No. 656,522.

Patented Aug. 21, 1900.

M. DÉRI.

APPARATUS FOR CONVERTING ALTERNATING CURRENTS INTO CONTINUOUS CURRENTS.

(Application filed July 6, 1899.)

(No Model.)

6 Sheets—Sheet 1.

Fig. 1

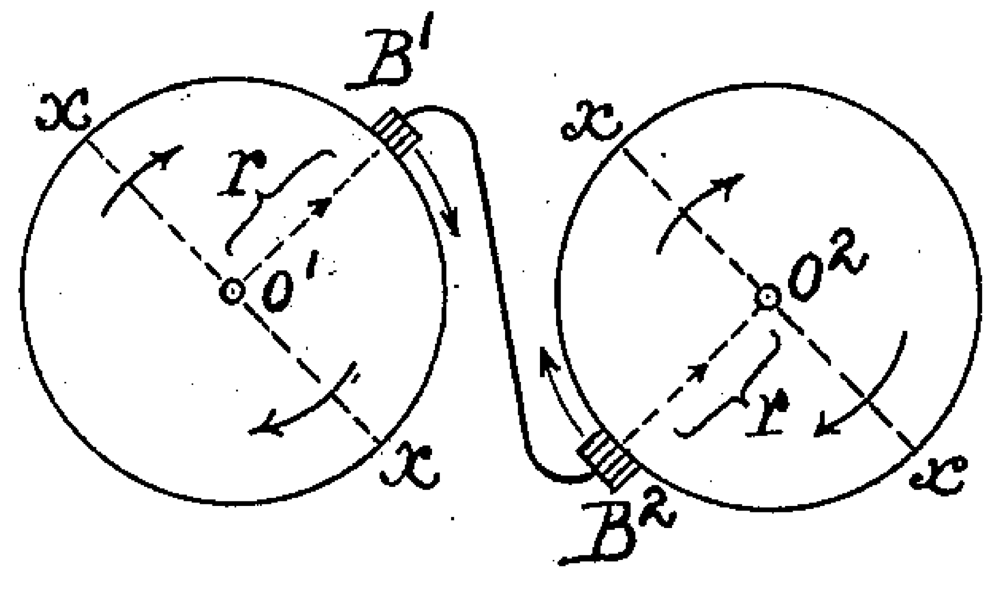


Fig. 2

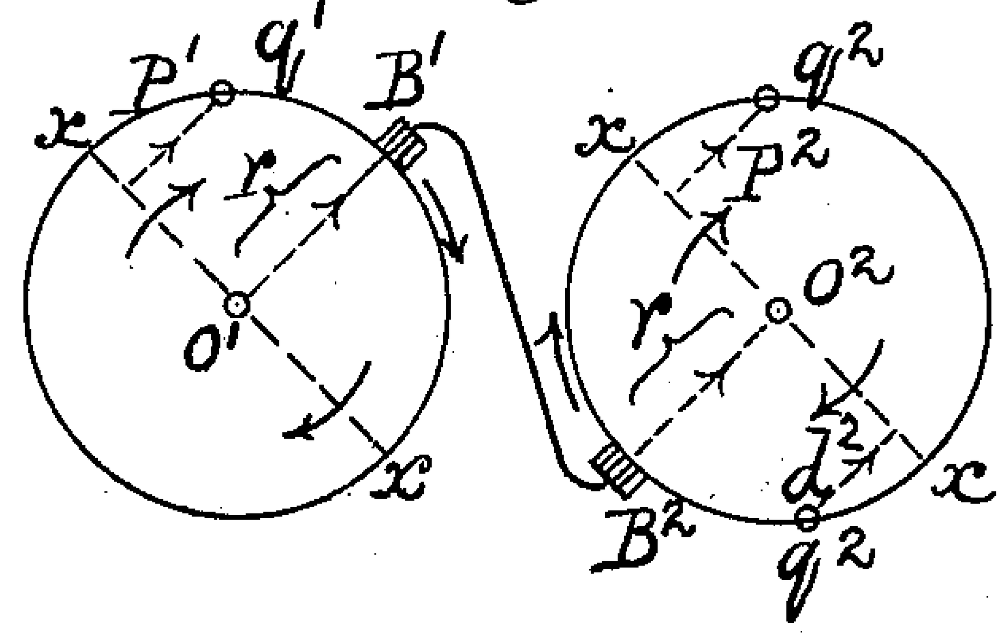
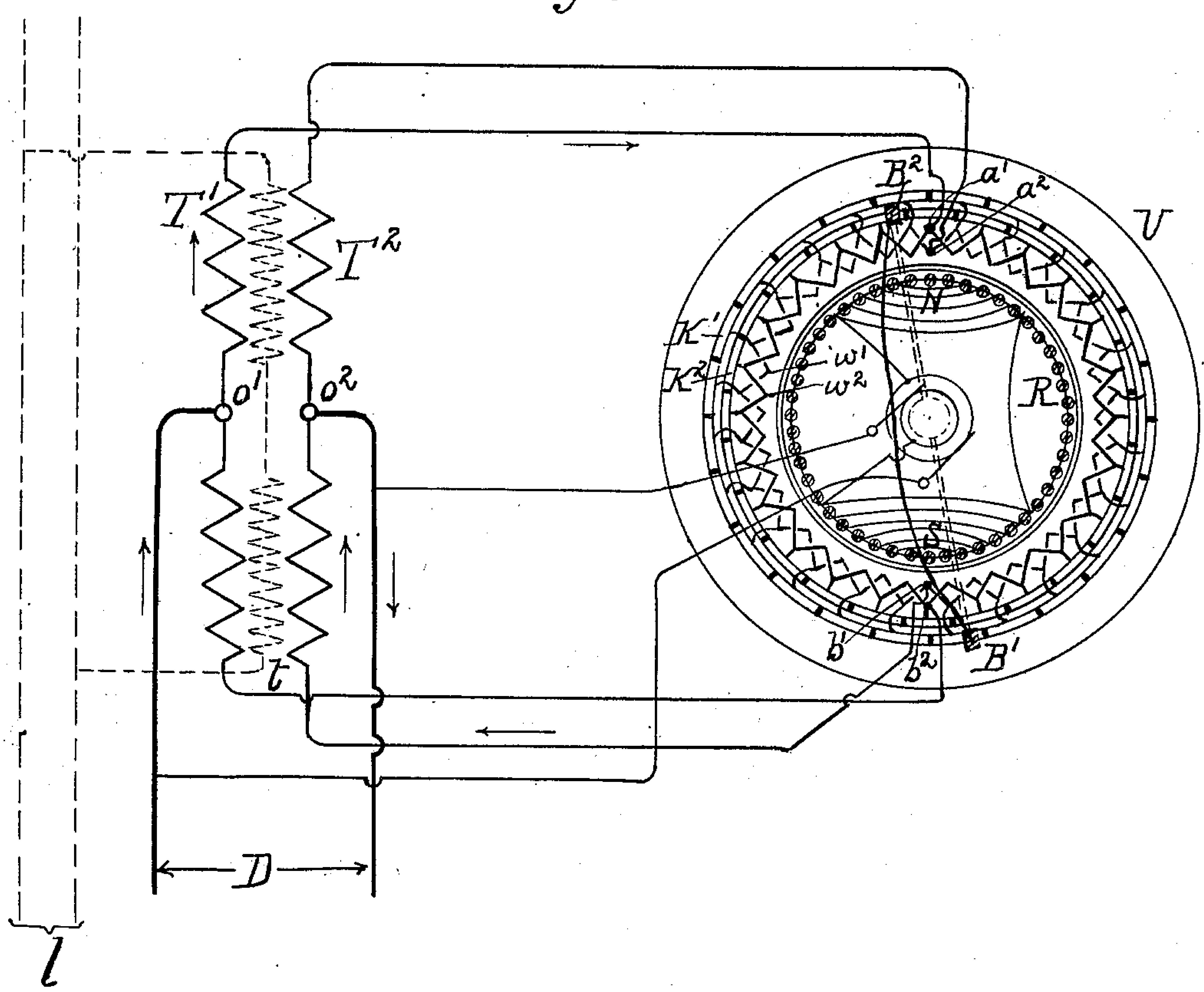


Fig. 3



WITNESSES:

Walter Abbe

S. C. Connor

INVENTOR

Max Déri

BY

Howson and Howson

ATTORNEYS

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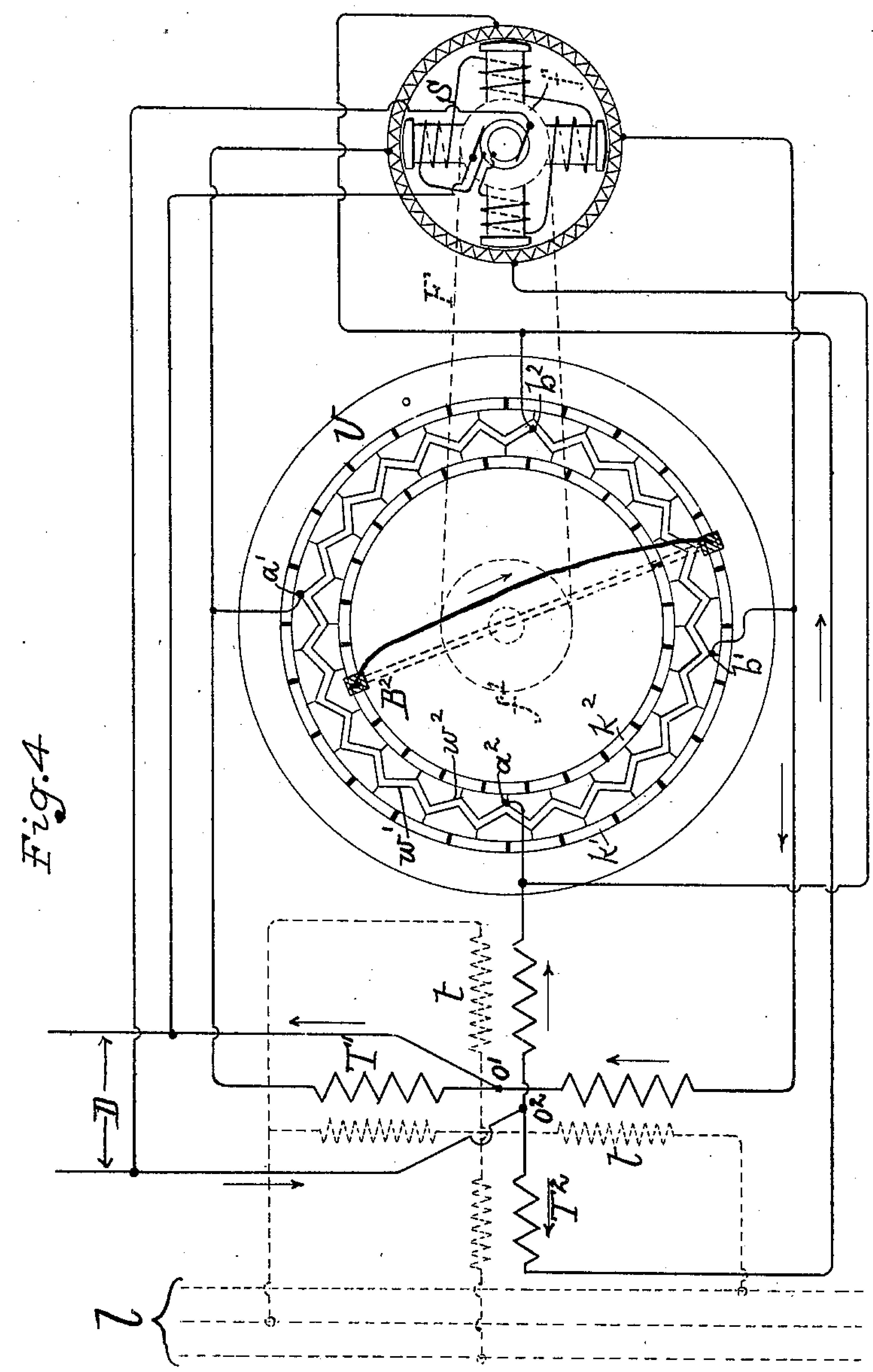

WITNESSES:

Walter Abbe

S. C. Connor

INVENTOR

Max Déri

BY

Howson and Howson

ATTORNEYS

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M. DÉRI.

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FIG. 5.

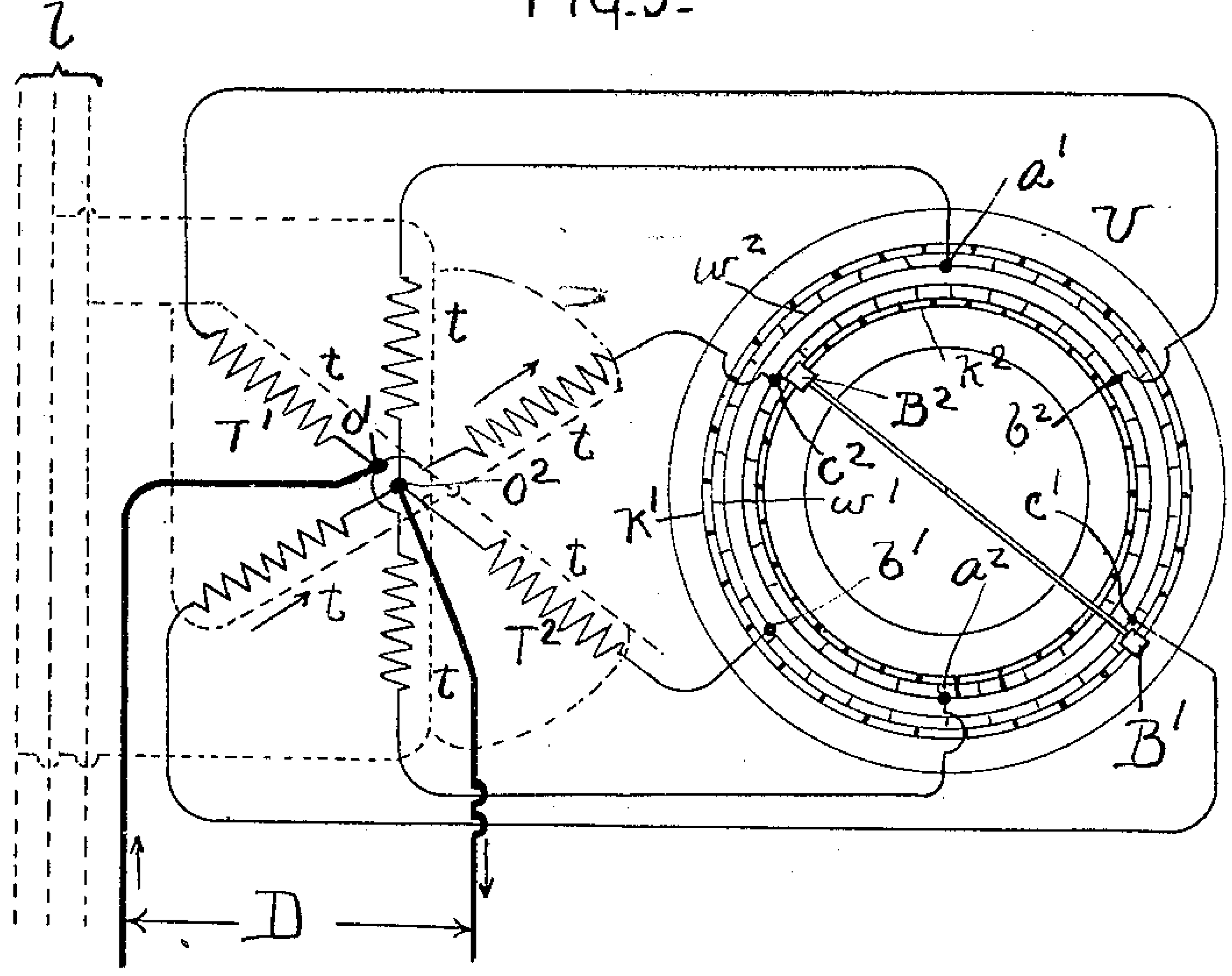
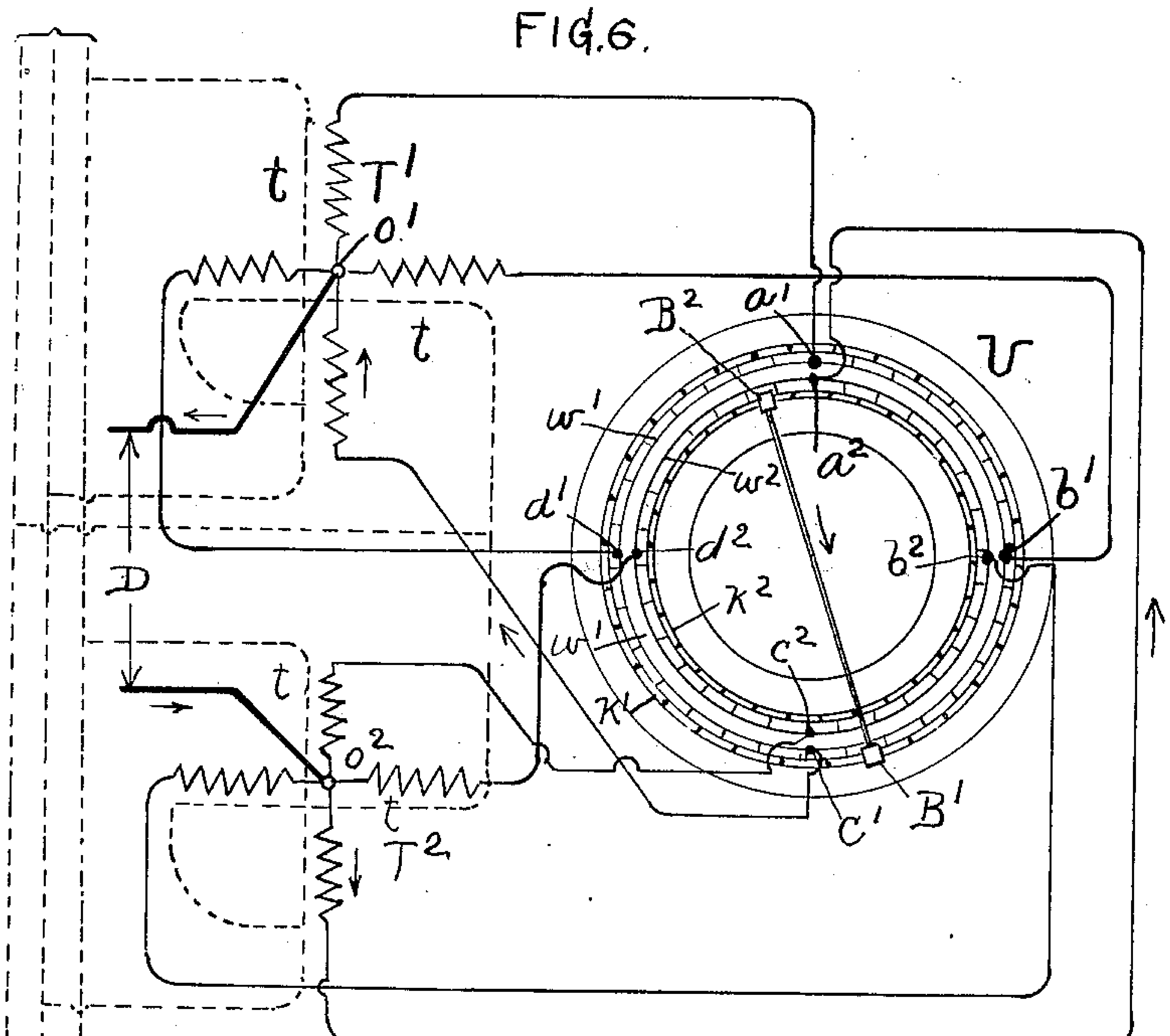


FIG. 6.



WITNESSES:

F. W. Wright.

Walter Abbe

INVENTOR

MAX DERI

BY

Howson and Howson

HIS ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 656,522. Patented Aug. 21, 1900.

M. DÉRI.

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FIG. 7.

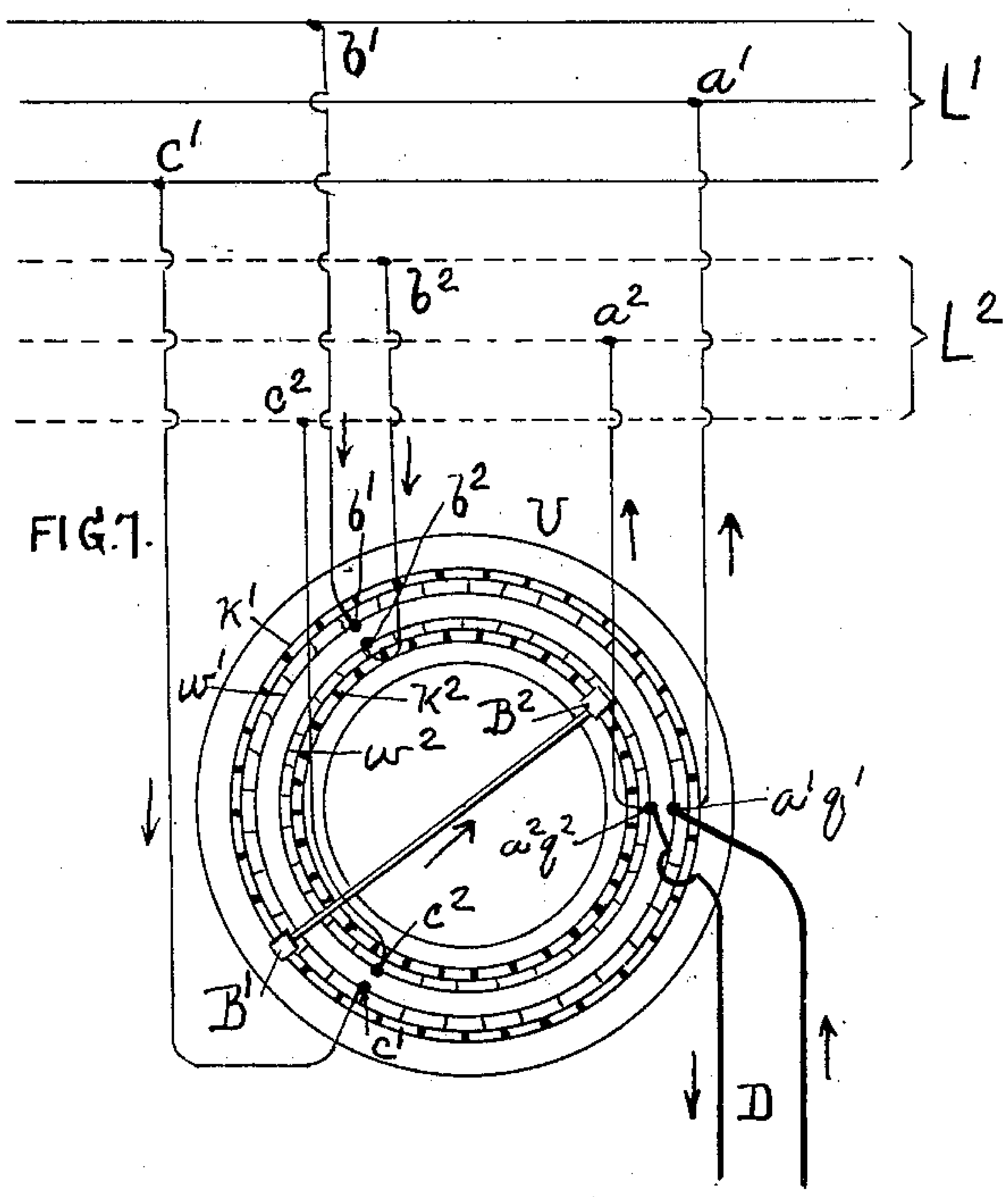
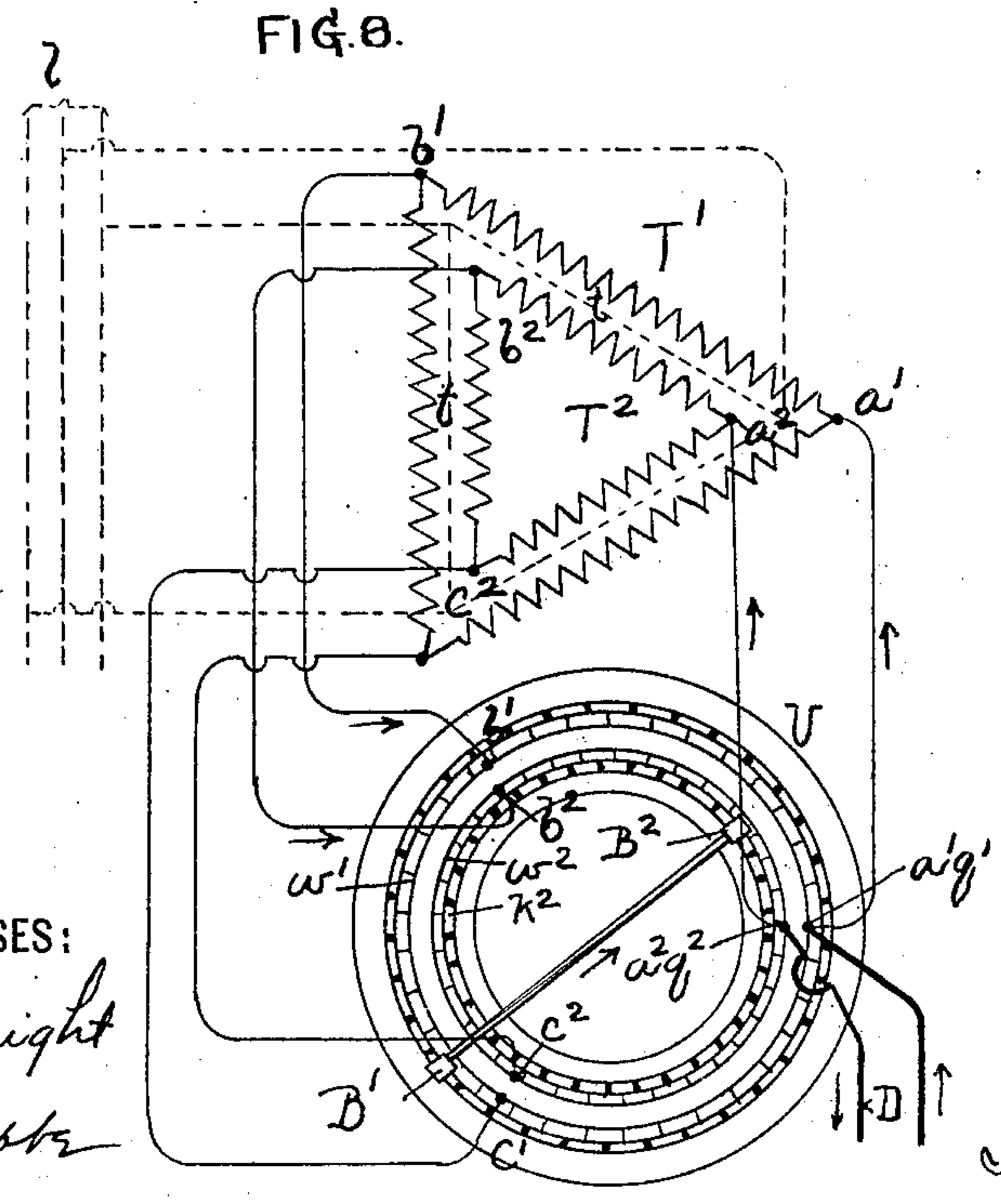


FIG. 8.



WITNESSES:

F. W. Wright

Walter Abbe

INVENTOR

MAX DÉRI

BY

Howson and Howson

HIS ATTORNEYS.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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M. DÉRI.

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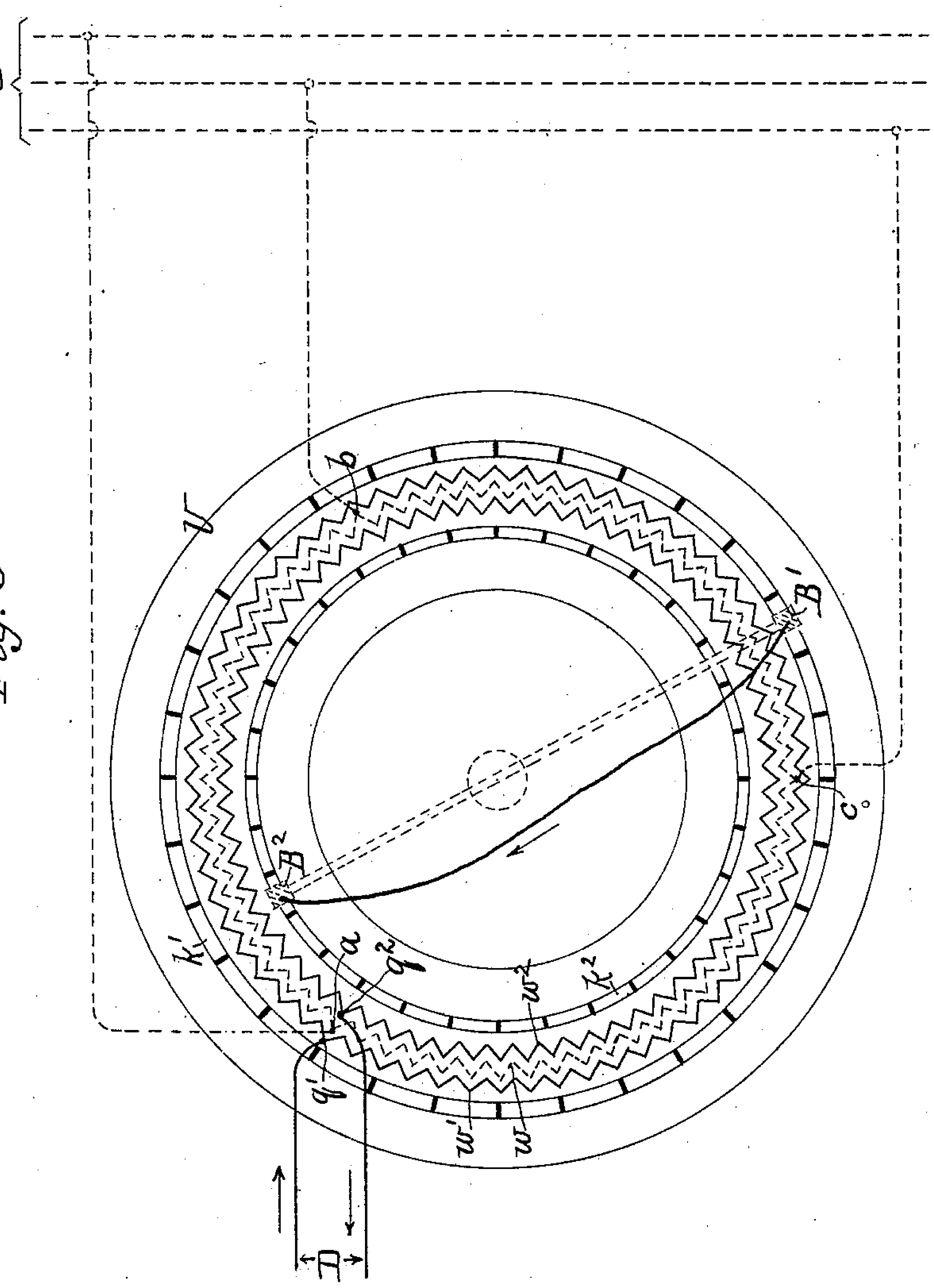

Fig. 9

WITNESSES:

Walter Abbe

S. C. Connor

INVENTOR

Max Déri

BY

Howson and Howson

ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 656,522. Patented Aug. 21, 1900.

M. DÉRI.

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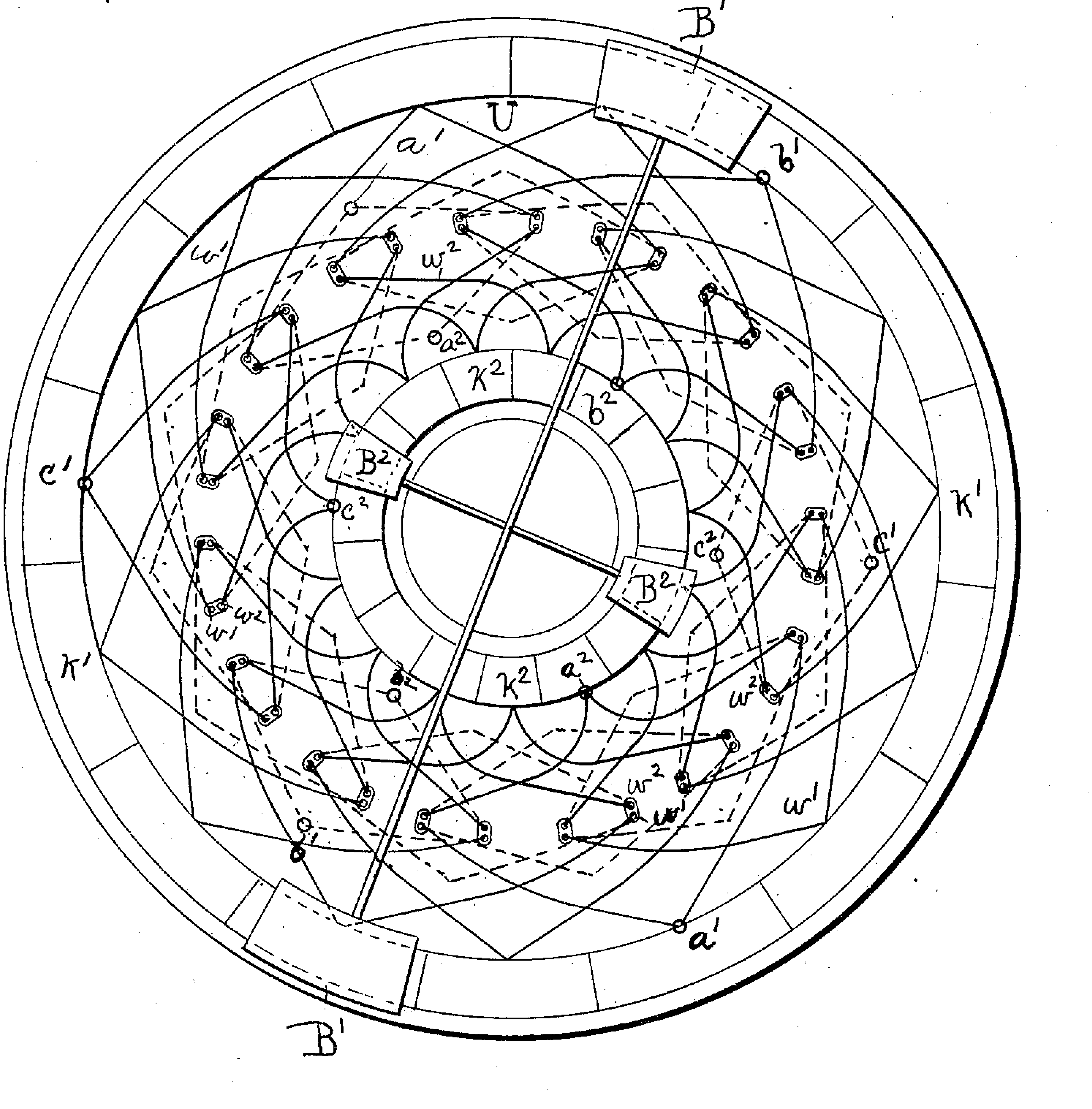
FIG.10.



WITNESSES:

F. W. Wright.

Walter Abbe

INVENTOR

MAX DÉRI

BY

Howson and Howson

HIS ATTORNEYS.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

MAX DÉRI, OF VIENNA, AUSTRIA-HUNGARY.

APPARATUS FOR CONVERTING ALTERNATING CURRENTS INTO CONTINUOUS CURRENTS.

SPECIFICATION forming part of Letters Patent No. 656,522, dated August 21, 1900.

Application filed July 6, 1899. Serial No. 722,904. (No model.)

To all whom it may concern:

Be it known that I, MAX DÉRI, a subject of the King of Hungary, residing at Vienna, in the Province of Lower Austria, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Apparatus for Converting Alternating Currents into Continuous Currents; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Various proposals have been made for employing stationary induced coils and commutators for converting alternating currents into continuous currents by producing a rotary field in the magnets and causing the brushes of the commutator to rotate. Arrangements of this kind offer several advantages both as to construction and action, in particular because with stationary magnets the magnetic flux can flow in closed circuits, and only small masses require to be set in motion. The main reason why this description of converters has not met with material practical application is that the current must be taken off with considerable difficulties by means of sliding contacts, such as have heretofore been employed in connection with the revolving brushes.

The present invention relates to a construction of such converters with stationary magnets and induced coils in which the continuous current produced is taken from points that are stationary. By this means the importance of the brush action is reduced, the construction and arrangement of the brushes are simplified, and the use of sliding rings is avoided.

In the accompanying drawings, Figures 1 and 2 are diagrams illustrating the principle of my invention; and Figs. 3 to 10, inclusive, are diagrams of converters embodying my invention in varying forms.

I will describe the principles on which the invention is based, with reference to Figs. 1 and 2 of the accompanying drawings. If in a magnet wound in a similar manner to the armature of a continuous-current dynamo a rotary magnetic field is produced—for example, by exciting the winding by a polyphase current—then each potential revolves with the rotary field around the zero-point of the system. The zero-point is either ideal or it is actually formed by a suitable interlinked connection (star connection) of the sources of current that excite the winding or of self-induction resistances combined with the winding. The axis of the rotary field is X X, the zero-point O. The circle described around O is the potential circle. The vertical distance of any point from the axis X X represents the potential of that point for the time being. That point of the circle will have the highest potential which lies in the radius perpendicular to X X. Consequently when a contact, such as a commutator-brush, situated at that point revolves synchronously with the axis then the brush potential relatively to the zero-point is a constant amount which is equal to the maximum potential value.

In Figs. 1 and 2 there are shown two separated winding systems. Although it is most advantageous to arrange the two windings concentrically on the same magnet-core, so that the same magnetic field rotates in both, yet for the sake of clearness there are assumed in the diagram to be two separated magnets, with separate rotary fields. In both figures, X X is the bipolar-field axis, and B' and B^2 are the revolving brushes, which are always situated in the radius perpendicular to the axis X X and revolve synchronously with the axis. O' and O^2 are the zero-points of the two systems. The potential of any point of the winding is indicated by P, and the maximum of the potential by r. The latter is equal to the radius of the potential circle. The directions or signs of the potential value are indicated by straight arrows and the direction of rotation by curved arrows. If the two rotating brushes B' B^2 are put in conducting connection, as in Fig. 1, the zero-points are put in potential relation to each other—namely, the sum of the potential values of B' and B^2 appears between O' and O^2, so that the potential difference D between the zero-points is equal to $2r$. If terminals be placed at O' and O^2, there will exist between these a constant-potential difference, and a continuous current can be taken therefrom. In Fig. 2 the field-axis X X also rotates, and the brushes B′ B² of the two winding systems revolve synchronously therewith. Also in this case the brushes are short-circuited. If terminals q' and q^2 be applied, one at a certain point in each of the two systems, the potential difference between the two terminals will be made up out of the varying potential values P′ and P² of the points q' and q^2 and of the constant-potential values of the brushes B′ and B². This sum D is with reference to the directions $=2r+$, $(P'-P^2)$. Each P varies between $+r$ and $-r$. Consequently D can never have a negative sign. D is therefore a pressure of always the same direction, but fluctuating between two values, the difference of which is greater or smaller according to the relative positions of the points q' and q^2. If the points q' and q^2 have the same relative positions as at Fig. 2, then P′ and P² balance each other and D is $=2r$, a constant value. If, on the other hand, the terminals lie in opposite potential points, as q' q^{12}, Fig. 2, then P′ and P² are always of opposite sign, and $P'-P^2$ varies between $+2r$ and $-2r$. The potential difference D is therefore variable between the limit values $+4r$ and zero. In general the pressure between any two points of the two circles will fluctuate between $2r+d$ and $2r-d$, where d can never become greater than $2r$.

In Figs. 3 to 9 the dotted lines l represent the primary mains of an alternating-current-supply system, and the dotted lines t represent the primary windings of the transformers, of which T′ and T² represent the secondary windings. The windings of the converter are marked w' and w^2 and may be in ring or drum form. In Fig. 10 these windings are represented, so far as practicable, in detail. In the other diagrams, Figs. 3 to 9, they are for the sake of simplicity indicated only by circles. In all these figures k' and k^2 are the commutators. B′ and B² are the brushes. U denotes the magnets of the converter, (the stationary armature,) and a', a^2, b', b^2, c', c^2, d', and d^2 are the points of connection of the magnet-windings with the transformer-coils, Figs. 3, 4, 5, 6, and 8, or with the feed-circuits L′ L², Fig. 7, except in the case of Fig. 9, where the connections are marked a, b, and c. The connections of the continuous-current mains D are at o' o^2 in Figs. 3, 4, 5, and 6 and at q' q^2 in Figs. 7, 8, and 9. In the former case, Figs. 3 to 6, the continuous current is taken from the zero-points of the transformer-coils, while in the cases shown in Figs. 7, 8, and 9 the continuous current is taken from the fixed points of the magnet-windings. In Fig. 3, R is the short-circuited armature. The arrows show the direction of the momentary pressures or of the current.

In all these examples the converter-magnet U is represented as a hollow iron cylinder, in which the two windings W′ and W² are embedded, so that they are surrounded with iron on all sides. Only with the single-phase converter, Fig. 3, are the two windings arranged on the inner surface of the hollow cylinder and are separated by an air-gap from the revolving armature R, which is provided with a squirrel-cage winding.

In the construction illustrated in Fig. 3 the rotary field is produced by exciting the converter-windings w' and w^2 by means of the two secondary coils T′ and T² of a single-phase alternating transformer and by rotating the short-circuited armature R synchronously with the periods of the alternating current. It is well known that if in a stator excited by single-phase alternating currents an armature provided with short-circuited windings be rotated synchronously there is produced, in consequence of the reaction of the currents induced in the short circuits, a constant magnetic field rotating with the armature, all other field components being neutralized by the named reaction. By these means there results a rotary field in the converter-magnet of a single-phase transforming device, (shown in Fig. 3,) as well as in the polyphase transforming devices represented in Figs. 4 to 9.

In Fig. 4 the rotary field is excited by two-phase transformer-coils T′ and T², which are connected to the windings W′ and W². In Fig. 5 the rotary field is produced by excitation from three-phase transformer-coils and in Fig. 6 by excitation from four-phase transformer-coils. In all these cases the transformer-coils, like the magnet-windings, are always present in two separate groups. In Figs. 3 and 4 the zero-points to which the terminals are attached are produced by halving, and in Figs. 5 and 6 by star connection of the transformer-coils, and in all four cases the continuous current is taken from the zero-points O′ and O². In an analogous manner any desired higher phase-number may be used, this being effected the more easily in this case, as the larger number of connection points with these arrangements where there are no sliding contacts, but only fixed terminals, does not cause difficulties, and as the connecting leads need only be of short length. In Fig. 4, for the sake of explanation only, I have shown a skeleton outline of a synchronous motor S, placed apart from the other devices and with a connection by pulleys f f' and belt F, (indicated by dotted lines;) but in practice in order to give the brushes a synchronous rotation there will be a direct and rigid connection between the brush-holder and the synchronous motor. The windings are indicated by zigzag lines.

Fig. 7 shows the three-phase excitation of the armature with two separate groups of feeders L′ and L². Fig. 8 shows the same excitation with two separate groups of transformer-coils interlinked in triangular form. In this case the terminals q' and q^2 are arranged in definite points of the two magnet-windings. When the terminals are situated at points having the same position in the two magnet-windings, as at a' and a^2, Figs. 7 and 8, a constant continuous current will be obtained. If, on the other hand, the terminals are not in the same position, a fluctuating continuous current will be obtained. Both kinds of current are herein considered as continuous current.

In Fig. 9 the converter-magnet is provided with three windings. The primary winding w, (marked with dotted line as a circle only,) connected with the primary mains l of an alternating-current supply, produce the three-phase excitation of the converter-magnet. The secondary windings w' and w^2, arranged with commutators in the same manner as in the other examples, are not connected with alternating-current mains, but solely with the continuous-current supply conductors attached at q' and q^2 to these windings. The primary windings generally being excited by high-pressure currents, will have a large number of turns. In this way the energy supplied as high-pressure alternating currents will be obtained as low-pressure continuous current from the transforming device, and consequently the pressure-transformer and the converter for transforming the form of currents are combined in one apparatus with a magnet common to both.

In the arrangements shown in Figs. 7, 8, and 9 there is three-phase excitation; but also in these cases any desired higher number of phases may be used in an analogous manner.

In all the above-described arrangements with single or polyphase excitation a bipolar rotary field has been assumed for the sake of simplicity. If the connecting-points be suitably increased, the rotary field can also be made multipolar—that is, with any desired greater number of poles.

Fig. 10 shows the winding system of a converter with two drum-winding circuits w' and w^2 and commutators K' and K^2, arranged with four poles, the connections a' a^2 b' b^2 c' c^2 for three phases being present in duplicate in each circuit. In this case there are provided at the two commutators two pairs of brushes, which are short-circuited with each other, and consequently all have the same potential. The brush arrangement can be still further simplified by shifting the commutator-sections of the one circle in the one direction and those of the other circle in the opposite direction to the extent of half a polar distance, so that the parts of opposite potential of the two commutators are situated in a radial position. In that case, instead of two brushes only one can be employed, which bridges over the diametrically-opposite commutator-sections in the shortest connection. Such double brushes require to be provided in such number as there are pairs of poles in the system. For example, in the arrangement at Fig. 10 there would only be two double brushes. The two winding systems are most advantageously coiled on a magnet-core common to both, formed of laminated soft iron, the windings being arranged concentrically, close together, and conveniently situated in one and the same set of channels passing through the armature-body at right angles to the iron laminae, as indicated in Fig. 10. The magnetic flux of the rotary fields, which flows entirely in iron, passes simultaneously through both the windings or is excited simultaneously by both, so that the contiguous wires have the same potential value. In the two commutators the potential differences will be equalized at those points where the rotating brushes are for the time being situated. Therefore the insulation of the brushes relatively to each other is not necessary. The commutators can be formed cylindrical and arranged one behind the other, or they may be arranged as plane commutators and placed concentrically one within the other. In all the figures the last-mentioned arrangement has been shown by way of example. In the armature of a converter constructed according to this invention no cross-fields nor dispersion-fields will appear which could prejudicially effect the action of the induction or commutation. Such an apparatus will consequently have a high degree of efficiency. The brushes, which for the purposes of this invention can be constructed in a simple and strong manner, must revolve synchronously with the rotary or alternating field. The rotation of the brushes, which requires very little power, is effected in the known manner by a synchronous motor, which is actuated either directly or indirectly from the same source of current as the converter.

In the case of the single-phase converter, Fig. 3, the short-circuited armature R can at the same time form the rotor of the synchronous motor actuating the brushes. In this case, however, the armature should be provided also with another winding for the excitation of the armature by the continuous currents in the usual way, which currents can also be taken from the converter itself.

I claim as my invention—

1. Apparatus for converting alternating currents into continuous current, comprising a stationary magnet-core having two separate winding systems similar to the armature-winding of a dynamo, each provided with a commutator and each connected with a separate group of conductors supplying, from generators or transformers, alternating currents which in the magnet produce fields, the magnetic flux of which common to both windings flows entirely through iron, in combination with short-circuited brushes revolving synchronously with said fields and connecting together those parts of the said two commutators which have in the one system the highest positive and in the other system the highest negative potential, and terminals for the

continuous current connected to fixed points of the two separate supplying and exciting circuits, substantially as described.

2. Apparatus for converting alternating currents into continuous current, comprising a stationary magnet-core having two separate winding systems similar to the armature-winding of a dynamo, and provided with commutators, and connected to two separate groups of feed-conductors producing in the magnet, fields, the magnetic flux of which common to both windings, flows entirely through iron, in combination with short-circuited brushes revolving synchronously with said fields and connecting together those parts of the said two commutators which have in the one system the highest positive, and in the other system the highest negative potential, and terminals for the continuous current connected each to a fixed point of the two magnet-windings, substantially as described.

3. Apparatus for converting polyphase alternating currents into continuous current, comprising a stationary magnet-core having two separate winding systems similar to the armature-winding of a dynamo, and provided with commutators, and connected to two separate groups of polyphase feed-conductors, producing in the magnet rotary fields, the magnetic flux of which common to both windings flows entirely through iron, in combination with short-circuited brushes revolving synchronously with the rotary fields and connecting together those parts of the said two commutators which have in the one system the highest positive, in the other system the highest negative potential, and terminals for the continuous current which are connected each to a fixed point of the two magnet-windings, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

MAX DÉRI.

Witnesses:

ALVESTO S. HOGUE,
AUGUST FRUGGER.