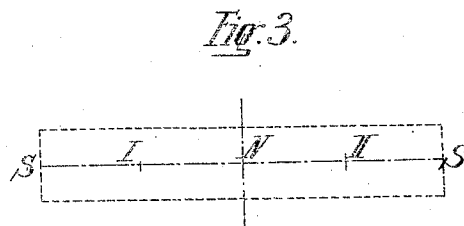
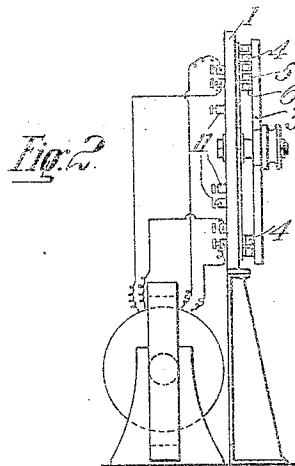
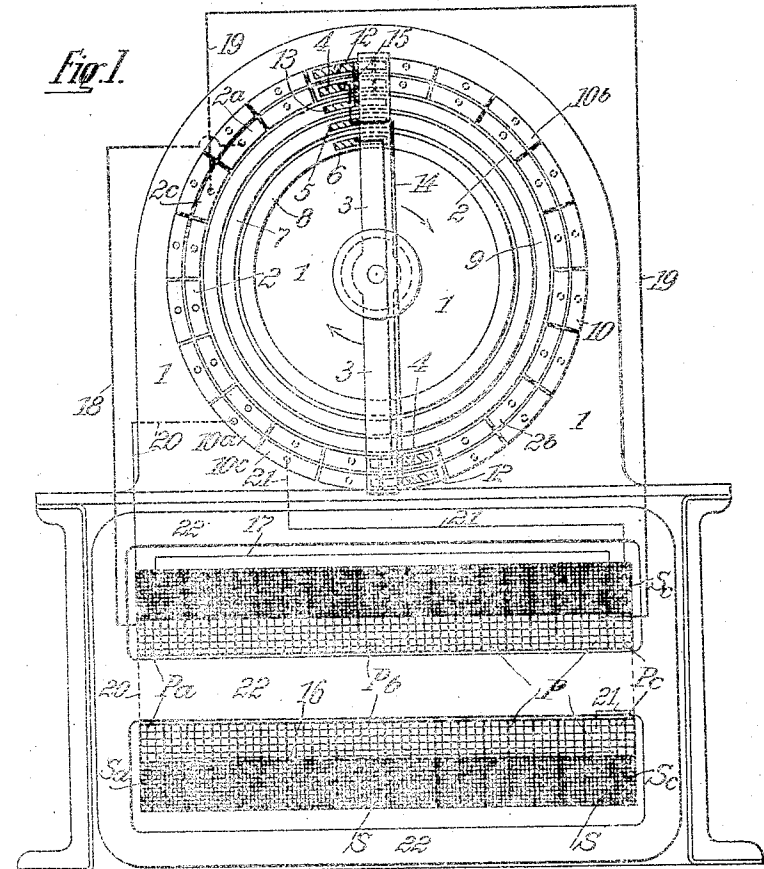


W. ALHORN.
 CONVERTER FOR CONTINUOUS CURRENT.
 APPLICATION FILED JUNE 8, 1911.

1,038,064.

Patented Sept. 10, 1912.

3 SHEETS—SHEET 1.



Witnesses:

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Inventor.

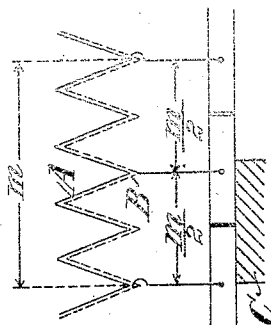
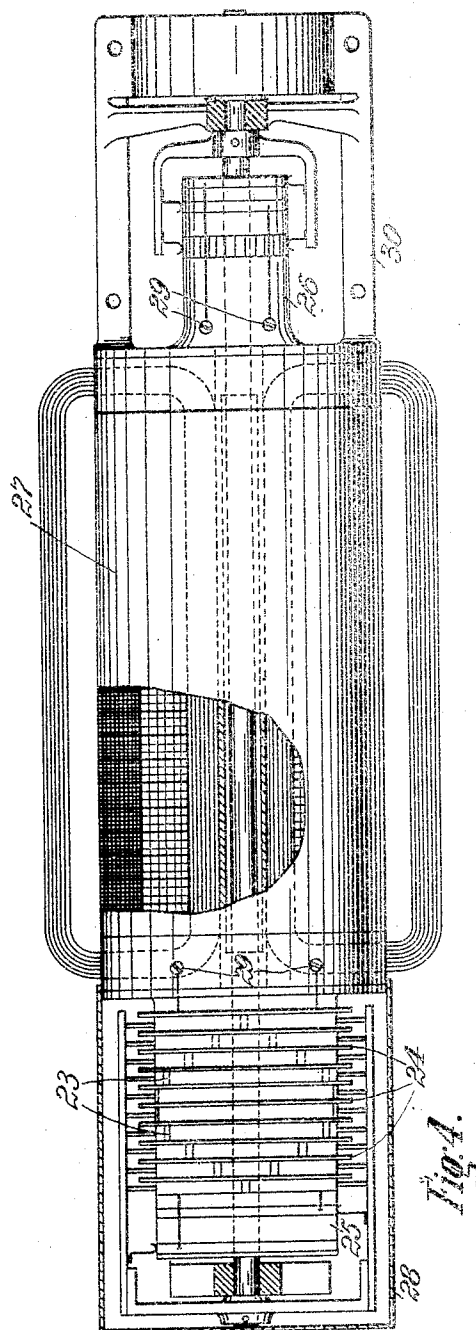
Wilhelm Alhorn

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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

Fig. 6.

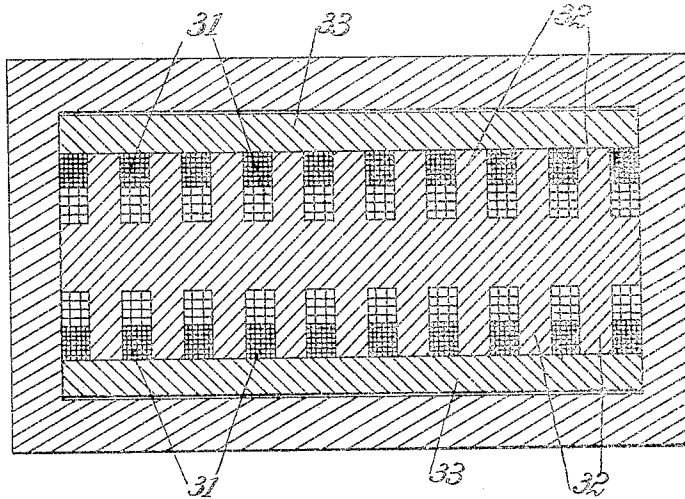
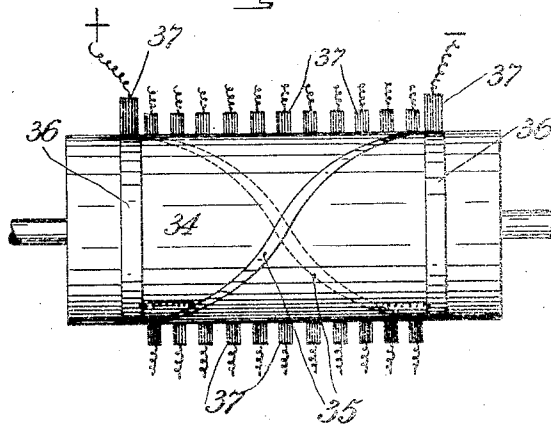


Fig. 7.



Witnesses:

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Inventor:

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UNITED STATES PATENT OFFICE.

WILHELM ALHORN, OF BERLIN, GERMANY.

CONVERTER FOR CONTINUOUS CURRENT.

1,038,064.

Specification of Letters Patent. Patented Sept. 10, 1912

Application filed June 8, 1911. Serial No. 631,989.

To all whom it may concern:

Be it known that I, WILHELM ALHORN, student of engineering, a subject of the German Emperor, and residing at 9 Wollnerstrasse, Berlin, Germany, have invented certain new and useful Improvements in Converters for Continuous Current, of which the following is a specification.

This invention relates to apparatus for transforming a continuous current from one voltage to another, and the object of my invention is to provide a transformer in which a periodic change of the magnetic field is produced, causing a corresponding transfer of electric energy by induction between the primary and secondary coils without physical movement of the primary or secondary members.

My invention will be understood from the following description, in connection with the accompanying drawings, in which—

Figure 1 is a diagrammatic representation of an apparatus embodying my invention; Fig. 2 is a side elevation of the same; Fig. 3 is a diagram illustrating the relative position of the magnetic poles; Fig. 4 is a top plan view of a modified form of my transformer, showing a different commutator construction from that of Fig. 1; Fig. 5 is a diagram illustrating an arrangement of the coils and commutator connections to produce sparkless commutation; Fig. 6 is a longitudinal section showing an arrangement of the primary and secondary coils with respect to the magnetic core; and Fig. 7 is a plan view of a modified form of the commutator.

Referring to Fig. 1, the primary coils P and secondary coils S, of the transformer, are arranged in superposed relation upon a longitudinal magnetic core 22. These coils are wound continuously, the ends being connected respectively by the wires 16 and 17, each coil being divided into sections, as in a Gramme ring, the sections of the primary being connected to the annularly arranged commutator segments 2, and the secondary sections to the segments 10, which are carried by the insulating circular base 1. The slip rings 7 and 8 are connected with a suitable source of current to be transformed, and the secondary or transformed current is taken from the rings 7 and 9, through suitable connections 11, shown in Fig. 2. The brushes for conveying the current to the segments connected with the primary and

secondary coil sections are carried by the rotary arm 3, which is mounted upon a central shaft or arbor and is provided with a driving pulley, as shown in Fig. 2. The lower primary-coil brush 4, is connected with the brush 6 bearing upon the ring 8, and the upper secondary-coil brush 12 is connected with the brush 13, bearing on the ring 9, while both the upper primary brush 4 and the lower secondary brush 12 are connected to the brush 5 bearing on the ring 7, common to the primary and secondary circuits. The coil sections are connected to the successive commutator segments in the same manner as the coils in the ordinary Gramme ring armature; thus, if the left hand section P^a is connected to the segment 2^a, the sections being connected to the successive segments in a right-hand direction, then the last section on the right, P^c, will be connected to the segment 2^c. If there are 2^a sections in the primary and secondary coils, then there are ^a sections between the brush connections. Thus, if at one instant, one brush 4 is connected with section P^b, the other brush 4, diametrically opposite, will be connected to the wire 16 connecting the ends of the coils P^a and P^c. In this position of the brushes, the north pole will be at the center of the magnetic core and the ends will be of opposite or south polarity, as indicated in Fig. 3. As in dynamo electric machines, the secondary coil or induced member must be connected to the brushes at the neutral magnetic points, corresponding to the points I, II, in Fig. 3. I have indicated this arrangement in Fig. 1, by connecting coil S^a by wire 20 to segment 10^a, which is 90° from the segment 2^a, connected to the corresponding primary coil P^a. As the arm 3, carrying the brushes, is rotated rapidly over the commutator segments by a motor, the direction of the current in the sections of the coil is successively reversed and the polarity of the core advances longitudinally, in consequence of which currents will be induced in the secondary coil which are taken from the commutator through the brushes and slip rings as a continuous current, the voltage depending upon the ratio of transformation between the primary and secondary coils. In all positions of the brushes, the coils connected to opposite sides thereof have opposing currents flowing therein and produce consequent poles at the opposite points of connection with the

brushes, just as in the opposite sides of a Gramme ring armature. It is evident that there is no magnetic path for the return of the lines of force from these poles.

5 In order to secure a high efficiency in transformer constructions, it is important that the magnetic flux should traverse closed magnetic paths. For this purpose, I prefer to arrange the iron core parts in the manner
10 shown in Fig. 6, in which lateral branches 32 project from the central iron core and pass between the sections of the primary and secondary coils and connect with a common magnetic return or yoke piece 33. It
15 is evident that with this construction the return magnetic flux passes successively through each of the branch magnetic paths 32 into the yoke, and that the lines of force always pass through closed magnetic paths.
20 Induction between the primary and secondary can only take place when the magnetism is advancing longitudinally. When the brushes are in intermediate position and short-circuit two coils, the magnetism does
25 not advance and consequently no induction currents are produced. When, however, a coil section is under the brush, there will be no current of self-induction which will produce sparking as the brush passes off of
30 one segment to the next. In order to eliminate this sparking, the coils may be divided into two equal parallel portions, as shown in Fig. 5. Each commutator segment extends over one half, and the sections of the
35 coil sections are connected alternately to segments which are separated by an intermediate segment. In this manner the brush C connects the coil portions alternately and cannot short-circuit a coil section. At the
40 instant when a brush rests upon two adjacent segments, both coil portions are connected in parallel, as the opposite brush rests upon the two corresponding segments upon the other side of the commutator. The
45 sparking due to the reactance of the individual coil sections will thus be avoided. It is obvious that this arrangement may be used for both primary and secondary or only one member.

50 The only limit in the voltage or tension which may be produced with the use of my continuous current transformer depends upon the insulation of the commutator segments. If this limit has been reached, the
55 voltage may be increased by arranging several commutators in series.

60 I have illustrated in Fig. 4, an arrangement for securing a very high insulation between the segments upon the high voltage side of the transformer. Instead of the usual annular segmental ring, the commutator segments 23 are disposed longitudinally upon the periphery of the supporting
65 cylinder 25, and arranged in a double spiral as shown, separated by insulating disks 24.

The brushes bearing upon opposite sides of the commutator are provided with teeth, after the manner of a comb, which project between the disks and bear upon the surface of the commutator. In this manner the
70 segments engage successively with the teeth of the brush, a segment being always in contact therewith. By properly proportioning the size of the cylinder and the height of the disks, sparks can be prevented from passing
75 between the segments at practically any voltage desired. The entire commutator may be inclosed in a protecting cap 28. The low voltage commutator is carried by the cylinder 26, at the opposite end of the trans-
80 former. The brushes which bear upon the commutators and slip rings for both high and low voltage are carried by yokes secured to the shaft of the motor indicated at the right-hand end of the machine, the bear-
85 ings for the motor being supported in the yoke 30 attached to the casing. If the primary side of the transformer is the high tension side, the motor should be provided with a double set of windings, and after
90 being started from the high tension side can be switched over to the low voltage side during normal operation. The wires connecting the commutator segments with the
95 coil sections should be carefully insulated, and are preferably carried through the interior of the cylinder. The high and low voltage external leads are connected to suitable binding posts or contacts 29 upon either
100 end of the machine.

105 In Fig. 4, above described, I have shown the brushes connected to the motor shaft in a manner to be rotated about the commutators. It is preferable, however, by reason of the high speeds frequently employed and for ease of adjustment and repair, to use stationary brushes, and I have, therefore, illustrated such an arrangement in Fig. 7. The
110 brushes 37 are connected with the respective coil sections, and bear upon an insulating cylinder 34 in which are embedded two diametrically disposed helical conducting bars 35, which are connected respectively with the slip rings 36. When the cylinder 34, connected to the motor shaft, is rotated, the
115 pairs of opposite brushes 37, will be connected in succession through the bars 35, and rings 36, with the circuit terminals or leads, effecting the commutation of the currents in the transformer coil sections in the
120 usual manner.

The several advantages of my continuous current transformer will be appreciated by engineers and by those skilled in the art from the above disclosure of the invention.
125 It has the advantage of requiring no rotating masses and no rotating coils. It is self regulating, requires practically no attendance, and possesses a great overload capacity. The small motor for driving the
130

rotary portion of the commutator is operated at a constant speed and therefore does not require attention.

The efficiency of this transformer is very high, and it is adapted not only for the charging of storage plants, but also for power transmission purposes.

While I have described in detail the constructions illustrated in the drawings for the purpose of disclosing embodiments of my invention, I am aware that changes may be made therein without departing from the spirit of my invention, and I desire to include such changes within the scope of my claims.

I claim:—

1. A converter comprising closed primary and secondary coils each divided into sections, a rectilinear magnetic core within said coils having lateral branches extending between said sections, a return magnetic piece or yoke connecting said branches, a commutator connected to said sections, and means for producing a substantially uniform and continuous advance of the magnetic field along said rectilinear core and within said coils.

2. A converter comprising closed primary and secondary coils each of which is composed of symmetrical interrelated portions and divided into an equal number of sections, a rectilinear magnetic core within said coils having lateral branches extending between said sections, a commutator having sets of segments for said coils, the corresponding sections of the two coil portions of the primary and secondary respectively being connected to the commutator segments alternately so that diametrically opposite contact brushes will connect the coil por-

tions alternately in circuit, and means for producing a continuously advancing magnetic field along said core and within said coils.

3. A converter comprising closed primary and secondary members, each of which is divided into sections and one of which is composed of duplex symmetrical interrelated coil portions, a commutator having sets of segments connected respectively to the sections of the primary and secondary members, the set of segments connected to the duplex member being connected alternately to the coil portions, and a brush support carrying a set of brushes adapted to contact successively with the segments of the duplex coil portions, whereby the coil portions thereof are connected alternately in circuit, and another set of brushes adapted to simultaneously contact with the segments of the other member.

4. A converter comprising closed primary and secondary members concentrically arranged and extending longitudinally, each of which is divided into sections, a magnetic core extending longitudinally through said members, a commutator having segments connected to said sections, said commutator having contact portions extending spirally along the periphery of the support, and means cooperating with said segments for producing a continuously advancing magnetic field along said longitudinal core and within said coils.

In testimony whereof I hereto affix my signature in presence of two witnesses.

WILHELM ALHORN.

Witnesses:

WOLDEMAR HAUPT,
HENRY HASPER.