A. R. BULLOCK.

CURRENT TRANSFORMING DEVICE.

APPLICATION FILED MAR. 7, 1911.

1,201,687.

Patented Oct. 17, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

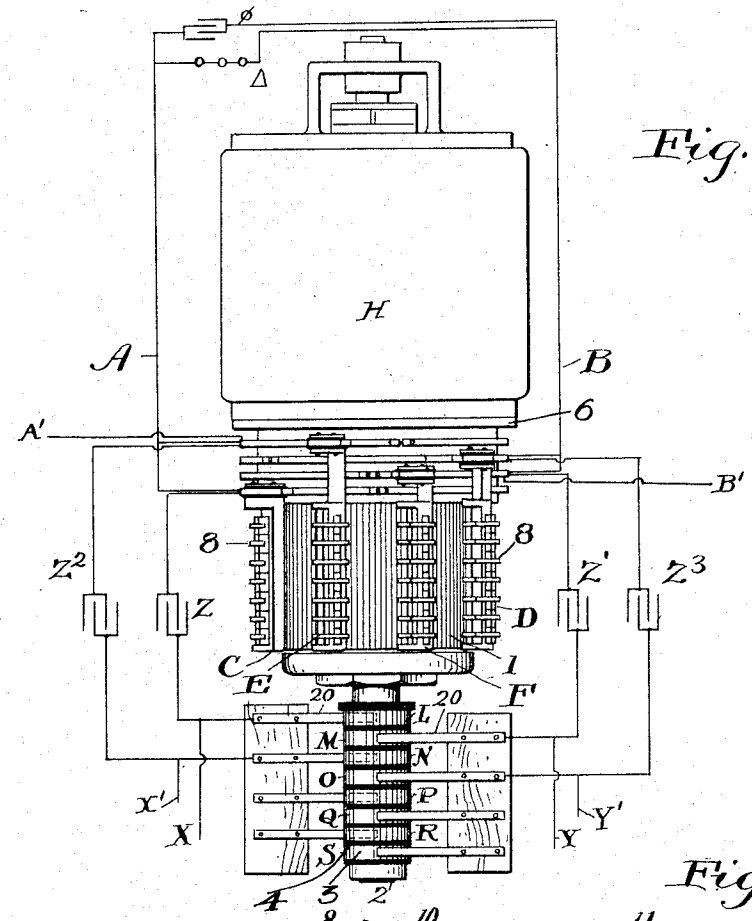


Fig. 2.

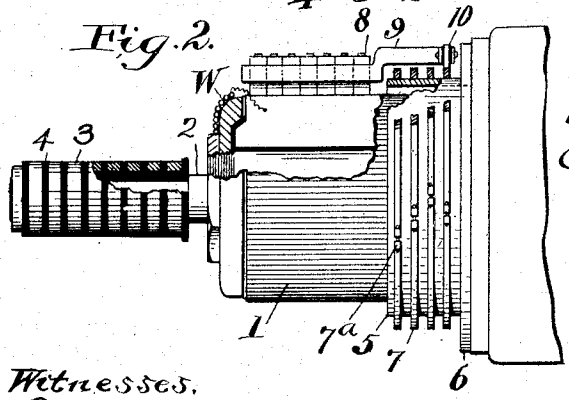
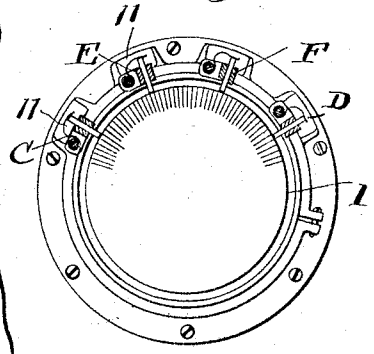


Fig. 3.



Witnesses.
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2 SHEETS—SHEET 2.

Fig. 4.

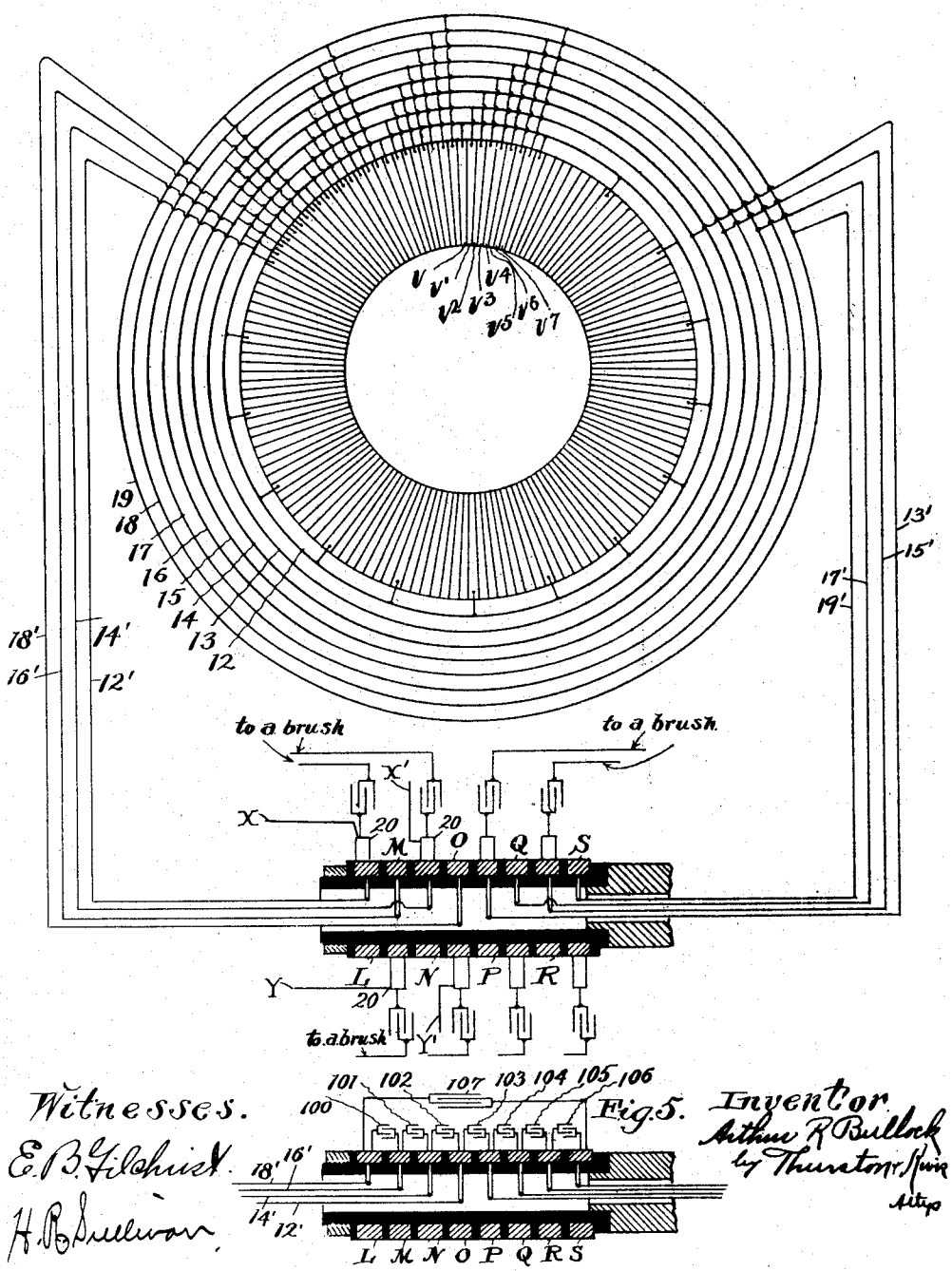


Fig. 5.

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UNITED STATES PATENT OFFICE.

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CURRENT-TRANSFORMING DEVICE.

1,201,687. Specification of Letters Patent. Patented Oct. 17, 1916.

Application filed March 7, 1911. Serial No. 612,917.

To all whom it may concern:

Be it known that I, ARTHUR R. BULLOCK, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Current-Transforming Devices, of which the following is a full, clear, and exact description.

This invention relates to a device which will, by mechanical means, convert currents of given characterization into currents of other characteristics,—that is to say, the device will change direct current into an alternating current of various phases and frequencies and is equally adapted to rectify an alternating current.

Generally speaking, the invention may be said to comprise the elements and combinations thereof set forth in the accompanying claims.

Reference should be had to the accompanying drawings forming a part of this specification in which—

Figure 1 is a top plan view of the device with the electrical connections diagrammatically represented. Fig. 2 is a side elevation of a portion of the machine as shown in Fig. 1. Fig. 3 is a cross section substantially on the line 3—3 of Fig. 1. Fig. 4 diagrammatically represents the electrical connections between the individual segment bars upon the rotating member and the rings from which the transformed current is collected. Fig. 5 is a diagrammatic representation of a condenser arrangement.

The device comprises, essentially, an annular rotating member such as indicated at 1 in Fig. 1, and this member in turn is composed of a number of segments of conducting material or conducting portions or conducting members, as they may be called, the number of which is immaterial, but in the present instance 144 are employed. These various segments are insulated from each other by means of thin mica partitions and, in fact, the whole construction of the member 1, is substantially the same as is the ordinary construction employed for commutators. In this particular instance the member 1 is mounted upon a shaft 2 which is an extension of the shaft of the motor M; hence the shaft 2 extends beyond the rotating member 1, and upon the projecting end thereof there is secured a number of rings generally indicated at 3 which are insulated from each other in any suitable manner as indicated at 4. The number of rings is immaterial and is selected according to the number of groups of connections which are effected between the conducting segments upon the member 1.

A face plate 6, which is secured upon the head of the casing of the motor H, is provided with the flange 5, which projects substantially at right angles with the face plate 6 and upon this flange a number of rings, such as indicated at 7, are mounted. These rings are split and are provided with bolts engaging opposite ends of the split portions, as indicated at 7^a, whereby they may be drawn tightly together and firmly grip the flange 5.

Each of the rings serves for the mounting of a brush, or brushes such as indicated at 8, which are mounted in a supporting bracket, and each supporting bracket is bolted upon one of the rings 7 and insulated therefrom as indicated at 10 in Fig. 2.

The brushes are held in engagement with the rotating member 1 by means of springs 11 such as indicated in Fig. 3.

The number of brushes or groups of brushes which are employed depends upon the particular character of transformation which it is desired to effect, and further the number may be regulated by the desired characteristics which it is desired to produce in the resultant current.

In the particular machine herein disclosed the conducting segments upon the rotating member 1 are divided into eighteen divisions and this is accomplished by electrically connecting every eighth segment upon the member 1, and the scheme of this connection can be readily seen from Fig. 4.

A wire loop 12 extends substantially concentric with the rotating member 1 and beginning with a certain segment, for instance the one marked V in Fig. 4, every eighth segment therefrom is connected with this particular wire 12. A second wire 13, is likewise extended substantially concentric with the axis of the rotating member 1, and to it the segments which are next to the segments connected with wire 12 are each connected. The same is true with regard to the wires 14, 15, 16, 17, 18 and 19, they being respectively connected to a given segment V', V^2, V^3, V^4, V^5, V^6 and V^7, upon the rotating member 1 and every eighth segment

thereafter. Each of these wires 12 to 19 is connected with a corresponding conductor 12′ to 19′, which in turn are electrically connected with one of the rings 3 upon the end of the shaft 2. This is preferably accomplished by hollowing out the end of the shaft 2 or providing it with grooves through which the wires may extend.

It will be understood that the wires 12 to 19 are in reality of less diameter than the extreme diameter of the member 1 and occupy a position upon the face or front of the rotating member 1 as indicated at W in Fig. 2 from whence the connections from the particular wires 13 to 19 can be easily effected with the segments 3.

There are a series of brushes, as indicated at 20 in Figs. 1, and 4, which bear upon the commutator rings 3, there being a brush bearing upon each commutator ring.

In operating the device the current which is to be transformed may be fed in over the brushes 8 and the transformed current collected from the rings 3 or the reverse of this operation may be practised with equal facility. In the description of the operation it will be assumed, however, that the current is being fed in over the brushes C and D and is flowing over conductors A and B which we will assume to be carrying a direct current. The current passing in over the wire A will be fed to the brush represented at C. The current from the brush C will pass to the conductor segments and will pass through these segments and be carried upon the wires forming and uniting the various groups, and finally be delivered upon the rings 3.

As is indicated in Fig. 4, the wires 12, 14, 16 and 18 are connected with rings L, M, N and O. We may for the time being discard the connections through the wires 13, 14, 15, 17, 18 and 19 and when they are out of use, the bars with which they are connected are dead spaces and in effect form insulations between the bars which are connected with the wires 12 and 16. Therefore, under these conditions, as the member 1 turns the current supplied through the wires A and B is broken every time it passes across one of these dead bars.

If we assume that the bars connected with the wire 12 first receive the current through the brush C, they will in turn permit the current to pass to the collector ring L, and this current being collected by the brush bearing upon the ring, will pass through the conductor X and through the external load, which is not represented, and back through the conductor Y through the brush bearing upon the ring M, thence through the conductor 16′ and the wire 16 to the particular segments which are connected with the wire 16. Upon one of these segments a brush or brushes D will be placed and this brush or brushes will be connected with the conductor B and thus form a return path for the circuit. In the next instant the brushes will pass over dead bars and then immediately following, the brush C will be in contact with one of the segments which is connected with the annular wire 16, while the brush D will be in electrical connection with a segment of the group of segments connected with the annular wire 12. Therefore, the current will flow from the brush C to the segments electrically connected with that segment with which it contacts, thence through the wire 16 and conductor 16′ to the ring M. The current will be taken from the ring M by the brush which bears thereon and will be sent out over the conductor Y, which flowing through the external load will return over the wire X. It will thus be seen that in the external circuit, which may be represented by the conductors X and Y, the current flows in an opposite direction to that which was previously described. The further rotation of the member 1 brings the brush D into contact with segments that are electrically connected with the annular wire 12, and the brush D into contact with segments which are electrically connected with the annular wire 16. It will therefore be clear that in the last mentioned instance, the current is flowing in the external circuit in a direction opposite to the second instance given and in the same direction as in the first instance given. This reversal takes place continuously and therefore it will be clear that the current thus obtained in the external circuit is an alternating current.

It is possible as far as the operation of the machine is concerned to select any two groups of segments and so arrange the external or load circuit that the selected group of segments shall be the terminals thereof. The particular groups of segments which have previously been mentioned are merely by way of example. The frequency of this current may be varied by the speed at which the rotating member 1 is revolved, and further may be varied by the number of times the circuit is broken during a single revolution of the rotating member,—that is to say, if every fourth or sixth bar, for instance, were to be connected with each other, the number of times which the circuit would be broken during a single revolution would be greater than where every eighth bar on the member 1 is connected together. It will therefore be apparent that it is perfectly possible to determine the frequency of the transformed current within reasonable limits in such manner as may be desired.

The rotating member 1 need not necessarily be mounted upon an extension shaft of a motor, but this is done simply for the ease of construction and, if desired, the rotating member 1 with its brushes, collecting

rings and their brushes, may be separately mounted and driven by a motor which is entirely disconnected.

In the practical operation of machines of this character the sparking, which occurs due to the rapid making and breaking of the circuits, is not only deleterious but prohibitive of the use of such devices unless some means be provided for preventing this sparking, or at least reducing the sparking to such a point as will make the operation of the machine safe. This has been accomplished by the use of condensers which are inserted in parallel across the break in the circuit,—that is to say, a condenser such as illustrated at Z is electrically connected to the brush C and to the brush bearing upon the ring L. Therefore, when the current is broken by the rotation of the member 1, the current which tends to cause the sparking, passes into the condenser Z, and thus the sparking is prevented. A similar condenser Z′ may be connected between the brush D and the brush which bears upon the segment N.

It will be remembered that the segments connected to the wire 12 ultimately connect with ring L, while the segments connected with the wire 16 ultimately connect with ring M.

When brushes C and D bear upon segments connected respectively with wires 12 and 16, there is a condenser connection between these brushes and the rings L and M. But when brushes C and D bear upon segments connected with wires 16 and 12 respectively, the current path is through brush C and ring M and through brush D and ring L, but there is no direct condenser connection between brush C and ring M, nor between brush D and ring L. It therefore becomes essential to have some connection between ring M and brush C and also between brush D and ring L. This will in effect be accomplished if brushes C and D be joined by some means that will absorb the current flowing at the time the break occurs between the segments and the brushes. For this purpose a condenser Ø of proper capacity may be connected at any two points across the line A B or if the load carried by the line A B is non-inductive, a bank of lamps may be connected as represented at △, or if the non-inductive load be in great predominence, there need be no other connection between the brushes than through the electrical apparatus on the line. However, it is safer to interpose a condenser across the line. It will thus be seen that there is always a condenser in parallel across the break in the circuit, as the brushes pass from one segment to another.

In Fig. 5 there is still another condenser arrangement shown, in which a condenser is electrically connected between each ring. These condensers are indicated at 100 to 106 and the condenser 107 connects the end rings L and S. This arrangement in effect places a condenser between successive segments on the rotating body, for each group of segments connects with one of the rings. With such an arrangement of condenser, the current which would otherwise cause sparking when a brush passes from one segment will flow into the condenser connected between the two segments effected and kill the spark. This arrangement also makes it unnecessary to use a condenser across the feed line as suggested in Fig. 1.

In Fig. 5, the brushes bearing upon the rings are omitted for convenience.

The current delivered to the external circuit through the conductors X and Y, as previously explained, is a single phase alternating current, the frequency of which will be dependent upon the speed at which the member 1 is rotated, as well as the number of times the circuit is broken during a single revolution.

It is possible with this apparatus to supply to the same external circuit, represented by the conductors X and Y, a following current or second current which will be in different phase than the current which was at first supplied to the conductors X, Y, and this is accomplished by the use of brushes E and F in addition to the brushes C and D,—the brush E being placed with respect to the brush C in such position that the brush E is a half a segment behind or in advance of the brush C^1—that is to say, the brushes C and E will not simultaneously bear upon segments which are electrically connected, but the brush E will be a little ahead or behind the brush C with respect to the segment upon which the brush C is bearing.

The brush F is arranged with respect to the brush D in a manner similar to the relation described between the brushes C and E and from this it will follow that the brushes E and F will be placed with respect to each other in a relation similar to the relationship existing between the brushes C and E.

The brushes C and E may be connected in parallel with each other and thence with the conductor A, while the brushes F and D may be connected in parallel with each other and thence with the conductor B. From this it follows that as the member 1 rotates and as the brush C is leaving a given group of segments, the brush E will just be coming into contact with the same group of segments and hence the current which has begun to ebb as the brush C was leaving that group will be again brought to its maximum because of the fact that the brush E is coming into contact with the said group. In this manner pulsations will follow each other upon the conductors X and Y and the pulsations of the current in the conductors X and Y will

be substantially doubled, although, of course, the frequency will not be changed from what it was in the first instance. However, for very many purposes, this apparent increasing in frequency accomplishes the desired result and is useful.

It will be apparent that brushes E and D may in their arrangement be displaced with respect to brushes C and F and the segments upon which they are bearing, so that the phase difference between the currents flowing from rings L, M and N, O, respectively, will be substantially 180 electrical degrees apart or any other desired amount. Under such an arrangement it will be clear that the current flowing over the external conductors X, Y and the conductors connected to the rings N, O will be a polyphase current. It is also possible to place the brushes E and F in such a manner that they will be bearing upon segments which are electrically connected with any two of the circular wires 13, 14, 15, 17, 18 or 19, while the brushes C and D are bearing upon segments which are electrically connected with the annular wires 12, and 16. In this event, the corresponding rings *n*, *o*, etc., may be connected with a load circuit entirely distinct from that represented by the conductors X Y.

The brushes E and F may be connected with a source of current entirely distinct from that which is supplied the brushes C and D, such as circuit A′ B′, in which event the alternate segments upon the rotating member 1 will be carrying currents from different sources and, I have found these currents will act independent to each other so that the current in alternate bars does not jump across the intermediate segment which is carrying the current from the different source. This current may likewise be delivered to the conductors X and Y, or it may be used in an entirely separate external circuit, such as the circuit X′ Y′ if desired. Of course, in this event the brushes E and F will be connected by condensers with the rings P, Q, R and S, with which last mentioned rings, the annular wires 13, 15, 17, and 19 are in electrical connection.

When the brushes E and F are used, condensers Z^2 and Z^3 will be electrically connected with these brushes and with the brushes bearing upon the rings *n* and *o* in order that when the current is broken between these respective brushes the extra current which causes the sparking may be taken up or absorbed by these condensers.

This transforming device may be used with equal facility for the rectification of an alternating current, and the particular construction herein shown may be adapted to rectify a single phase alternating current. When the device is used in this manner, however, it is necessary to supply in place of the ordinary motor, such as illustrated at M, a motor which will revolve in synchronism with the generator which is supplying the alternating current to be rectified. Under such conditions, the alternating current may be fed in either over the conductors X—Y, or the conductors A—B, and the rotating member 1 will be revolved at such a speed that the segments bearing the current will come under the proper brushes in sequence, so as to send all the pulsations of the alternating current over the same wire and in the same direction in the external circuit.

The precise manner in which a device of this character will rectify is clearly explained in my co-pending application No. 593,776, filed November 23rd, 1910, Patent Number 1,119,397 of date Dec. 1, 1914.

Having thus described my invention, what I claim is:—

1. In a current converting device, the combination with a plurality of conducting segments adapted to be rotated which are insulated from each other, a plurality of terminal members to which the segments are electrically connected, conducting members bearing upon the segments, and conducting members electrically connected with the terminal members, and one or more condensers electrically connected with each of the conducting members and with the conducting members connected with the terminal members.

2. In a current converting device, the combination with a rotary body provided with conducting segments arranged in groups which are insulated from each other, a plurality of rings, said segments being electrically connected with said rings, conducting members bearing upon said segments, and conducting members bearing upon the said rings, and one or more condensers electrically connected with each of the brushes and with the members bearing on the rings.

3. In a current converting device, the combination with a plurality of conducting segments which are insulated from each other and adapted to rotate, said segments being electrically connected with each other to form groups, a plurality of rings, each of said groups being connected to one of the rings, current conducting members bearing upon the said segments, other current conducting members bearing upon the rings, and one or more condensers electrically connected with each of the said current conducting members bearing upon the rotating member and with the conducting members bearing on the rings.

4. In a current converting device, the combination with a suitable supporting shaft, a rotary member mounted upon said shaft and provided with conducting segments which are insulated from each other, a plurality of rings mounted upon the same shaft and insulated from each other, the segments

upon the rotary body being arranged in groups, each of said groups being connected with one of the rings, current conducting members mounted to bear upon the conducting segments, and other current conducting members mounted to bear upon the rings, and one or more condensers electrically connected with each of the current bearing members contacting with the rotary member and with the conducting members bearing on the rings.

5. The combination with a motor having an extended shaft, of a plurality of conducting segments which are arranged in groups and insulated from each other supported by the shaft, a plurality of rings also mounted upon said extended shaft, electrical connections between the segments and the said rings, a plurality of current conducting members supported from the casing of the motor and bearing upon the said segments, other current conducting members bearing upon the said rings, and one or more condensers electrically connected with each of the current conducting members which bear upon the segments and with the conducting members bearing on the rings.

6. In a current converting device, the combination with a motor having an extended shaft, of an annular member mounted upon said shaft and provided with a plurality of conducting segments which are insulated from each other, a plurality of rings mounted upon the shaft, electrical connections between the said segments and the rings, current conducting members supported by the motor casing and bearing upon the segments of the annular member, means for adjusting said members axially of the motor shaft, other current conducting members bearing upon the rings, and one or more condensers electrically connected with each of the current conducting members which bear upon the segments, and with the conducting members bearing upon the rings.

7. In a current converting device, the combination with a plurality of conducting segments arranged in groups and adapted to be rotated, a terminal member bearing upon each group of segments, means for conducting a current to or from said segments, and a condenser connected in parallel between each terminal member and the said means for conducting the current to or from the segments.

8. In a polyphase current converting device, the combination with a plurality of sets of conducting members, a plurality of sets of rings with which the conducting members are electrically connected, said rings being adapted to be connected with a polyphase circuit, and brushes bearing upon conducting members, and a condenser electrically connected in parallel between each brush and its corresponding ring.

9. In a polyphase current converting device, the combination with a plurality of conducting members adapted to be rotated, conducting rings with which the conducting members are electrically connected, conductor means bearing upon the conducting members, and conductor means bearing upon the rings, one of said last mentioned means being adapted to connect with a polyphase alternating current, and a condenser electrically connected in parallel between each conductor means upon the conducting members, and each conductor means upon the rings.

10. In a polyphase current converting device, the combination with a plurality of conducting portions adapted to be rotated, means forming circuit terminals bearing upon said conducting portions, means for conducting current to or from said segments, one of said means being adapted to connect with a polyphase alternating current, and a condenser connected in parallel between each terminal means, and said means for conducting the current to or from the conducting portions.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

ARTHUR R. BULLOCK.

Witnesses:
H. R. SULLIVAN,
A. J. HUDSON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."