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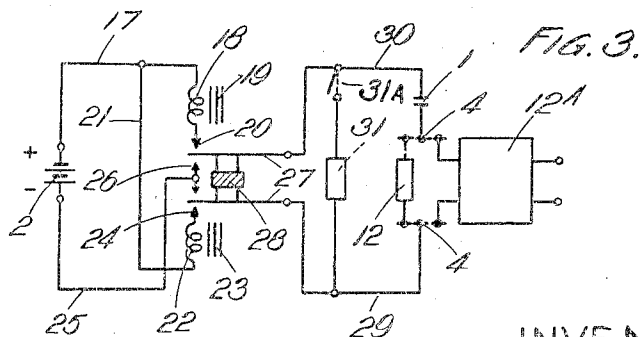
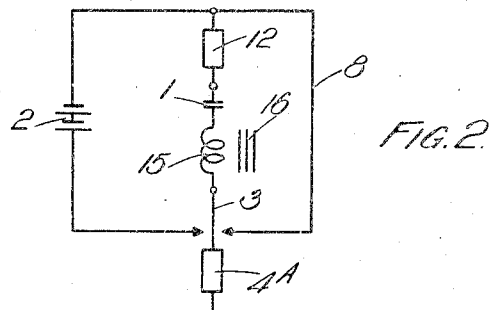
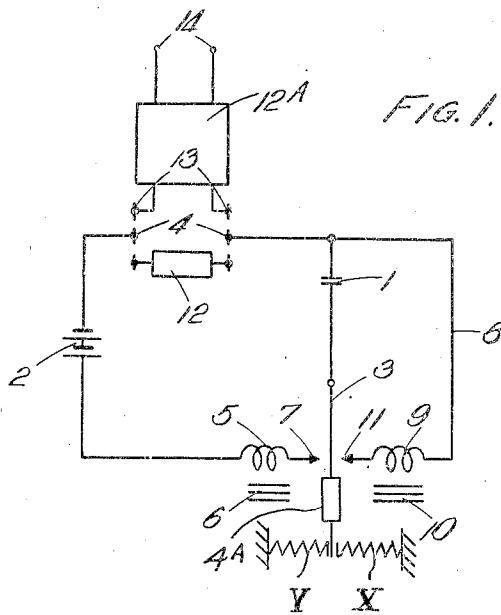
K. H. SCHMIDT ET AL

2,258,303

APPARATUS FOR CONVERTING DIRECT CURRENT INTO PERIODIC VARYING CURRENT

Filed July 20, 1938

2 Sheets-Sheet 1



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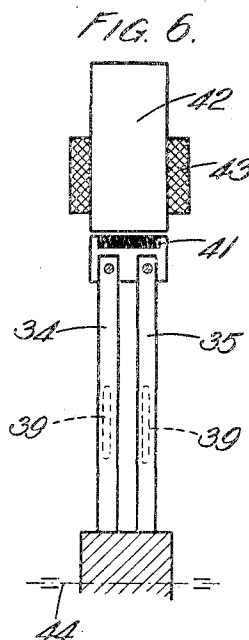
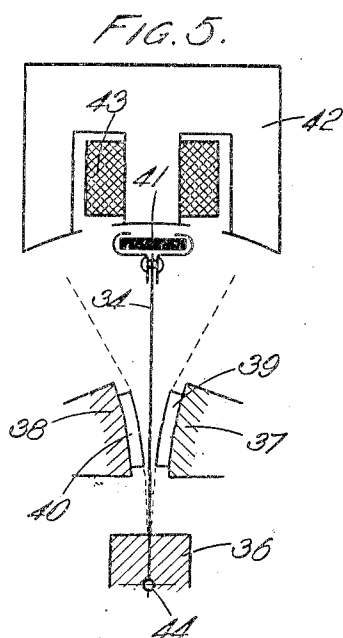
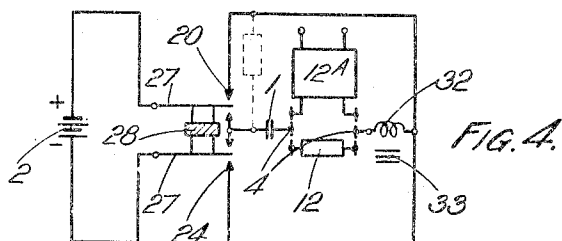
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UNITED STATES PATENT OFFICE

2,258,303

APPARATUS FOR CONVERTING DIRECT
CURRENT INTO PERIODIC VARYING CUR-
RENTKarl Hermann Schmidt, London, England, and
Marius Widakowich, Vienna, Germany; said
Widakowich assignor to said SchmidtApplication July 20, 1938, Serial No. 220,176
In Austria July 29, 1937

6 Claims. (Cl. 175—365)

This invention relates to apparatus for converting direct current into periodic variable current and is concerned with apparatus which may produce an alternating current or generally a cyclic current that may be pulsating direct current.

Up to the present, mechanical transformers having oscillating or rotating contacts have been little used in practice due to the fact that if large currents are being passed between the contacts there is rapid wear caused by arcing and the like.

It is one of the chief objects of the invention to devise apparatus which will permit the use of contact devices whilst substantially avoiding the difficulties hitherto experienced therewith. Following the principles of the invention a condenser is arranged for charging from the direct current source and the charging of the condenser is continued until the charging current reaches a low point, where the circuit is broken and, if desired, a discharge of the condenser through an auxiliary circuit is permitted. In this way the break of the circuit takes place at a point where only low currents are concerned. If desired, instead of allowing the condenser to discharge through an auxiliary circuit it may be connected back to the direct current source in such manner that it is charged in an opposite direction whereby the full value of the condenser is more nearly utilised.

Hereinafter, and in the claims that are appended hereto, the expression "the condenser" is to be read as covering a single condenser or a group thereof arranged in any desired manner.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings, in which:

Figures 1 to 4 are diagrammatic illustrations of how electrical apparatus embodying the invention may be connected and arranged, and

Figures 5 and 6 are respectively side and end views of a constructional detail of the apparatus forming the subject of the invention.

Referring first to Figure 1 of the drawings it will be seen that there is a condenser 1 and a source of direct current 2. One side of the current source 2 is shown connected with one of a pair of terminals 4, the other of which is connected to one side of the condenser 1. The other side of the condenser connects with a leaf 3 which serves as a contactor and which also carries an armature 4A. The latter is arranged to

be influenced by an electro-magnetic winding 5 having a core 6, the winding 5 being connected to the other side of the source of direct current 2. There is a contact piece 7 connected with the coil 5 and adapted to be engaged by the leaf 3. A parallel connection 8 is made across the condenser 1 and includes a winding 9 similar to that indicated at 5 and likewise possessing a core 10. There is also a contact 11 disposed in like manner to the contact 7.

The terminals 4 are connected by an output element 12 or by an output element 12A. The output element 12, as will be seen from the drawings, has but two terminals which bridge across the terminals 4 whereas with the output element illustrated at 12A, there is a pair of input terminals 13 and a pair of output terminals 14, the terminals 13 being for connection to the terminals 4. These output elements may be of any desired form, and may in certain instances represent the load that is to be supplied with the periodic varying current. The output elements may include merely ohmic resistance or may include a combination of ohmic resistance, inductance or capacitance.

With the apparatus so far described in operation, the leaf 3 carrying the armature 4A may contact with either of the contacts 7 or 11. If it is supposed that it is contacting with the contact member 7, it will be observed that a circuit is completed from the source of direct current 2, through the output element 12 or 12A, to the condenser 1 from whence there is a return through the leaf 3 itself and the winding 5 to the source of electro-motive force 2. Under these circumstances, the condenser 1 will charge and, in known manner, when the condenser is reaching full charge the current flowing in the charging circuit will be gradually reduced. The leaf 3 will be held in contact with the contact member 7 for the reason that the current flowing in the charging circuit will also flow through the coil 5, and the armature 4A will be attracted to the core 6. In a manner which will be explained hereinafter a spring X is arranged to urge the armature 4A away from the core 6, so that as the current in the charging circuit decreases there will be a point where the spring just referred to will cause the armature 4A to move away from the core 6 and thereby to break the charging circuit. The leaf 3 then moves over to an opposite position against the action of a spring Y where a circuit is completed through the condenser 1, the parallel connection 8 and the coil 9, for the reason that the leaf 3 will contact with

the contact member 11. As soon as this circuit is completed, the condenser 1 will cause a surge of current to flow through the closed parallel circuit, and such current will continue to flow until the condenser is substantially discharged when the force of attraction exerted on the armature 4A by the core 10 of the coil 9 will fall below a predetermined magnitude. The spring Y is arranged in the same manner as the spring X, so that the leaf will be carried back to its opposite working position with consequent breaking of the circuit through the previously closed parallel circuit when the current therein has fallen below said predetermined value. The initial operation of the described device may be effected by hand.

The circuit arrangement described above may be modified in certain respects and, in particular, if desired, a current consumer may be included in the parallel circuit or in the common part of the circuit associated with the condenser 1 itself. Similarly, the electro-magnetic holding means for the armature 4A might be included in the part of the circuit containing the condenser 1 so as to obviate the necessity for two separate electro-magnetic holding means. In Figure 2 of the drawings a circuit similar to Figure 1 is shown except that both modifications just indicated have been made. The output element 12 is shown located in the common branch of the circuit so that it now experiences the flow of current in both directions, and similarly the electro-magnetic coil 15 with associated core 16 is located in the common branch.

The core 16 will have its polarity changed with each alternation of the current in the common branch, and thus the armature 4A will take up its alternate positions to cause the desired alternate closing of the two circuits offered. The arrangement is otherwise the same as that described in connection with Figure 1.

In the arrangement according to Figures 1 and 2, it will be observed that the condenser 1 is first charged and then allowed to discharge through the auxiliary parallel circuit. In Figure 3 the arrangement is such that the condenser 1 is first charged in one direction and is then charged in the opposite direction, whereby the condenser is used to greater advantage. In the circuit arrangement of Figure 3, there is, as before, a source of direct current 2 and output terminals 4. There is a lead 17 from one side of the current source 2 connecting with a coil 18 associated with a core 19 and a contact member 20. There is a branch connection 21 joining one end of a further coil 22 likewise associated with a core 23 and a contact member 24. There is a connection 25 from the other side of the current source 2, to a double-pole contact member 26. There is, in this case, a pair of leaves 27 and an associated armature 28, the armature 28 being arranged so as to be influenced by either the core 19 or the core 23, according to whether the winding 18 or the winding 22 is excited. One of the leaves 27 is joined by a connection 29 which extends to one of the terminals 4. The other of the leaves 27 is joined by a connection 30 through the condenser 1 to the other of the output terminals 4. The output terminals 4 may be associated with an output element 12 or 12A, as already described. The leaves 27 and the associated armature 28 are spring-loaded in the same manner as described with reference to Figures 1 and 2, that is to say, in such manner that when the leaves 27 are brought to a position where one contacts with, say, the contact member 24

and the other with the double-pole contact member 26, there is a resilient spring pressure tending to return the leaves 27 with the associated armature 28, to the opposite position where one leaf contacts with the contact member 20, and the other with the opposite contact of the contact member 26. The spring pressure thus tends always to displace the leaves and armature to the opposite working position from that in which they may be, for the time being, situated. However, such spring pressure cannot assert itself until the current flow through the associated holding electro-magnet has fallen below a predetermined minimum.

In operation the arrangement of Figure 3 is such as to charge the condenser 1 first in the one direction, and then to charge it in the opposite direction and so on continuously, the leaves 27 oscillating between their extreme working positions. The outflow obtained between the terminals 4 will, in this instance, be alternating. When the converter apparatus is on light-load or is merely idling it is preferable that the output terminals 4 should be bridged in order to prevent the stopping of the mechanical oscillations of the leaves 27. In Figure 3, there is indicated in dotted lines at 31 a condenser which may be connected in parallel between the connections 29 and 30 for the purpose of maintaining the mechanical oscillation of the said leaves. A switch 31A allows the condenser 31 to be brought optionally into operation.

In Figure 4 an arrangement similar to that of Figure 3 is shown, with the distinction that in this case the two electro-magnetic devices consisting of the windings 18 and 22, and associated cores 19 and 23, are replaced by a single winding 32 which is located in a common branch of the circuit including the condenser 1. The arrangement otherwise corresponds to Figure 3 in the same way that Figure 2 corresponds to Figure 1. The winding 32 has a core 33 adapted to cooperate with the armature 28.

In Figures 5 and 6 of the drawings, there is shown a constructional form of the electro-magnetic device together with vibrator leaves and armature therefor. In the illustrated embodiment, the vibrator leaves corresponding to those indicated at 27 in Figure 3 are shown at 34 and 35. They are supported in a block 36 of insulating material and may oscillate between extreme working positions defined by pairs of stops 37 and 38, (only one of each pair shown in Figure 5). There are pairs of contact elements 39 and 40 secured to each of the stops.

At the upper end, the leaves 35 and 34 support the armature 41. An E-shaped core 42 carries a winding 43 which may correspond to the winding 32 shown in Figure 4. The lower ends of the spring leaves 34 and 35 are pivotally secured as at 44 in the block 36.

It will be understood that when a pulsating direct current or an alternating current is being passed through the winding 43 the core 41 will oscillate and will cause the leaves 34 and 35 to be flexed. As the amplitude increases the leaves will be bent back over the contacts 39 and 40, which contacts are shaped as will be seen in Figure 5, so as to permit the leaves to bend over them.

It will be understood that the armature 41 might be replaced by one of the polarised type. Furthermore, each leg of the E-shaped core 42 might carry a winding; for example the two outside legs might have windings placed thereon

adapted to conduct a pulsating direct current, or the innermost leg of the core might have a winding conducting only an alternating current, as shown in the drawings, or the dispositions of the windings mentioned might be entirely reversed. The dotted lines in Figure 5 indicate the limit working positions of the spring leaves.

In those constructions described above where flexion springs are employed, as in Figures 5 and 6, to store mechanical energy it is not necessary that the flexion springs should be arranged exactly as indicated in Figures 5 and 6. Thus, the stationary contacts indicated at 39 and 40 may be replaced by springs. Also the surface contacts indicated may be replaced by pointed contacts. The arrangement may be such that the mechanical resonance of the vibratory system is not such as to influence greatly the electrical resonance point of the described systems. Where such mechanical resonance does not predominate to any marked extent, it will be observed that the frequency or the amplitude of the pulsating or alternating current given as the output from the apparatus of the invention, will depend upon the voltage of the direct current source, since the rate of charging of the condenser will depend upon such voltage.

What we claim and desire to secure by Letters Patent of the United States is:

1. Apparatus for converting direct current into periodic varying current, comprising a condenser arranged in a circuit including a direct current source, a circuit breaker located in the circuit of the condenser, an electro-magnetic device controlled by the current in the condenser circuit and arranged to hold the circuit breaker closed when current above a predetermined minimum is flowing through said electro-magnetic device, means associated with said circuit breaker and arranged to be held in tension whilst current above said minimum is flowing and for bringing said circuit breaker into an open position after the current has fallen below said minimum and at least one current consumer located in the condenser circuit.

2. Apparatus for converting direct current into periodic varying current, comprising a first circuit, a condenser, a direct current source and a switch device all located in said circuit, a second circuit including said condenser and being closable through said switch device, means for normally maintaining said switch device in an operative position where it completes neither circuit, an electro-magnetic means for operating said switch device so that said first and second circuits are alternately closed, each circuit being maintained closed until the current therein falls below a predetermined minimum, and at least one current consumer located in circuit with the condenser.

3. Apparatus for converting direct current into periodic varying current, comprising a first circuit, a source of direct current, a condenser and a switch device, all located in said circuit, a second circuit consisting of a parallel connection across the condenser and joined to said switch device, an operative member in said switch device for closing either said first circuit or said

second circuit, electro-magnetic means for controlling said operative member of the switch device so that the latter may alternately close either of said circuits maintaining the circuits closed until the current therein falls below a predetermined minimum, means for influencing said operative member of the switch to cause the latter always to tend to occupy an opposite working position from that which it may, for the time being, be occupying, and at least one current consumer located in circuit with the condenser.

4. Apparatus for converting direct current into periodic varying current, comprising a first circuit including a source of D. C. supply, a second circuit parallel across the source of D. C. supply, a changeover switch device, a condenser connected to the common poles of said changeover switch device, connections in both said first and second circuits to the fixed poles of the changeover switch device to permit either said first or second circuit to be completed through said condenser, electro-magnetic means for holding the changeover switch device in either extreme working position, said electro-magnetic means being controlled according to the current in said first and second circuit, so that when said current falls below a predetermined minimum, the changeover switch device assumes an opposite working position under the action of said electro-magnetic device, and at least one current consumer in circuit with the condenser.

5. Apparatus for converting direct current into periodic varying current, comprising a condenser arranged in a circuit including a direct current source, a circuit breaker device located in the circuit of the condenser, an electro-magnetic device controlled by the current in the condenser circuit, an armature secured to the operative member in said circuit breaker device and located adjacent said electro-magnetic device to allow the effect of the latter to hold the operative member of the circuit breaker in a closed position when current above a predetermined minimum is flowing through said electro-magnetic device, means associated with said circuit breaker and arranged to be held in tension whilst current above said minimum is flowing and for bringing said circuit breaker to an open position after the current has fallen below said minimum and at least one current consumer located in the condenser circuit.

6. Apparatus for converting direct current into periodic varying current, comprising a condenser arranged in a circuit including a direct current source, a fixed contact located in said circuit, at least one vibrator leaf connected in said circuit and arranged to co-operate with said fixed contact, an armature carried by said vibrator leaf, electro-magnetic means controlled by the current in the condenser circuit and arranged to hold said armature in a position where the vibrator leaf co-operates with said fixed contact to close the said circuit when current above a predetermined minimum is flowing through said electro-magnetic means, and a current consumer located in the condenser circuit.

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