itself in the yet uninterrupted parallel contact 21 during the short interval involved between the successive openings of the parallel sets of contacts. In the event that the contact 21 opens

prior to the contact 19, then the combination of the balancing winding 38 and the current-diverting capacitor 29 operates to prevent the current which is interrupted by the contact 21 from suddenly re-establishing itself in the yet uninterrupted parallel contact 19. The description with reference to the contacts 19 and 21 apply equally well to the contacts 20 and 22 except that the winding 46 on the balancing inductance 18 is employed instead of the balancing winding 38. Each half of the windings on the inductance 18, as the case might be, develops in series with the contacts an inductive impedance to oppose the sudden re-establishment of the current which formerly flowed through an interrupted contact to a yet uninterrupted contact during the short interval of time involved between the successive openings of the contacts. During the time that the windings are opposing the flow of the current therethrough, the capacitors 29 or 30, as the case might be, acts as a current-diverting capacitor to permit the current which formerly flowed through the interrupted contact to flow thereinto.

In my circuit as illustrated, the capacitors 29 and 30 are buffer condensers commonly used in vibratory circuits but I have also used them as current-diverting condensers during the short interval of time involved between the successive openings of the contacts. In addition, the capacitors 29 and 30 are each substantially one-half the capacity of what a condenser would be if it were connected across a vibratory converter having but a single set of oppositely disposed contacts. Therefore, in regard to the making of a circuit, it will be noted that the condenser effect is divided in half, the capacitance of the condensers 29 and 30 totalling what would normally be the entire primary buffer condenser. This means that the condenser energy on the "make" contact is halved and its effect reduced. Consequently, in my invention I provide for reducing the damage to the contacts upon both the "make" and the "break" cycle of the interrupting contact.

In Figure 2 I show an extension of the principle of my invention in Figure 1 in that I am able to control the proper division of the current through four sets of parallel contacts 57, 58, 59 and 60 of the vibratory interrupter 54 by employing three balancing inductances 55, 56 and 61. The balancing inductance 55, together with the capacitors 79 and 80, controls the proper division of the current for the two sets of parallel contacts 57 and 58, the balancing inductance 56 together with the capacitors 81 and 82 control the proper division of the current through the parallel sets of contacts 59 and 60. The balancing inductance 61 is arranged to electrically connect in a balancing relation the two balancing inductances 55 and 56 to the primary winding of the transformers 70 having a secondary winding 78 for supplying an alternating current to the load. As illustrated, the end 62 on the upper winding for the balancing inductance 61 is connected to the center tap 64 of the upper winding for the balancing inductance 55 and the end 63 for the upper winding of the balancing inductance 61 is connected through the center tap 65 of the upper winding for the inductance 56. Similarly, the ends 66 and 67 for the lower winding of the inductance 61 are respectively connected to the center tap 68 and 69 of the lower windings of the inductances 55 and 56. The center tap 73 for the upper winding of the inductance 61 is connected to the end 71 of the primary winding and the center tap 74 for the lower winding on the inductance 61 is connected to the end 72 on the primary of the transformer. The center tap 75 on the primary of the transformer is connected to one side 76 of the direct current source and the other side of the direct current source 77 is connected to the vibrating reed of the vibratory interrupter 54. In Figure 2 I am able to achieve parallel operation of four sets of parallel contacts without liability of inductance included in the vibratory load circuit. The operation of the circuit in Figure 2 is substantially the same as that for Figure 1 except that it comprises an extension thereof.

Summarizing, my invention includes the arrangement for preventing the current which is interrupted in an interrupted parallel contact path incident to slight variations in the breaking of the plurality of set of contact means from suddenly re-establishing itself in a yet uninterrupted parallel contact path during the short interval of time involved between the successive openings of the contact means to prevent the damaging of the contacts. My invention also reduces the damaging to the contacts during the "making" cycle in that the primary buffer condenser is divided into two parts wherein both parts when taken together make up the entire primary buffer condenser, wherein the condenser energy upon the "make" contact is reduced to one-half its value where the primary buffer condenser is not divided. The reduction in the condenser energy reduces the effect of the damage to the contacts during the "making" thereof.

While I have illustrated and described my invention as having peculiar utility in connection with interrupting parallel contacts, it is to be understood that my invention is not limited thereto and, therefore, includes any interrupting system comprising interrupting means having a plurality of parallel interrupting paths which are substantially simultaneously interrupted for jointly interrupting the current in the electrical system.

Although I have described my invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

1. In an electrical system for converting current from a direct current source into alternating current and supplying the latter to a load, said system comprising a transformer having primary winding means with two ends and a center tap and secondary winding means supplying the alternating current to the load, and a vibratory interrupter having two interrupting sets of parallel contact means substantially simultaneously operated during a vibratory interval for jointly supplying an interrupted direct current through a plurality of parallel contact paths to the primary winding means of the transformer, each of the two sets of parallel contact means including oppositely disposed contact means and vibratory contact means operating therebetween, said center tap being connected to one side of the direct current source and said vibratory contact means being connected to the other side of the direct current source, first circuit connection means including two branches each connecting

respectively an oppositely disposed contact means on one side of the vibratory contact means to one end of the primary winding means and second circuit connection means including two branches each connecting respectively an oppositely disposed contact means on the other side of the vibratory contact means to the other end of the primary winding means; the arrangement for preventing the current which is interrupted in an interrupted parallel contact path incident to slight variations in the breaking of the plurality of sets of contact means from suddenly re-establishing itself in a yet uninterrupted parallel contact path and increasing the burden on the set of contacts therein during the short interval involved between the successive openings of the parallel sets of contacts, said arrangement comprising the combination of a capacitor connected across the oppositely disposed contact means of each set of parallel contact means, and balancing inductance means having a first balancing winding with two ends and a center-tap dividing the said first balancing winding into two halves with a half thereof included in each of the branches of the first circuit connection means and having a second balancing winding with two ends and a center-tap dividing the said second balancing winding into two halves with a half thereof included in each of the branches of the second circuit connection means for developing, in series with each of the sets of parallel contact means, an inductive impedance to the flow of the current therein, the inductive impedance in the yet uninterrupted parallel contact path opposing the sudden re-establishment of the current of an interrupted parallel contact path during the short interval involved between the successive openings of the parallel sets of contacts in the yet uninterrupted parallel path, thereby preventing the damaging of the contacts, the said center-tap of the first balancing winding being connected to one end of the primary winding means of the transformer and the two ends of the first balancing winding being connected respectively to the two branches of the first connection means, thus forming a T-connection to balance out the inductive impedance of the said first balancing winding with respect to the current flowing through the primary winding means of the transformer, the said center-tap of the second balancing winding being connected to the other end of the primary winding means of the transformer and the two ends of the second balancing winding being connected respectively to the two branches of the second connection means, thus forming a T-connection to balance out the inductive impedance of the said second balancing winding with respect to the current flowing through the primary winding means of the transformer.

2. In an electrical system for converting current from a direct current source into alternating current and supplying the latter to a load, said system comprising a transformer having primary winding means with two ends and a center tap and secondary winding means supplying the alternating current to the load, and a vibratory interrupter having two interrupting sets of parallel contact means substantially simultaneously operated during a vibratory interval for jointly supplying an interrupted direct current through a plurality of parallel contact paths to the primary winding means of the transformer, each of the two sets of parallel contact means including oppositely disposed contact means and vibratory contact means operating therebetween, said center tap being connected to one side of the direct current source and said vibratory contact means being connected to the other side of the direct current source, first circuit connection means including two branches each connecting respectively an oppositely disposed contact means on one side of the vibratory contact means to one end of the primary winding means and second circuit connection means including two branches each connecting respectively an oppositely disposed contact means on the other side of the vibratory contact means to the other end of the primary winding means; the arrangement for preventing the current which is interrupted in an interrupted parallel contact path incident to slight variations in the breaking of the plurality of sets of contact means from suddenly re-establishing itself in a yet uninterrupted parallel contact path and increasing the burden on the set of contacts therein during the short interval involved between the successive openings of the parellel sets of contacts, said arrangement comprising the combination of a capacitor connected across the oppositely disposed contact means of each set of parallel contact means, and balancing inductance means with a common core having a first balancing winding thereon with two ends and a center-tap dividing the said first balancing winding into two halves with a half thereof included in each of the branches of the first circuit connection means and having a second balancing winding thereon with two ends and a center-tap dividing the said second balancing winding into two halves with a half thereof included in each of the branches of the second circuit connection means for developing, in series with each of the sets of parallel contact means, an inductive impedance to the flow of the current therein, the inductive impedance in the yet uninterrupted parallel contact path opposing the sudden re-establishment of the current of an interrupted parallel contact path during the short interval involved between the successive openings of the parallel sets of contacts in the yet uninterrupted parallel path, thereby preventing the damaging of the contacts, the said center-tap of the first balancing winding being connected to one end of the primary winding means of the transformer and the two ends of the first balancing winding being connected respectively to the two branches of the first connection means, thus forming a T-connection to balance out the inductive impedance of the said first balancing winding with respect to the current flowing through the primary winding means of the transformer, the said center-tap of the second balancing winding being connected to the other end of the primary winding means of the transformer and the two ends of the second balancing winding being connected respectively to the two branches of the second connection means, thus forming a T-connection to balance out the inductive impedance of the said second balancing winding with respect to the current flowing through the primary winding of the transformer.

3. An electrical system for converting current from a direct current source into alternating current and supplying the latter to a load, said system comprising a vibratory circuit including a transformer and a vibratory interrupter having two sets of parallel contact means with each set comprising oppositely disposed contact means and a vibratory contact means oper-

ating therebetween, a capacitor connected across the oppositely disposed contact means of each set of the parallel contact means, and balancing inductance means having a first balancing winding with a center-tap connected to the transformer and dividing the said first winding into two halves with a half thereof connected respectively in series with the oppositely disposed contact means on one side of the vibratory contact means and having a second balancing winding with a center-tap connected to the transformer and dividing the said second winding into two halves with a half thereof connected respectively in series with the oppositely disposed contact means on the other side of the vibratory contact means.

4. An electrical system for converting current from a direct current source into alternating current and supplying the latter to a load, said system comprising a vibratory circuit including a transformer and a vibratory interrupter having two sets of parallel contact means with each set comprising oppositely disposed contact means and a vibratory contact means operating therebetween, a capacitor connected across the oppositely disposed contact means of each set of the parallel contact means, and balancing inductance means having a first balancing winding with a center-tap connected to the transformer and dividing the said first winding into two halves with a half thereof connected respectively in series with the oppositely disposed contact means on one side of the vibratory contact means and having a second balancing winding with a center-tap connected to the transformer and dividing the said second winding into two halves with a half thereof connected respectively in series with the oppositely disposed contact means on the other side of the vibratory contact means, said balancing inductance means having a common core with the first and second balancing windings mounted thereon.

5. An electrical system for converting current from a direct current source into alternating current and supplying the latter to a load, said system comprising a vibratory circuit including a transformer and a vibratory interrupter having four sets of parallel contact means with each set comprising oppositely disposed contact means and a vibratory contact means operating therebetween, a capacitor connected across the oppositely disposed contact means of each set of the parallel contact means, a first balancing inductance means having a first balancing winding with a center-tap dividing the said first winding into two halves with a half thereof connected respectively in series with oppositely disposed contact means on one side of the vibratory contact means and having a second balancing winding with a center-tap dividing the said second winding into two halves with a half thereof connected respectively in series with two disposed opposite contact means on the other side of the vibratory contact means, a second balancing inductance means having a third balancing winding with a center-tap dividing the said third winding into two halves with a half thereof connected respectively in series with the two remaining oppositely disposed contact means on said one side of the vibratory contact means and having a fourth balancing winding with a center-tap dividing the said fourth winding into two halves with a half thereof connected respectively in series with the two remaining oppositely disposed contact means on said other side of the vibratory contact means, and a third balancing inductance means having a fifth balancing winding with a center-tap connected to the transformer and dividing the said fifth winding into two halves with a half thereof connected respectively in series with the center-taps of the first and third balancing windings and having a sixth balancing winding with a center-tap connected to the transformer and dividing the said sixth winding into two halves with a half thereof connected respectively in series with the center-taps of the second and fourth balancing windings.

6. An electrical system for converting current from a direct current source into alternating current and supplying the latter to a load, said system comprising a vibratory circuit including a transformer and a vibratory interrupter having four sets of parallel contact means with each set comprising oppositely disposed contact means and a vibratory contact means operating therebetween, a capacitor connected across the oppositely disposed contact means of each set of the parallel contact means, a first balancing inductance means with a common core having a first balancing winding thereon with a center-tap dividing the said first winding into two halves with a half thereof connected respectively in series with oppositely disposed contact means on one side of the vibratory contact means and having a second balancing winding thereon with a center-tap dividing the said second winding into two halves with a half thereof connected respectively in series with two disposed opposite contact means on the other side of the vibratory contact means, a second balancing inductance means with a common core having a third balancing winding thereon with a center-tap dividing the said third winding into two halves with a half thereof connected respectively in series with the two remaining oppositely disposed contact means on said one side of the vibratory contact means and having a fourth balancing winding thereon with a center-tap dividing the said fourth winding into two halves with a half thereof connected respectively in series with the two remaining oppositely disposed contact means on said other side of the vibratory contact means, and a third balancing inductance means with a common core having a fifth balancing winding thereon with a center-tap connected to the transformer and dividing the said fifth winding into two halves with a half thereof connected respectively in series with the center-taps of the first and third balancing windings and having a sixth balancing winding thereon with a center-tap connected to the transformer and dividing the said sixth winding into two halves with a half thereof connected respectively in series with the center-taps of the second and fourth balancing windings.

7. In a vibratory circuit having two parallel sets of interrupting contacts with each set including oppositely disposed contact means with a vibratory contact means operating therebetween, a capacitor connected across the oppositely disposed contact means of each set of the parallel contact means, balancing inductance means having a first balancing winding with a center-tap included in the load circuit and dividing the said first winding into two halves with a half thereof included respectively in series with the two oppositely disposed contacts on one side of the vibratory contact means having a second balancing winding with a center-tap included in the

load circuit and dividing the said second winding into two halves with a half thereof included respectively in series with the two oppositely disposed contacts.

8. In an interrupting system having interrupting means for interrupting a plurality of groups of parallel interrupting paths, the parallel paths of each interrupting group comprising a plurality of paths and being substantially simultaneously interrupted by the interrupting means for jointly interrupting the current in the system, said interrupting paths of said groups being also arranged to constitute a plurality of sets of interrupting paths, current diverting means connected in effective current-diverting relation with the interrupting paths of the said plurality of sets of interrupting paths, and balancing inductance means having a plurality of groups of inductance windings, each group of inductance windings being respectively connected with the interrupting groups of the parallel paths with an inductance winding in series with each of the interrupting parallel paths for developing in series with each of the interrupting parallel paths an inductance impedance to the flow of the current therein, each group of inductance windings having tap connection means to establish opposing fluxes within each group of inductance windings to minimize the inductance impedance to the flow of the current in the system.

9. In an interrupter system having interrupting means for interrupting a plurality of groups of parallel interrupting paths, the interrupting paths of each interrupting group comprising two parallel paths and being substantially simultaneously interrupted by the interrupting means for jointly interrupting the current in the system, said interrupting paths of said groups being also arranged to constitute a plurality of sets of interrupting paths, the arrangement for preventing the current which is interrupted in an interrupted parallel path of a group incident to slight variations in the interruption of the parallel paths of the group from suddenly re-establishing itself in a yet uninterrupted parallel path and increasing the burden on the said yet uninterrupted parallel path during the short interval involved between successive interruptions of the parallel paths of a group, said arrangement comprising current-diverting means connected across each set of said interrupting paths; and balancing inductance means having a plurality of groups of inductance windings with each group of inductance windings being respectively connected to the interrupting groups of parallel paths, each group of inductance windings having a center-tap connection dividing the inductance winding into two halves with a half thereof connected in series with each of the interrupting parallel paths for developing, in series with each of the interrupting parallel paths, an inductance impedance to the flow of the current therein, the inductance impedance in the yet uninterrupted parallel path in combination with the current-diverting means opposing the sudden re-establishment of the current of an interrupted parallel path of a group during the short interval involved between the successive interruptions of the parallel paths of the group in the yet uninterrupted path, thereby preventing the damaging of the interrupting means.

10. In an interrupter system having interrupting means for interrupting a plurality of groups of parallel interrupting paths, the parallel paths of each interrupting group comprising a plurality of paths and being substantially simultaneously interrupted by the interrupting means for jointly interrupting the current in the system, said interrupting paths of said groups being also arranged to constitute a plurality of sets of interrupting paths, the arrangement for preventing the current which is interrupted in an interrupted parallel path of a group incident to slight variations in the interruption of the parallel paths of the group from suddenly re-establishing itself in a yet uninterrupted parallel path and increasing the burden on the said yet uninterrupted parallel path during the short interval involved between successive interruptions of the parallel paths of a group, said arrangement comprising current-diverting means connected across each set of said interrupting paths, and balancing inductance means having a plurality of groups of inductance windings, each group of inductance windings being respectively connected with the interrupting groups of parallel paths with an inductance winding in series with each of the interrupting parallel paths for developing, in series with each of the interrupting parallel paths, an inductive impedance to the flow of the current therein, the inductive impedance in the yet uninterrupted parallel path in combination with the current-diverting means opposing the sudden re-establishment of the current of an interrupted parallel path of a group during the short interval involved between the successive interruptions of the parallel paths of the group in the yet uninterrupted path, thereby preventing the damaging of the interrupting means, each group of inductance windings having tap connection means to establish opposing fluxes within each group of inductance windings to minimize the inductive impedance to the flow of the current in the system.

11. In an interrupter system having a common circuit and interrupting means for interruptingly connecting a plurality of groups of parallel interrupting paths to the common circuit, the parallel paths of each interrupting group comprising a plurality of paths and being substantially simultaneously interrupted by the interrupting means for jointly interrupting the current in the system, said interrupting paths of said groups being also arranged to constitute a plurality of sets of interrupting paths with the common circuit therebetween, the arrangement for preventing the current which is interrupted in an interrupted parallel path of a group incident to slight variations in the interruption of the parallel paths of the group from suddenly re-establishing itself in a yet uninterrupted parallel path and increasing the burden on the said yet uninterrupted parallel path during the short interval involved between successive interruptions of the parallel paths of a group, said arrangement comprising current-diverting means connected across each set of said interrupting paths, and balancing inductance means having a plurality of groups of inductance windings, each group of inductance windings being respectively connected with the interrupting groups of parallel paths with an inductance winding in series with each of the interrupting parallel paths for developing, in series with each of the interrupting parallel paths, an inductive impedance to the flow of the current therein, the inductive impedance in the yet uninterrupted parallel path in combination with the current-diverting means opposing the sudden re-establishment of the cur-

rent of an interrupted parallel path of a group during the short interval involved between the successive interruptions of the parallel paths of the group in the yet uninterrupted path, thereby preventing the damaging of the interrupting means, each group of inductance windings having tap connection means to establish opposing fluxes within each group of inductance windings to minimize the inductive impedance to the flow of the current in the system.

12. In an interrupter system having first and second electrical circuit connections and interrupting means for interrupting two groups of parallel interrupting paths, the interrupting paths of each interrupting group comprising two parallel paths, each being substantially simultaneously interrupted by the interrupting means for interrupting the current in the system, said interrupting paths of said groups being also arranged to constitute two sets of interrupting paths, first current-diverting means connected across the interrupting paths of the first set, second current-diverting means connected across the two interrupting means of the second set, and balancing inductance means having a first balancing winding with a center-tap connected to said first electrical circuit connection and dividing the said first winding into two halves with a half thereof connected respectively in series with each of the two interrupting paths of said first group and having a second balancing winding with a center tap connected to said second electrical circuit connection and dividing the said second winding into two halves with a half thereof connected respectively in series with each of two interrupting paths of said second group.

13. In an interrupted system comprising a transformer having a first and second circuit connection, and interrupting means for interrupting four groups of parallel interrupting paths, the interrupting paths of each interrupting group comprising two parallel paths and being substantially simultaneously interrupted by the interrupting means for interrupting the current, said interrupting paths of said groups being also arranged to constitute four sets of interrupting paths, current-diverting means connected across the interrupting paths of each of the four sets, a first balancing inductance means having a first balancing winding with a center-tap dividing the first winding into two halves with a half thereof connected respectively in series with the two parallel paths of the first group and having a second balancing winding with a center-tap dividing the said second winding into two halves with a half thereof connected in series with the two parallel paths of the second group, a second balancing inductance means having a third balancing winding with a center-tap dividing the said third winding into two halves with a half thereof connected respectively in series with the two parallel paths of the third group and having a fourth balancing winding with a center-tap dividing the fourth winding into two halves with a half thereof connected respectively in series with the two parallel paths of the fourth group, and a third balancing inductance means having a fifth balancing winding with a center-tap connected to said first circuit connection on the transformer and dividing the said fifth winding into two halves with a half thereof connected respectively in series with the center-taps of the first and third balancing windings and having a sixth balancing winding with a center-tap connected to the said second circuit connection on the transformer and dividing the said sixth winding into two halves with a half thereof connected respectively with the center-taps of the second and fourth balancing windings.

14. In an interrupter system having interrupting means for interrupting a plurality of groups of parallel interrupting paths, the interrupting paths of each interrupting group comprising two parallel paths and being substantially simultaneously interrupted by the interrupting means for jointly interrupting the current in the system, said interrupting paths of said groups being also arranged to constitute a plurality of sets of interrupting paths, current-diverting means connected in effective current-diverting relation with the interrupting paths of the said plurality of sets of interrupting paths, and balancing inductance means each having a plurality of groups of inductance windings, each group of inductance windings being respectively connected with the interrupting groups of parallel paths and having a center tap connection dividing the said inductance winding into two halves with a half thereof connected in series with each of the interrupting parallel paths for developing, in series with each of the said interrupting parallel paths an inductive impedance to the flow of the current therein.

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