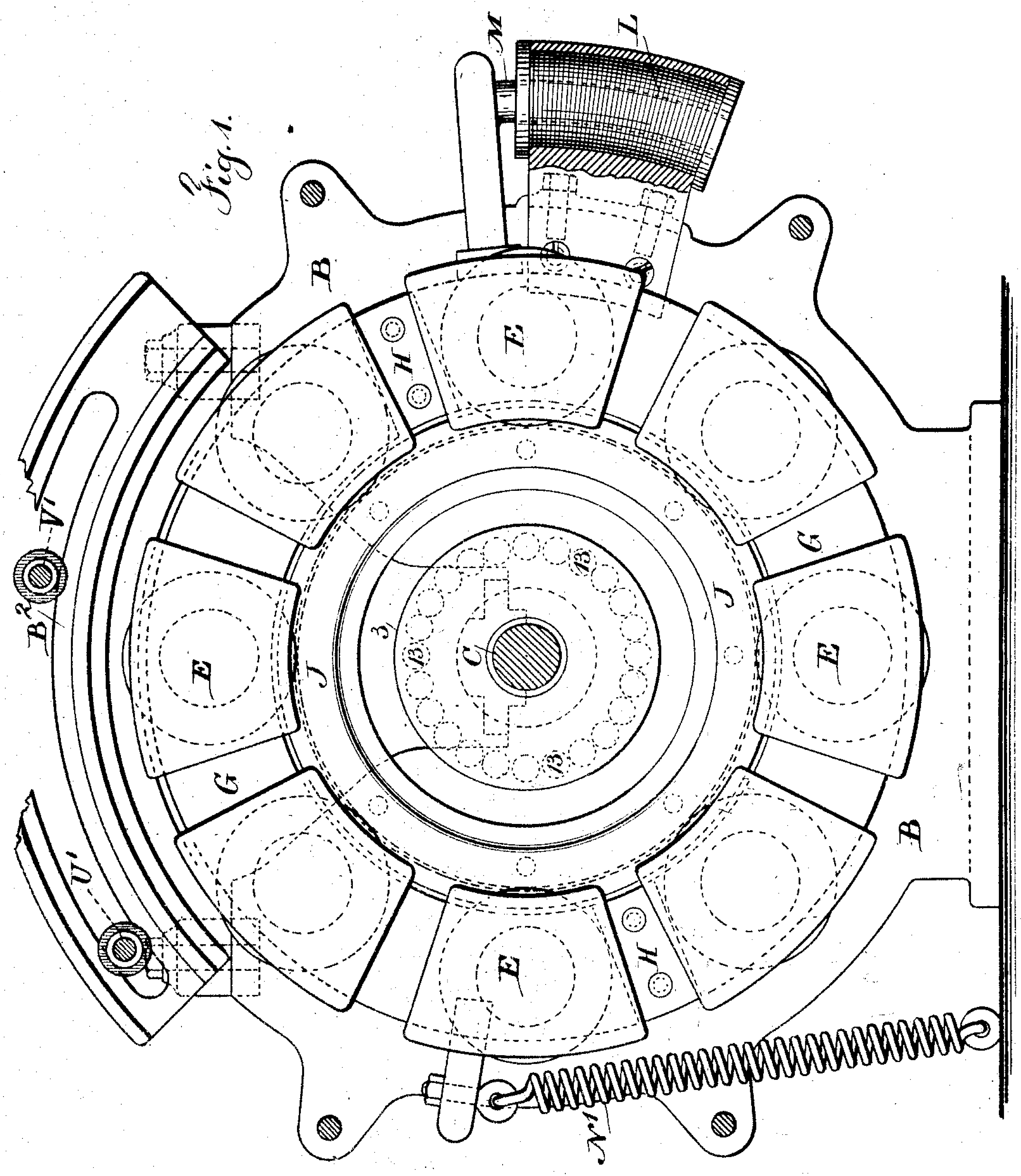
(No Model.) 7 Sheets—Sheet 1.

R. ELDREDGE.

DYNAMO ELECTRIC MACHINE.

No. 504,914. Patented Sept. 12, 1893.



Witnesses
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Inventor
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per Lemuel W. Serrell
atty

(No Model.)

7 Sheets—Sheet 2.

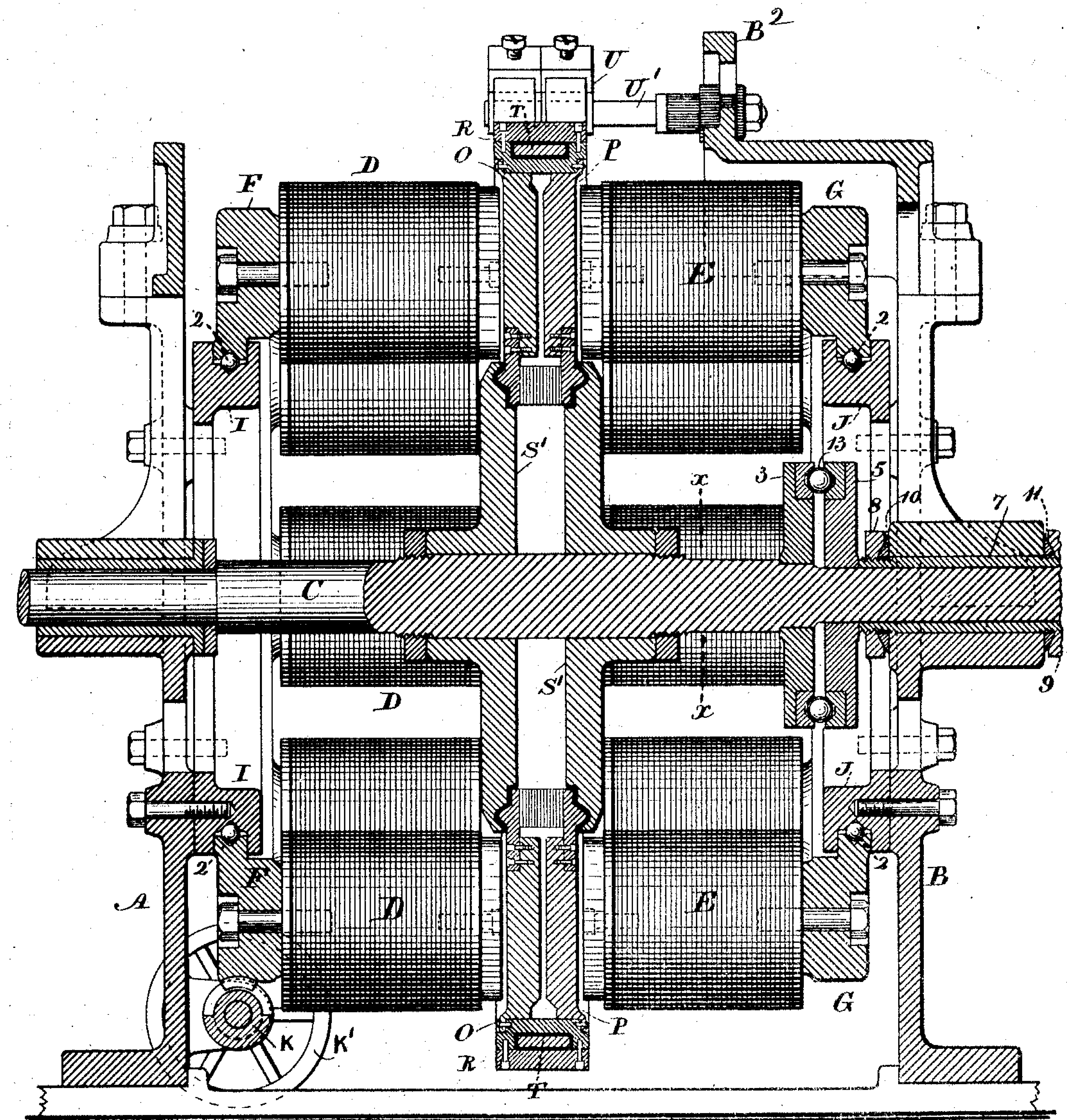
R. ELDREDGE.

DYNAMO ELECTRIC MACHINE.

No. 504,914.

Patented Sept. 12, 1893.

Fig. 2.



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R. ELDREDGE.

DYNAMO ELECTRIC MACHINE.

No. 504,914. Patented Sept. 12, 1893.

Fig. 3.

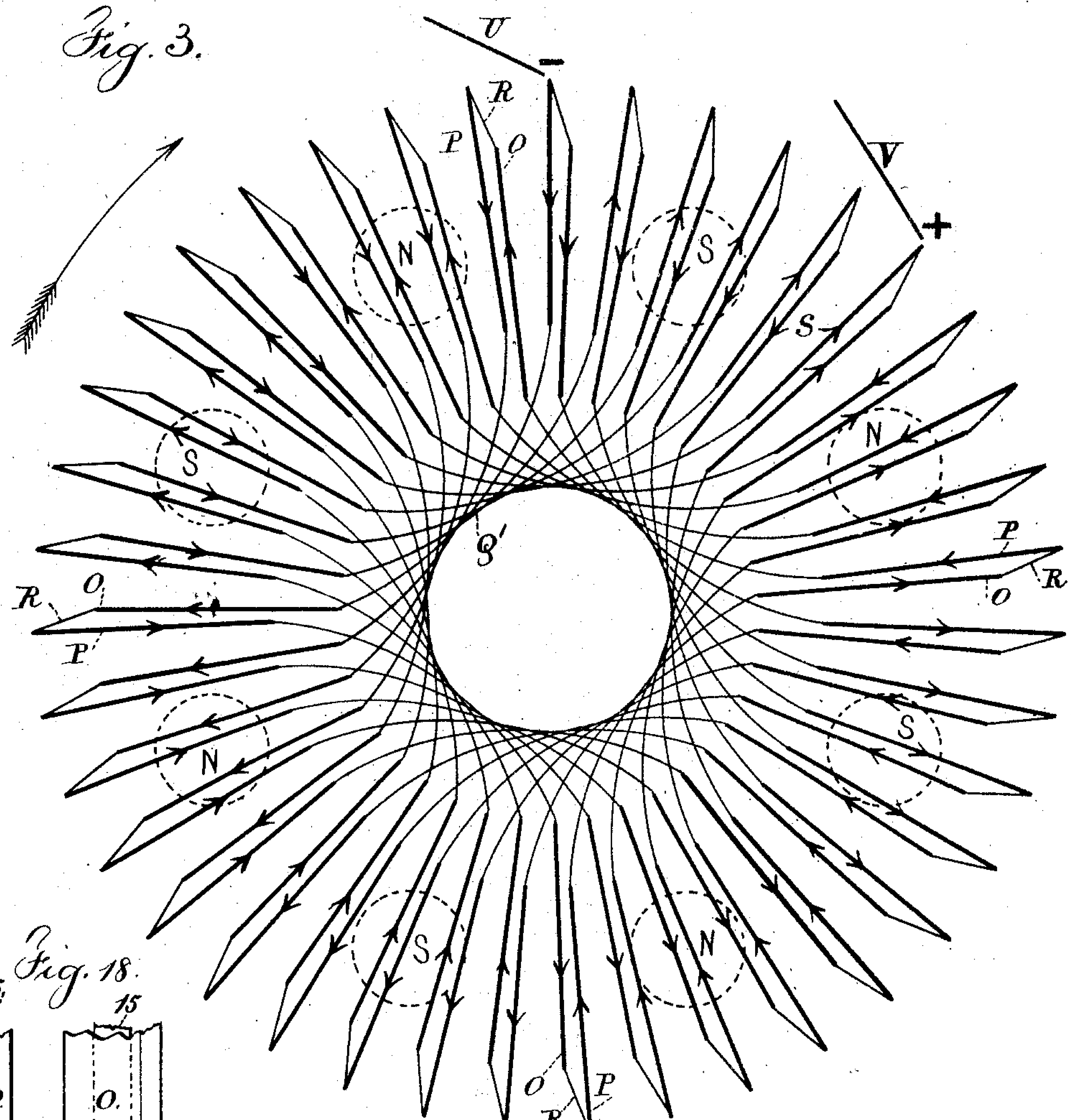


Fig. 18.

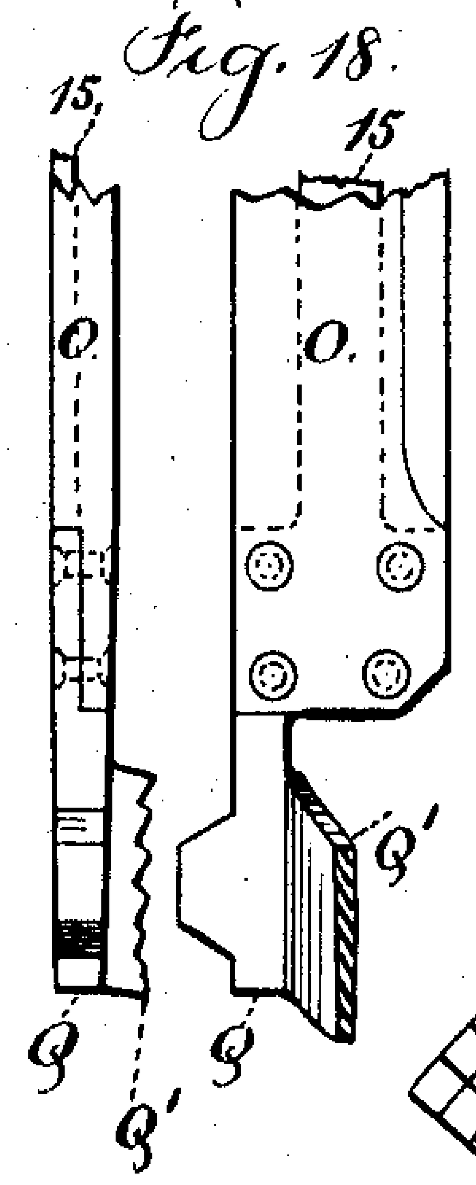
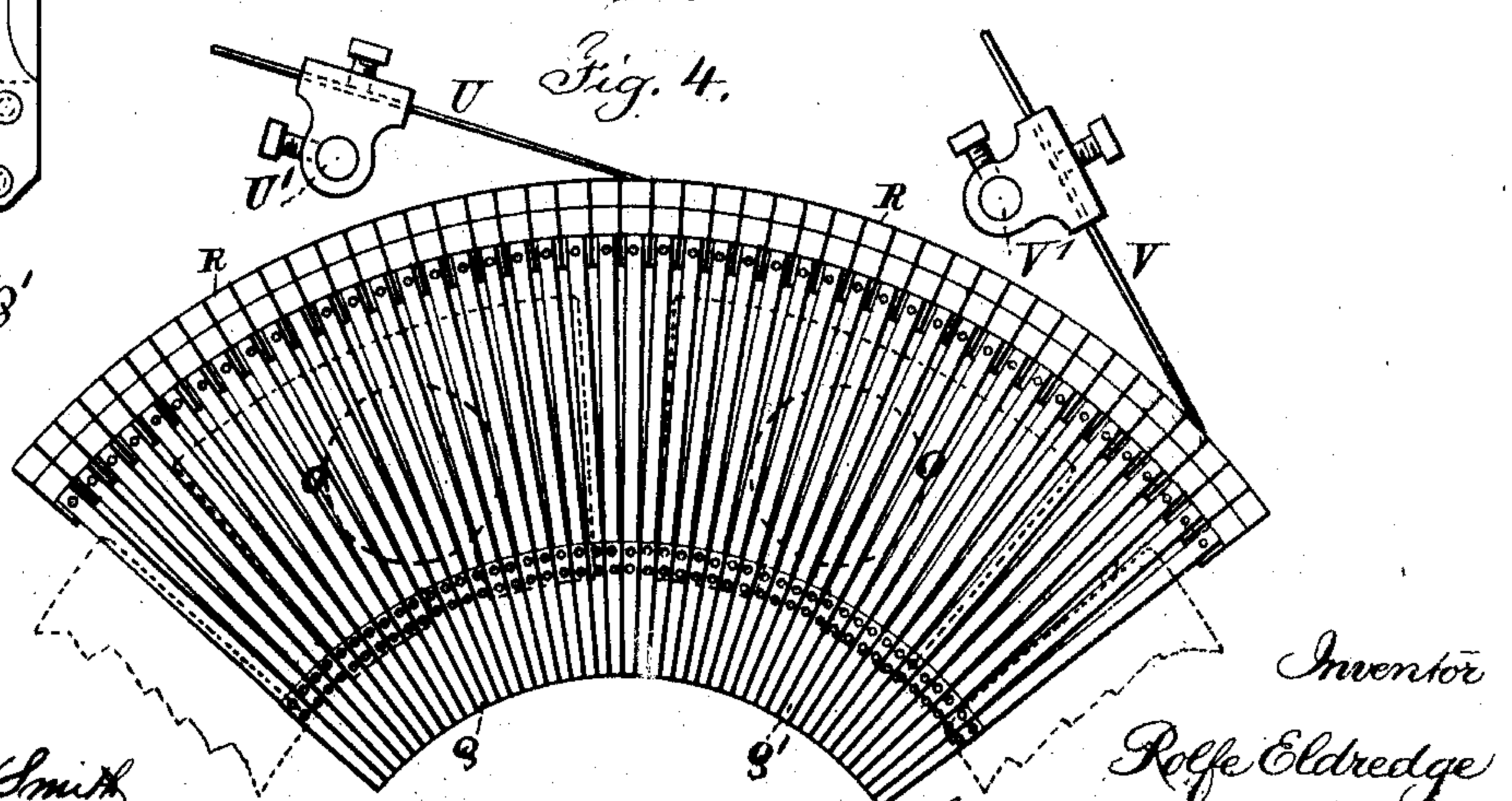


Fig. 4.



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(No Model.) 7 Sheets—Sheet 4.

R. ELDREDGE.

DYNAMO ELECTRIC MACHINE.

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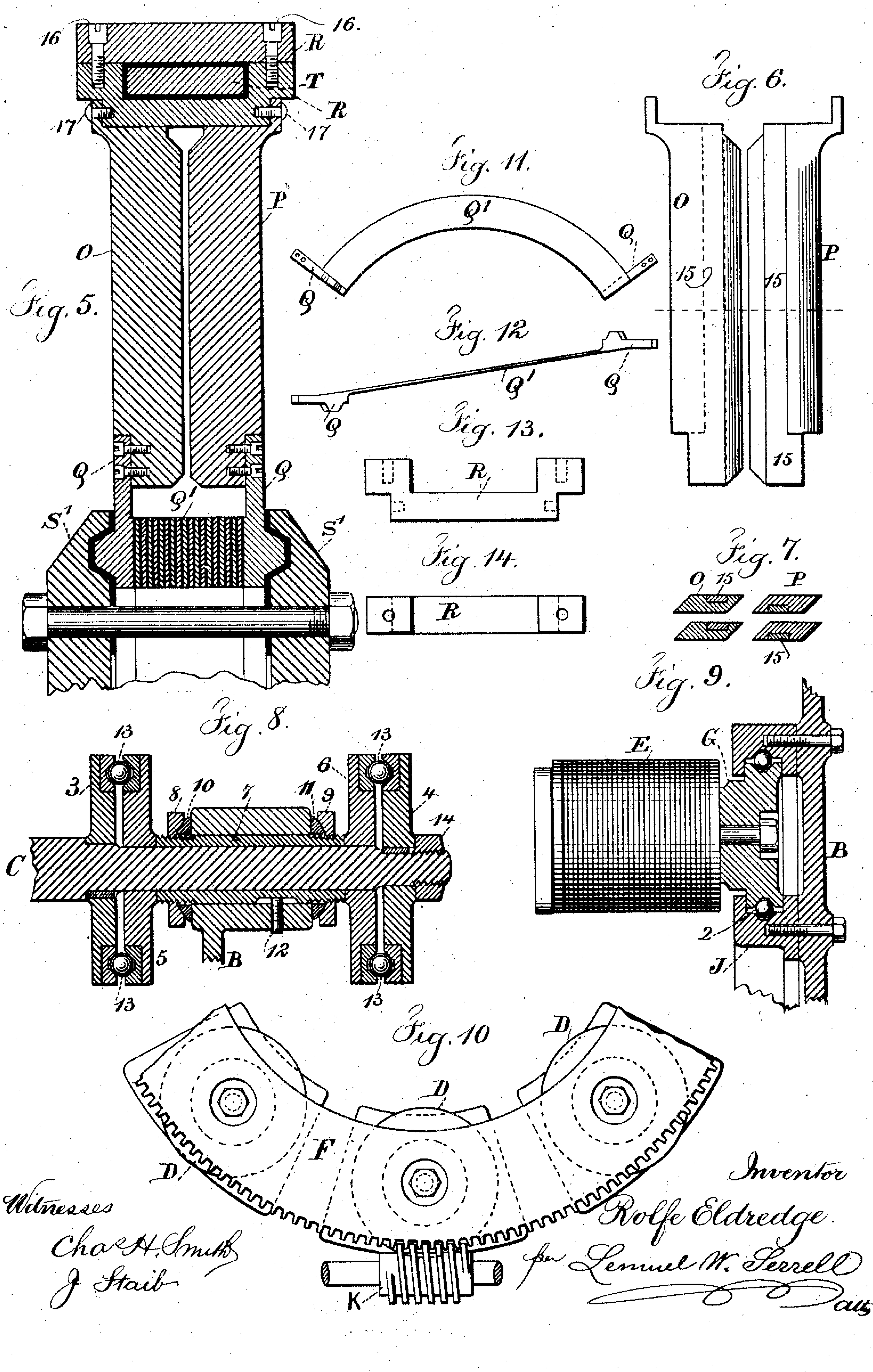

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R. ELDREDGE.

DYNAMO ELECTRIC MACHINE.

No. 504,914. Patented Sept. 12, 1893.

Fig. 15

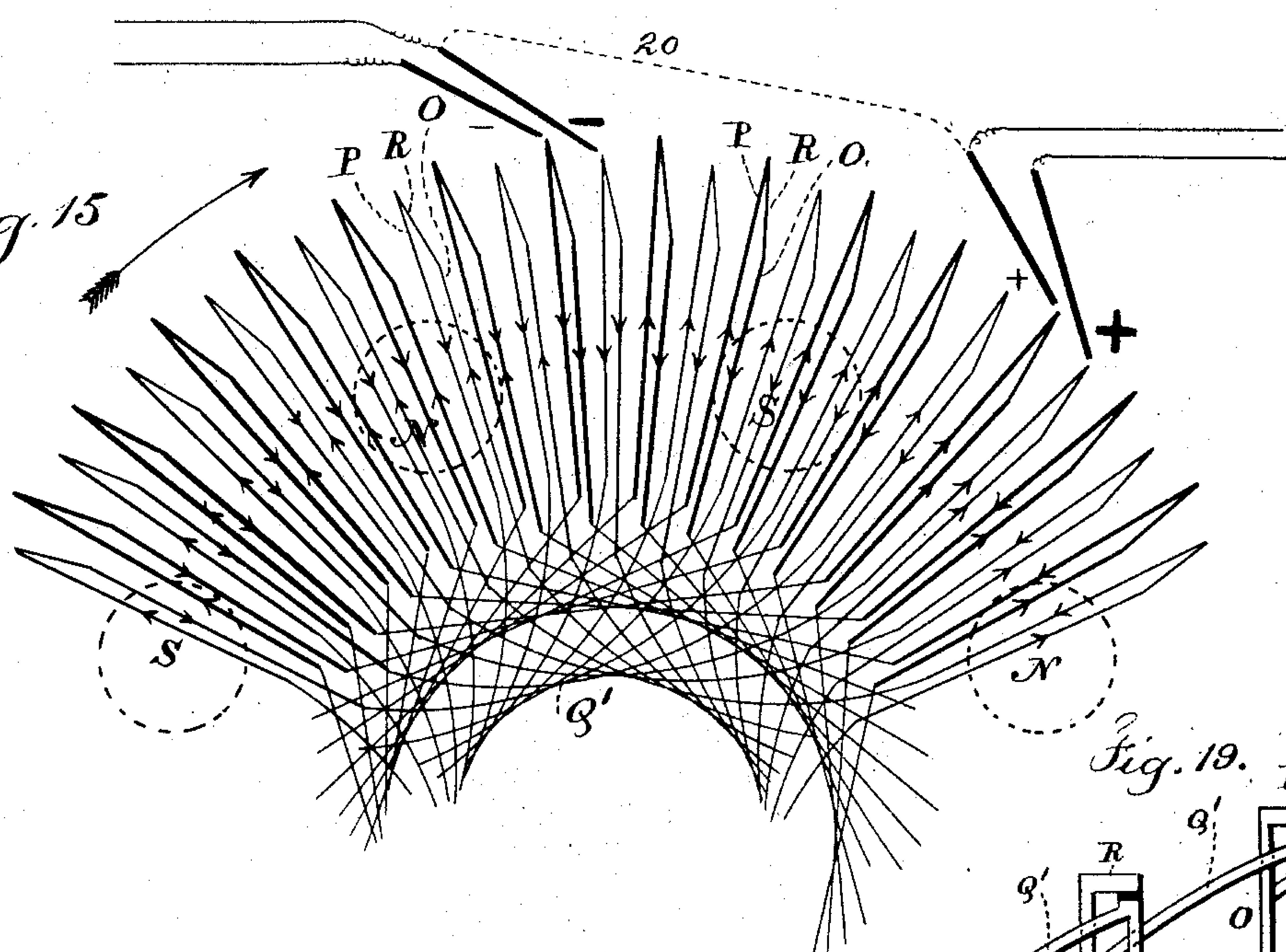

Fig. 19.

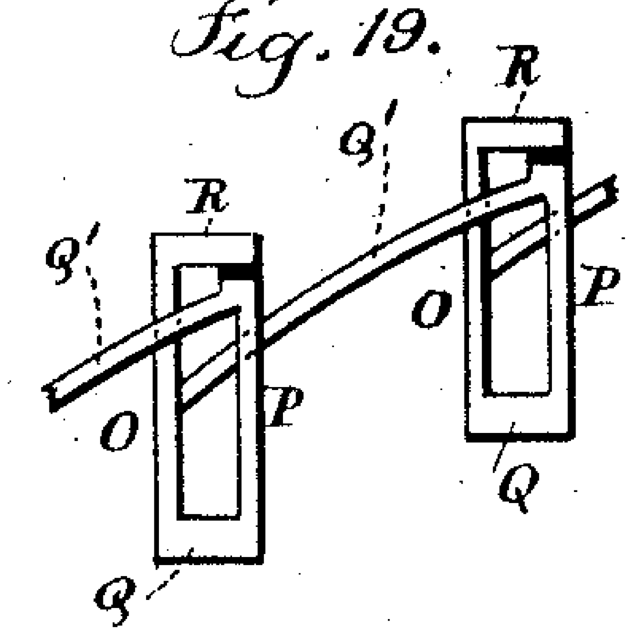

Fig. 16.

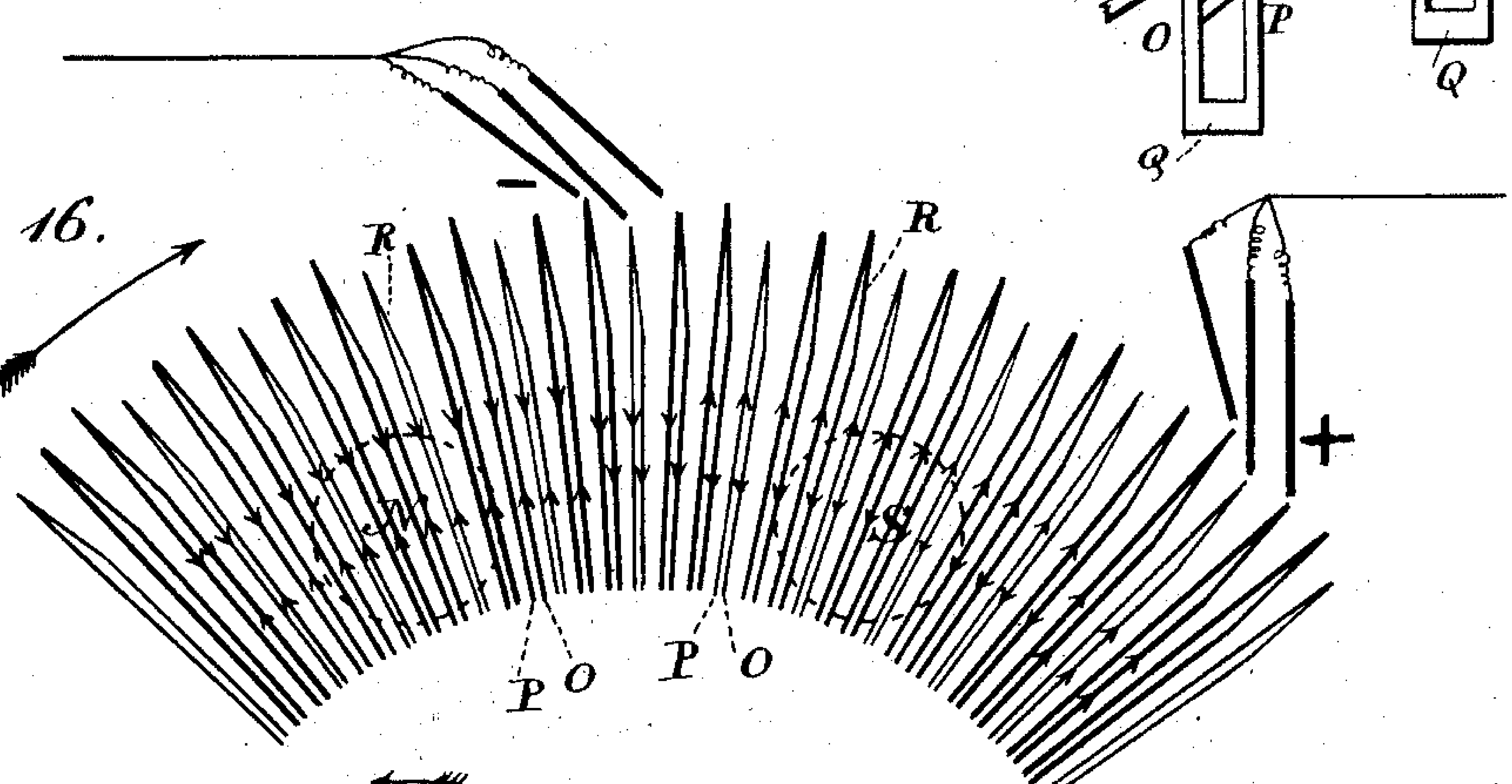

Fig. 17.

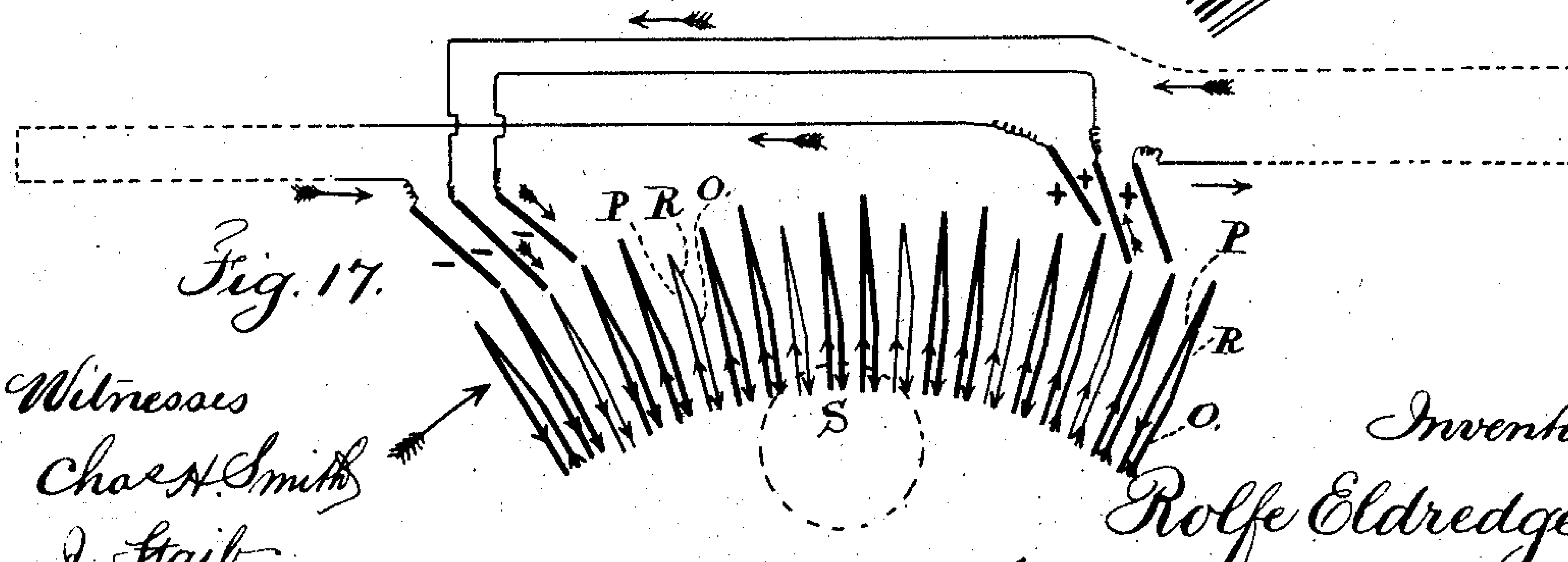

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Fig. 20.

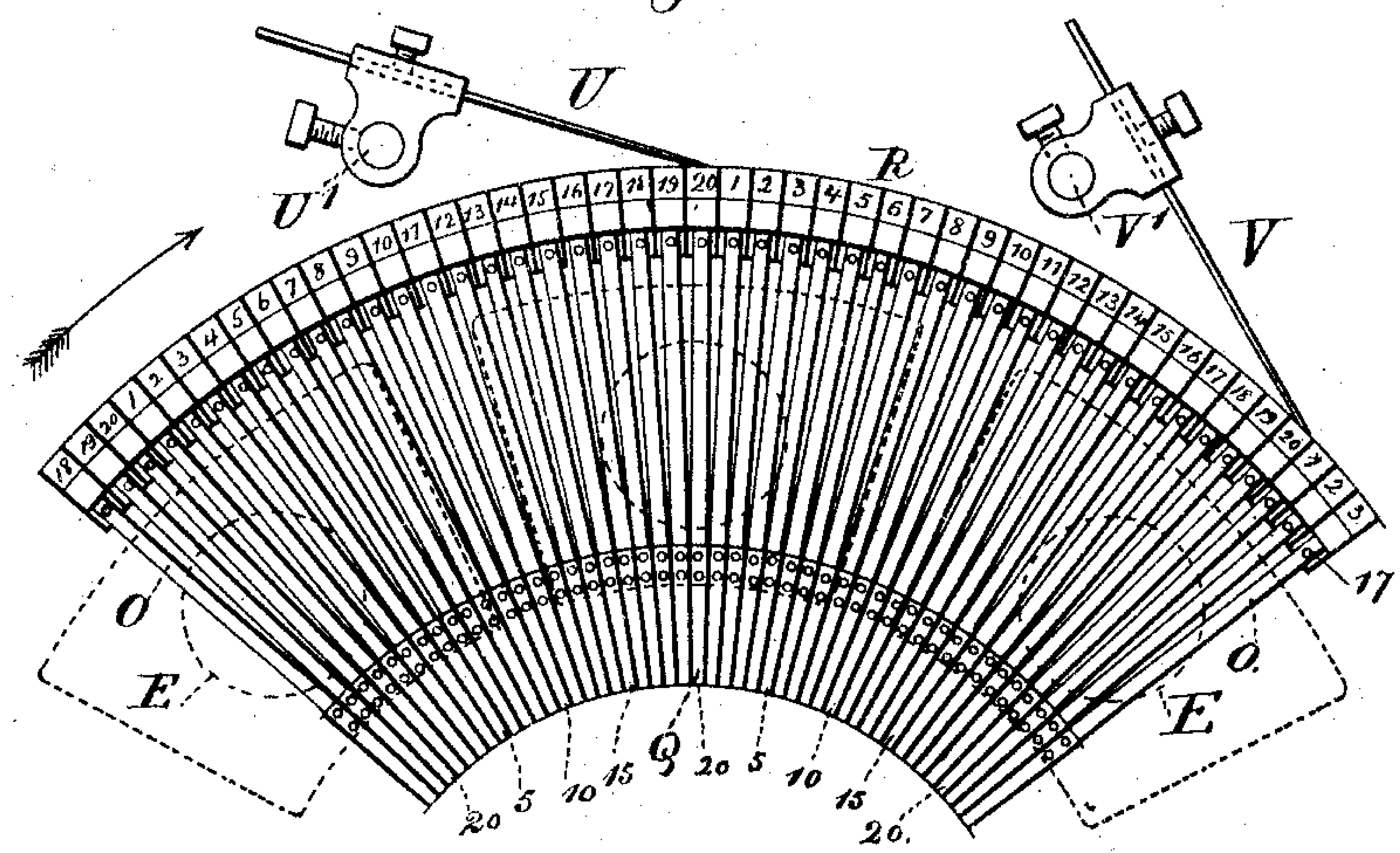


Fig. 21.

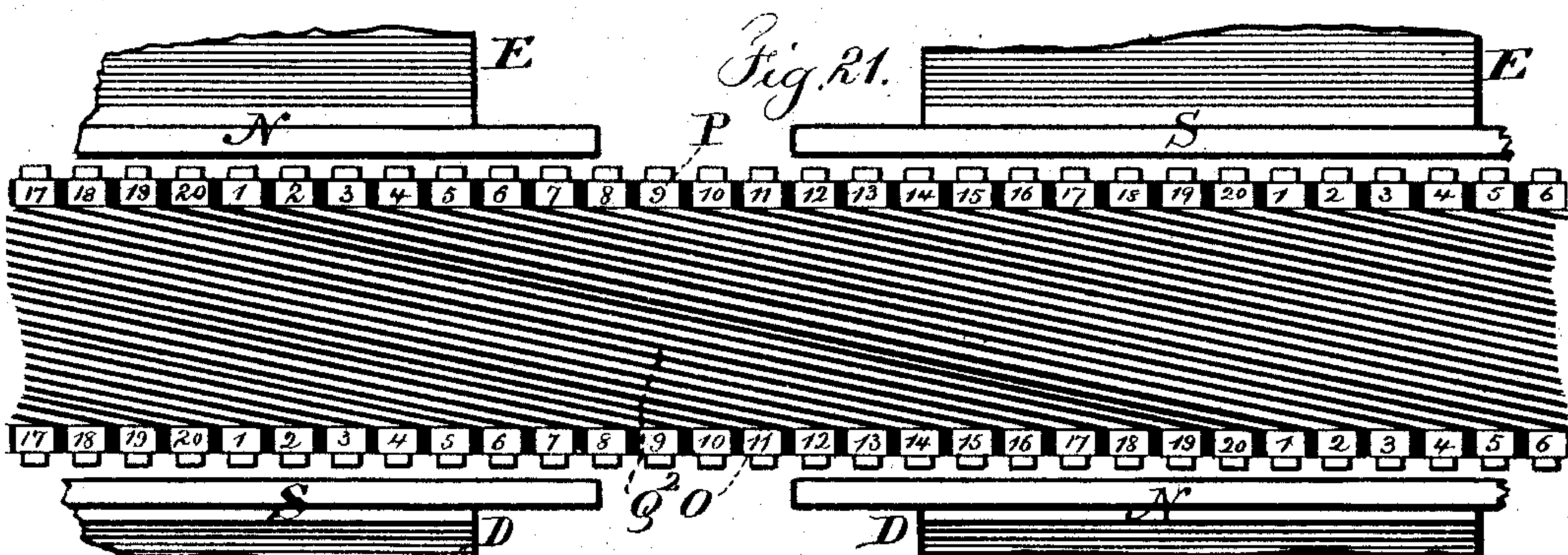
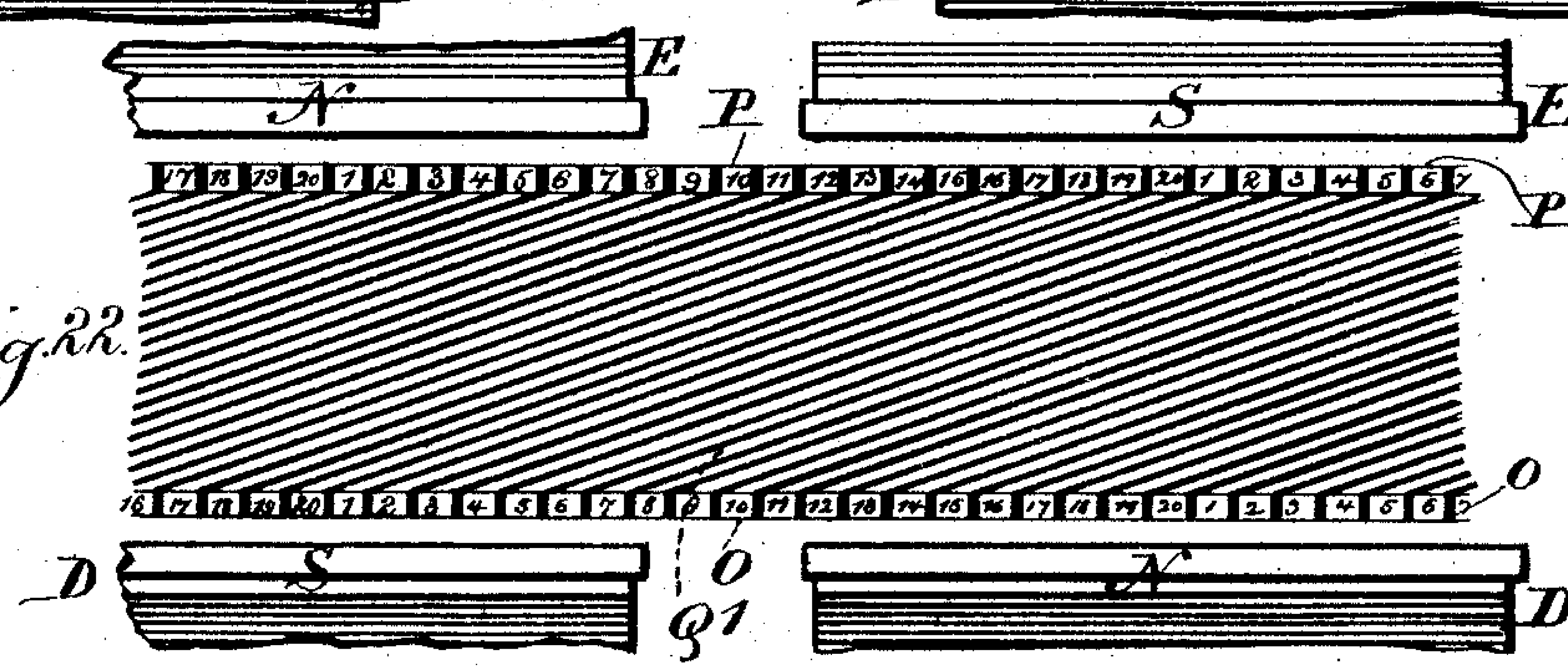


Fig. 22.



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atty

(No Model.) 7 Sheets—Sheet 7.

R. ELDREDGE.

DYNAMO ELECTRIC MACHINE.

No. 504,914. Patented Sept. 12, 1893.

Fig. 23.

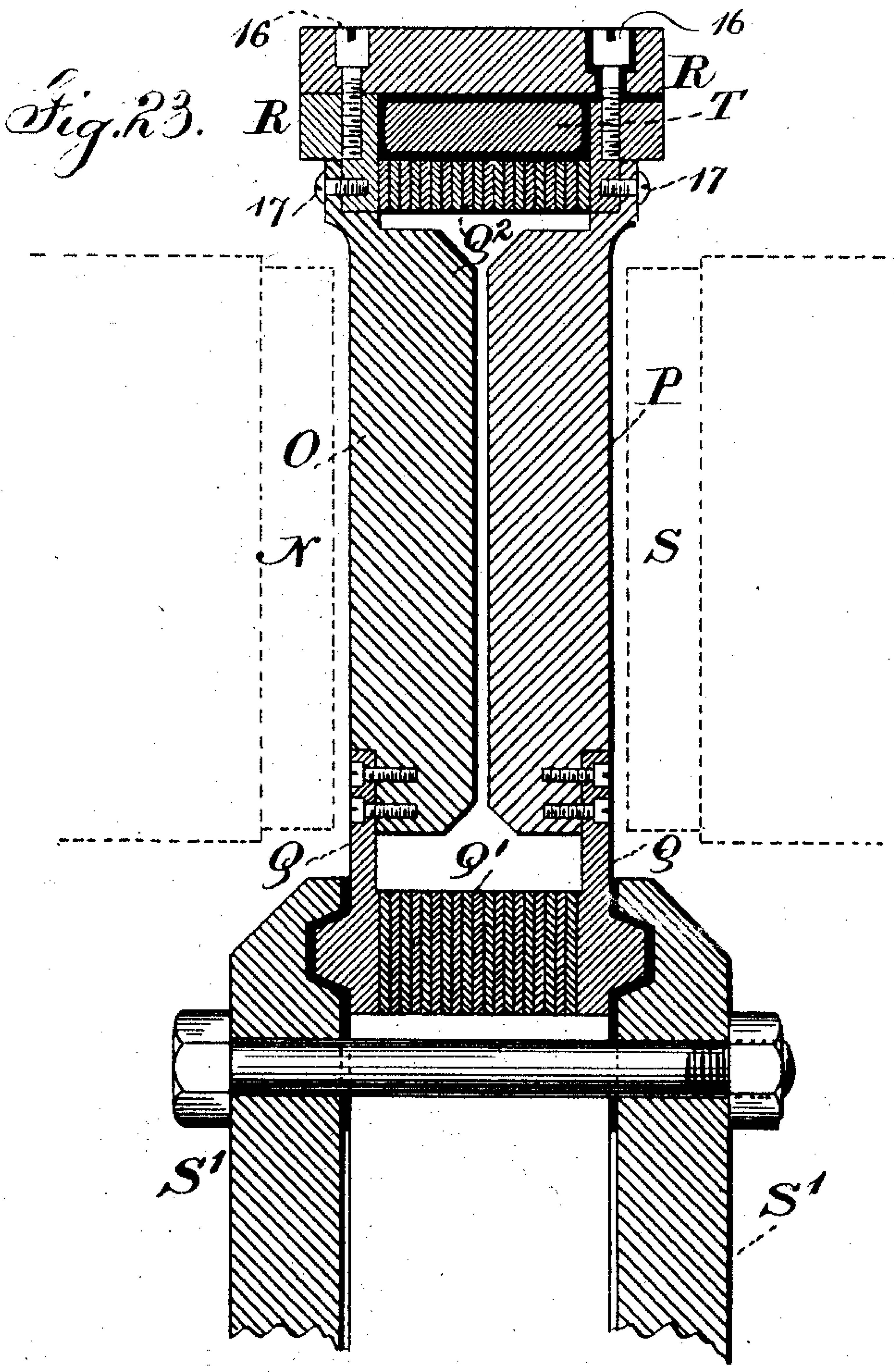


Fig. 24.

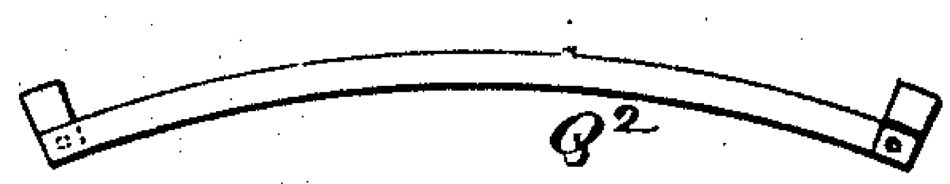


Fig. 25

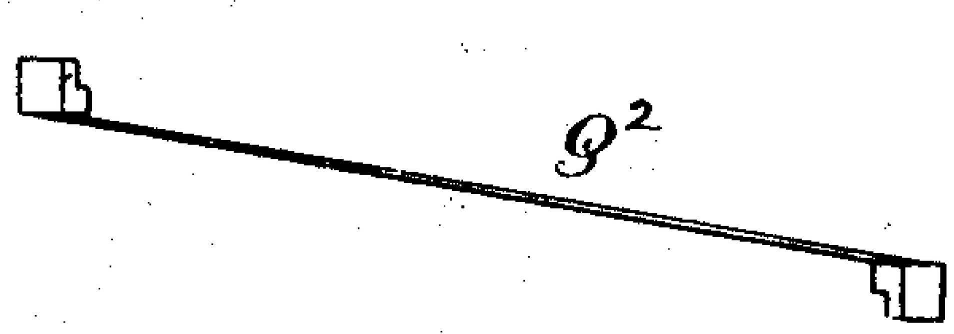


Fig. 26

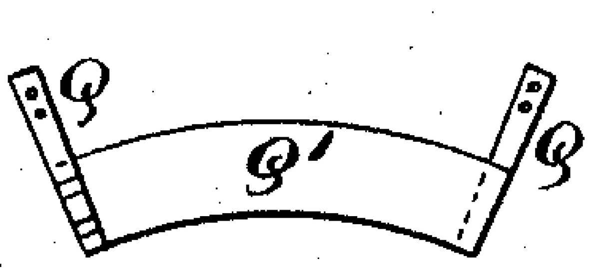
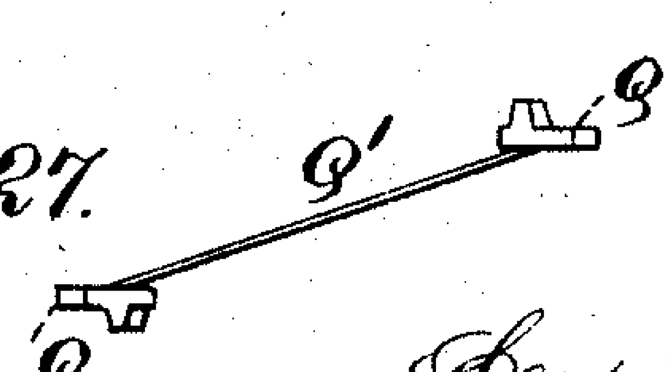


Fig. 27.



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UNITED STATES PATENT OFFICE.

ROLFE ELDREDGE, OF NEW YORK, N. Y.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 504,914, dated September 12, 1893.

Application filed May 13, 1891. Renewed June 3, 1892. Again renewed June 1, 1893. Serial No. 476,299. (No model.)

To all whom it may concern:

Be it known that I, ROLFE ELDREDGE, a citizen of the United States, residing in the city and State of New York, have invented an Improvement in Dynamo-Electric Machines, of which the following is a specification.

In my improvements the armature bars are made in two ranges or layers on the radial lines and they are connected up in such a manner that the current passes through the bars of the armature from one commutator brush to the other, and these bars are preferably of magnetic material usually soft iron and the armature is revolved between the pole pieces of opposing field magnets, but my improvements are available with an armature having radial bars of copper or other metal. By this arrangement I am able to reduce the magnetic resistance of the inter polar space by the soft iron of the armature and I dispense with the wires heretofore usually employed in armatures and lessen the risk of injury to such armature by burning out any portion thereof because the bars of the armature are of larger sectional area than the external conductors, and by this construction no core being needed, the false or Foucault currents, often set up in the armature, are avoided, and in arranging the field magnets, the polarity alternates and the south of one range is opposite the north of the other range when the dynamo is running at its full capacity, but these circular ranges of field magnets are variable in the position of one range in relation to that of the other range, or to the brushes, so that the energy of the field magnets on the armature and the current set up, can be lessened to any desired extent by a movement given to one or both ranges of field magnets to bring the pole pieces toward the place where the respective polarities will coincide thereby lessening the current set up in the bars of the armature.

In the drawings Figure 1 represents one range of field magnets, the armature being removed and the shaft in section at the line x, x, of Fig. 2. Fig. 2 is a vertical section of the machine a portion of the shaft being shown in elevation. Fig. 3 is a diagram illustrating the circuit connections through the armature. Fig. 4 is a side view of some of the armature bars. Fig. 5 is a section in larger size of a portion of the armature. Fig. 6 is an elevation of two of the armature bars detached. Fig. 7 is a cross section representing four of the adjacent armature bars. Fig. 8 is a section of the bearing at one end of the main shaft and Fig. 9 is a section of the field magnet ring having both internal and external supports. Fig. 10 is an elevation of a portion of one of the field magnet rings and of the screw pinion for turning the same. Fig. 11 is a side and Fig. 12 an edge view of one of the diagonal connecting bars of the armature. Figs. 13 and 14 represent the cross bars or blocks to which the outer ends of each pair of radial bars are connected, and Figs. 15, 16 and 17 are diagrams of modified circuit connections. Fig. 18 represents a side and edge view of the inner end of one of the radial bars of the armature illustrating a modification in the connection of said inner end to its block. Fig. 19 is a diagram representing the radial bars of the armature connected diagonally at their outer ends. Fig. 20 is a diagrammatic elevation of part of the armature similar to Fig. 4. Fig. 21 is a diagrammatic view of the connections between the outer ends of the armature bars, and Fig. 22 is a similar view of the connections between the inner ends of such armature bars. Fig. 23 is a section similar to Fig. 5, but with the connections between the ends of the armature bars that are illustrated in Figs. 21, 22. Figs. 24 and 25 show the segmental connections for the outer ends of the bars, and Figs. 26 and 27 show the segmental connections for the inner ends of the bars.

The frames A and B are of suitable size and adapted to receive the other parts of the machine and the armature shaft C passes across the machine and centrally of the frames and there are two ranges of field magnets D and E the range of magnets E being supported by the frame B and the range of magnets D being supported by the frame A. Each range of magnets is upon a supporting ring, the magnets D being on the ring F and the magnets E being on the ring G. Each of these rings is by preference made of two parts and bolted together as shown at H and there are circular bearings for the respective rings F and G, the bearing I receiving the ring F and the bearing J the ring G. These bearings are preferably of bronze or other non-magnetic material. These circular bearings I and J are permanently bolted to the respective frames A and B and they are grooved upon their peripheries for the reception of the inner circular flanges of the respective rings F and G so that such rings F and G can be rotated more or less upon their circular bearings, and it is preferable to groove the respective adjacent faces for the reception of the balls 2 so that the friction of the parts may be lessened, and upon the periphery of the ring F there are teeth engaging the screw pinion K the shaft of which is held in suitable bearings upon the frame A and such screw pinion may be rotated by a hand wheel K′ or by other suitable means. If the circular range of field magnets E is in a fixed position, the circular range of field magnets D can be rotated by the screw pinion K to bring the poles opposite to the poles of the magnets E for exerting the maximum magnetic influence upon the armature revolving between the pole pieces. If the armature bars and connections are arranged as shown in Figs. 3, 15, 16, and 17, the maximum effect will be produced by similar poles being opposite to each other. If the armature bars and connections are arranged as shown in Figs. 20, 21, and 22, the maximum effect will be produced when opposite poles face each other. By the movement of one range of poles in relation to the other, or by moving one or both range of poles in relation to the brushes the magnetic field will be varied and the current set up in the armature will be increased or lessened. I avail of this variation in the relative positions of the two circular ranges of field magnets for varying the electro motive force of the machine, and this may be effected automatically by making use of a solenoid L with a core M one of these being attached to the frame and the other to one of the field magnet rings. I have represented the solenoid L as fastened to the frame B and the core M as connected with the field magnet ring G and the electric circuit in the machine is connected so as to include the solenoid helix L in a shunt or in series with the external circuit from the dynamo so that this solenoid moves the ring G in one direction and the spring N′ moves the said ring G in the other direction, and the tension of this spring N′ is to be adjusted so that the poles of the respective field magnet ranges will be brought opposite to each other or nearly so and of opposite polarity when the maximum power of the dynamo is required from the armature as connected in Figs. 21, 22, 23 and such opposite poles will be moved away from each other according to the electro motive force required in the external circuit, and to prevent sudden movement, a dash pot or other known regulator may be used. It is important that the armature disk shall be revolved in close proximity to the pole pieces of the field magnets, and such armature must occupy an accurate position equi-distant from the respective pole pieces, especially when the bars of the armature are of soft iron; otherwise the magnetic attraction will move the armature disk toward the nearest field magnets, giving an end motion to the shaft and causing great friction thereof in the bearings, or else causing the armature to stop by contact with the pole pieces.

To adjust the armature shaft and armature with accuracy and to lessen the friction, I make use of the disks 3 and 4 permanently fastened to the armature shaft C and the disks 5 and 6 loose thereon and at opposite ends of the stationary bearing or journal box 7 which journal box 7 passes through the frame B, and is provided with clamping nuts 8 and 9 and preferably with conical washers 10 and 11, and to prevent the journal box 7 rotating in the frame B there is a screw 12 passing into a groove in such journal box 7. The opposite faces of the pairs of disks 3 5—6 4—are usually grooved circularly for the reception of balls 13 by which friction is lessened, and it is to be understood that by the nut 14 upon the end of the shaft C the parts can be tightened up so that there will not be any looseness between the pairs of disks or between the disks 5 and 6 and the ends of the journal box 7, but such nut 14 must not be set up so tight as to produce unnecessary friction, and by the nuts 8 and 9 that are screwed upon the journal 7 such journal 7 can be moved endwise within the frame B so as to adjust the armature accurately to its position between the circular ranges of field magnets, and it is advantageous to make use of the conical washers 10 and 11 between the nuts and the surfaces of the frame B to insure a perfect alignment of the shaft in the frame. By this arrangement the shaft C and armature are free to revolve with but little friction, and any end thrust is taken upon the balls 13 and the parts can be adjusted to bring the armature disk accurately between the poles of the field magnet, so that the magnetic attractions on the armature are balanced axially. It is advantageous to apply this attachment at one end of the shaft C and to allow the shaft C to pass through a plain bearing or journal box in the frame A so that the driving pulley may be placed upon the armature shaft C adjacent to the frame A, or the engine can be connected to this end of such shaft. The armature bars occupy two parallel planes perpendicular or nearly so to the axis of the armature and being of soft iron they reduce the resistance of the interpolar space between the field magnets.

In the diagram Fig. 3 I have illustrated by two ranges of bars the mode of connecting the same and the relative positions of the armature bars to one range of field magnets. In this diagram the heavier radial lines indicate the respective bars O and P and the diagonal lines the bars or segments R, and the connections at the inner ends are made by metallic plates Q′ insulated from each other and passing diagonally from one segmental block O to an opposite block Q which connections are indicated in Fig. 3 by the arcs of circles. The segmental blocks Q are connected to the lower ends of the respective radial bars O and P in any suitable manner. I prefer and have represented screw connections, and these blocks Q are preferably of copper or other metal of superior conductivity, and the thicknesses of the diagonal plates Q′, shown in Figs. 11 and 12, are to be such that said diagonal plates Q′ and the insulating material between them will fill up the space between the segmental blocks Q as they are clamped between the heads S′. By following out the lines in the diagram Fig. 3 it will be observed that the circuit connections pass in two lines through the armature, the current entering through the − brush U and passing to the + brush V in two routes, and this is accomplished in consequence of the number of pairs of armature bars not being a multiple of the number of field magnets. In this diagram eight field magnets are represented and thirty-nine pairs of armature bars O and P; but the number may be varied, and by reference to the arrow indicating the direction of rotation, and considering that the bars P revolve adjacent to the field magnets represented and that the bars O revolve adjacent to the opposite field magnets, it will be seen by the arrow heads upon the respective armature bars, that each pair of bars contributes its quota to the current set up in the entire armature and the current is taken off at the + and − brushes upon or near to the neutral lines of two pairs of field magnets. This neutral line corresponds generally with the minimum magnetic field between the pairs of field magnets as usual in machines of this class.

It will be apparent that if twice the number of bars were employed in the revolving armature, as indicated in the diagram Fig. 15, two pairs of independent brushes might be made use of, and connected to independent external circuits; or these brushes might be connected up for intensity as indicated by the dotted line 20.

Figs. 16 and 17 show method of constructing armatures with three independent sets of bars which may be connected up as in Fig. 16 for quantity, or two independent circuits may be taken from the armature as shown in Fig. 17 where two pairs of brushes are so connected that two sets of bars are in series thus doubling the electro motive force induced in a single set, and a second independent circuit from a single set of bars is shown as taken off the armature by the third set of brushes. When all the sets of bars are connected in series through the brushes the electro motive force will be augmented. In Figs. 16 and 17 it is to be understood that the armature bars are connected up into three groups instead of two groups as indicated in Fig. 15. It will be discovered that there are two complete metallic routes through the armature from each − to each + brush. Hence the resistance of the armature is reduced to a minimum; and these armature bars O and P are large and offer but little resistance, and when of iron there is but little resistance in the interpolar space. The bars O and P may either be tapering or parallel and the portions Q which form the insulated segments are preferably tapering as seen in Fig. 4 so as to set closely against the mica or other insulating material introduced between the segmental blocks Q and the arc bars Q′.

If the armature bars O P are made of iron throughout their length there may be a risk of their becoming heated near their inner ends. To obviate this difficulty the segmental block Q and the branches extending therefrom to the respective armature bars O and P are preferably of copper or similar metal of high conductivity in order that the resistance in the armature may be lessened and these branches may be extended along within grooves in the respective armature bars as seen at 15 Figs. 6, 7 and 18. This construction also lessens the Foucault currents that might result from induction or from polarity in the iron armature bars.

The mode of securing the inner insulated segmental blocks Q may be varied. I prefer to introduce layers of mica between the respective segmental blocks Q and their branches and also between the ends of these segmental blocks and the clamping disks S′ as shown in Figs. 2 and 5 and by tapering the ends of the segmental blocks Q and grooving the disks S′ a very firm connection is effected by simply clamping the disks S′ to the ends of the segmental blocks Q.

The outer ends of the bars O and P are to be connected to the segments R in any desired manner. I however prefer to make the segments R in two parts screwed together by the screw 16 and the outer ends of the respective bars O and P are screwed to the inner halves of the segments R by the screw 17 and the tire T may be of aluminum bronze or other suitable material without insulating material surrounding the same within the segments R, and these segments R are insulated from one another by layers of insulating material such as mica or hard rubber.

In connecting up the dynamo, the circuits may be arranged in any desired manner. It is preferable to place the coils of the field magnet in a shunt around the armature and this shunt may contain all of the field helices or there may be two or more shunt circuit connections containing the field helices in groups, or the field helices may have compound winding.

When this dynamo is rotated there is a tendency to revolve the group of field magnets with their rings in the direction of rotation, in consequence of the magnetic attraction, and the spring N′ or its equivalent a weight, should be sufficient to rather more than counteract this tendency. For this reason when the machine is at rest the range of field magnets at one side will be drawn behind the axial line of the field magnets on the other side, and when the machine is started there will be but little resistance to overcome and as the intensity of the magnetic attraction increases with the current, the spring N′ will be distended until the maximum electromotive force is obtained, and by placing the helix of the solenoid L in multiple arc, or in a shunt of the external circuit, the movable range of field magnets can be easily varied in its position according to the current required in the external circuit; and I also remark that in cases where both ranges of field magnets are provided with springs (the screw pinion K being dispensed with), the said springs N′ may rotate the field magnets in relation to the stationary commutator brushes so that when the machine is started, such brushes will not coincide with the neutral line and as the intensity of the magnetic fluid increases and the ranges of field magnets are moved by the magnetic attraction in the direction of the rotation of the armature, the said field magnets will be brought to such a position in relation to the brushes as to obtain the maximum current without corresponding fall in voltage. By making the iron armature bars with grooves in them as seen in Figs. 6 and 7 the copper connections 15 can be extended along in such armature bars a greater or less distance and on one or both sides so as to promote the conductivity without materially interfering with the magnetic action. The bars of the armature being inclined in opposite directions on their edges as seen in Figs. 6 and 7 act like a fan blower to cause a current of air to pass through between the armature bars to keep the same cool.

It is advantageous to cast the armature bars of an alloy of iron and aluminum to lessen the cost of construction, and in consequence of the commutator bars being at the outer ends of the pairs of armature bars, they are easy of access for turning off or replacing without dismembering the machine, but I do not limit myself to the manner in which the commutator bars are applied on the armature. The number of pairs of brushes may equal the number of like poles on one range of field magnets, but the electro motive force will be proportionately lowered.

The diagram Fig. 19 represents the relative positions of the parts when the diagonal connections Q′ are at the outer ends of the bars O P instead of being at the inner ends. In this arrangement the operations will be precisely the same, but the commutator bars R will be insulated at one end from the range of bars P as indicated in the diagram.

Figs. 20 to 27 more fully illustrate the device shown in Fig. 19, when inner insulated segments are used as shown in Fig. 5 as well as the outer insulated segments. The construction of the armature in these figures does not vary from that before described nor the mode of its operation, but when the field magnets alternate N S in the range and a north is opposite to a south, as indicated in Fig. 21, it is advantageous to make the outer segmental bars Q^2 Figs. 24 and 25, of a length to extend from the bar that is opposite to a north field at one side, to the bar that is opposite the north field on the other side, and to connect the inner segmental bars Q′, Figs. 26, 27, at the opposite angle as seen in Fig. 22. The object of this manner of connecting the outer and inner segmental bars is to divide up the segmental bars by making the diagonal connections in opposite directions at the respective ends instead of having the diagonal connections at either the outer or inner ends only, and to adapt the parts to the shorter magnetic circuit between the opposite poles of the field magnets. The respective numbers put upon the bars Figs. 21, 22, indicate clearly which bars are connected to each other, and the numbers of armature bars and their connections to form two routes for the current through the armature are as before described. The armature bar passing at one side in front of a north field has a current set up in the opposite direction to a bar on the other range passing in front of a north field and so on. Hence it is advantageous to connect these bars by the segments Q′, Q^2 in the diagonal directions shown in order that the poles of the field magnets may alternate N and S around the circular range and that the north in one range may be opposite to the south in the other as seen in Fig. 21. In all cases the currents are taken by the brushes at the commutator blocks at the places where the currents converge and diverge respectively.

I claim as my invention—

1. The combination in a dynamo electric machine of a revolving disk armature and its shaft, two opposite circular ranges of field magnets, frames and movable rings for supporting such ranges of field magnets, and adjusting devices for changing the relative position of one range of field magnets to the opposite range of field magnets for varying the intensity of the interpolar field, substantially as set forth.

2. The combination with a revolving disk armature and its shaft, of the frame for supporting such shaft and the field magnets, two opposite circular ranges of field magnets rings for connecting such ranges of field magnets, circular bearings upon the frames for receiving such rings and means for varying the position of one range of field magnets in relation to the other range of field magnets, substantially as set forth.

3. The combination in a dynamo electric machine, of a disk armature and its shaft and the frames of the machine, two circular ranges of field magnets of alternate polarity in each

range and opposite polarity in the magnets that face each other, rings for supporting the respective ranges of field magnets and an adjusting mechanism for varying the position of such circular ranges in relation to each other or to the commutator brushes, substantially as set forth.

4. The combination in a dynamo electric machine of a revolving armature, its shaft, the frames of the machine, a circular range of field magnets connected to the frame, a second circular range of field magnets, a movable ring for supporting the same and a spring for holding the movable range of field magnets and allowing such range of field magnets to partially revolve under the action of the magnetism, substantially as set forth.

5. The combination with a revolving armature, its shaft and the machine frames, of two circular ranges of field magnets, circular supports for the respective ranges of magnets and an electro magnet for controlling the position of one range of field magnets in its relation to the other range of field magnets, substantially as set forth.

6. The combination with the revolving armature, its shaft and the frames, of two circular ranges of field magnets circular supports for such field magnets upon which one range of field magnets can be partially revolved, a spring or equivalent for acting upon such circular range of field magnets in one direction and an electro-magnet for varying the power exerted in partially rotating such range of field magnets, substantially as set forth.

7. In a dynamo electric machine, two circular ranges of field magnets facing each other, in combination with a revolving armature composed of two ranges of bars of magnetic material, segmental connections at the outer and inner ranges of such armature bars, and bars of copper or similar metal of superior conductivity uniting the inner ends of the armature bars with the inner segments, substantially as set forth.

8. The combination in a revolving armature, of clamping disks upon the shaft, inner segments with inclined ends received and held by such clamping disks, there being insulating material between the parts, two ranges of armature bars and connections at their inner ends to the inner insulated segments, outer insulated segments connecting the outer ends of the armature bars and forming the commutator plates and an insulated tire connecting the outer segments together, substantially as set forth.

9. The combination in an armature, of armature bars of magnetic material, outer segments to which the ends of the armature bars are connected and an insulated tire between the parts of the outer insulated segments and to which such segments are clamped, inner connections between the armature bars, and an armature shaft and disks for supporting the armature bars, substantially as set forth.

10. The combination in a revolving armature, of a range of armature bars of soft iron or other magnetic material, each tapering inwardly, and connecting plates of copper or similar metal of superior conductivity fastened to the inner parts of such iron armature bars, substantially as set forth.

11. The combination with two circular ranges of field magnets, of an armature disk composed of bars of magnetic material in two ranges and connected up to form a closed circuit, substantially as specified, with two routes through the armature for the passage of the current to the respective commutator brushes, substantially as set forth.

12. The combination in a dynamo electric machine of radial bars O P outer insulated segments R connecting such radial bars O P an insulated tire within such range of outer insulated segments, the inner insulated segments Q and the insulated arc bars Q′ passing diagonally from one range of radial armature bars to the other, substantially as set forth.

13. The combination with stationary field magnets in two circular ranges, of an armature between the ranges of field magnets said armature being composed of radial bars connected in pairs at their outer ends and diagonal connections at their inner ends, the number of pairs of armature bars not being a multiple of the field magnets and being connected to form two metallic circuits through the armature bars from the negative to the positive brushes, substantially as set forth.

Signed by me this 11th day of May, 1891.

ROLFE ELDREDGE.

Witnesses:

GEO. T. PINCKNEY,

CHAS. H. SMITH.