No. 788,291. PATENTED APR. 25, 1905.

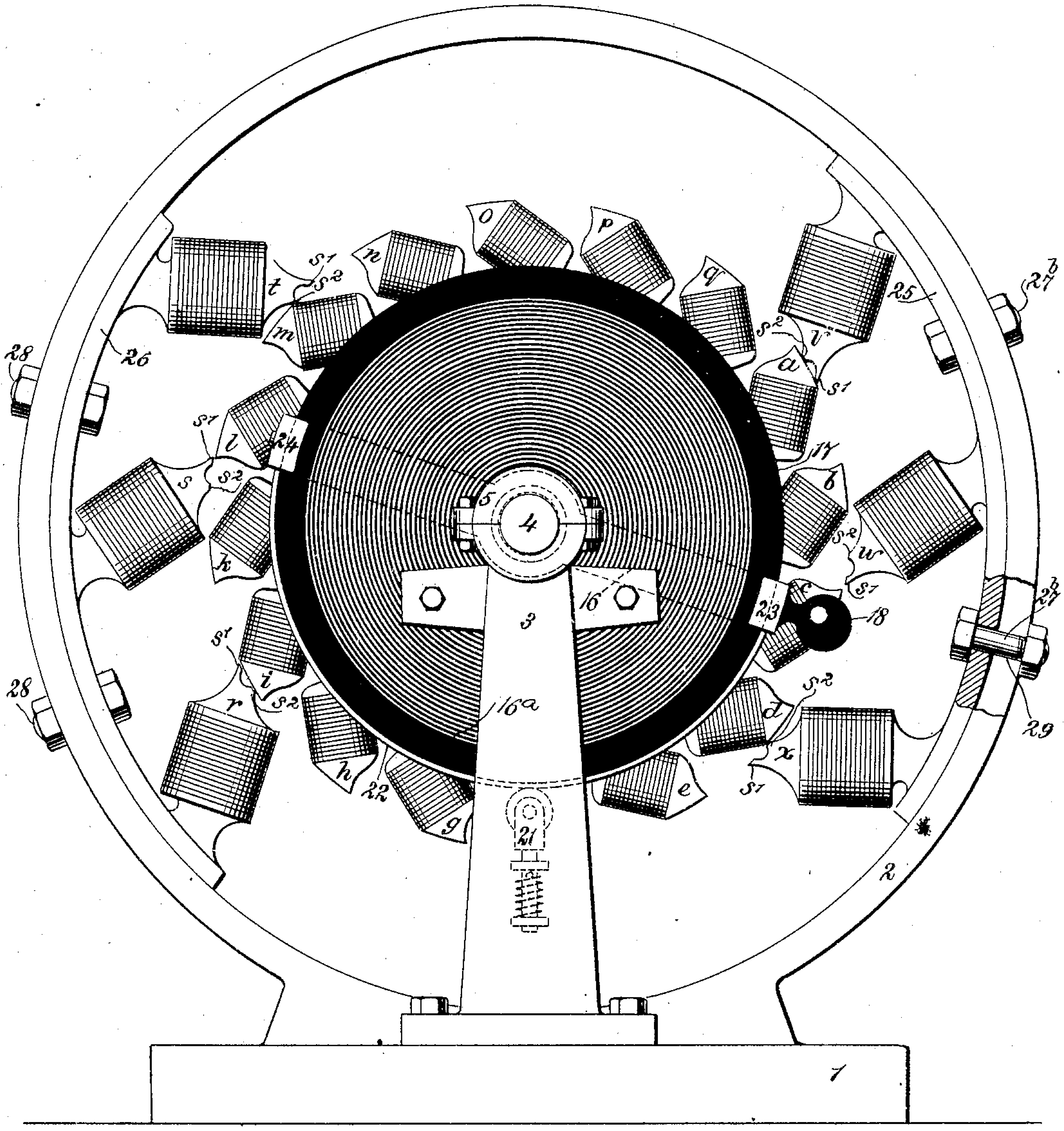
J. A. TITZEL, Sr.

DYNAMO OR MOTOR.

APPLICATION FILED NOV. 9, 1901.

5 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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5 SHEETS—SHEET 2.

Fig. 2,

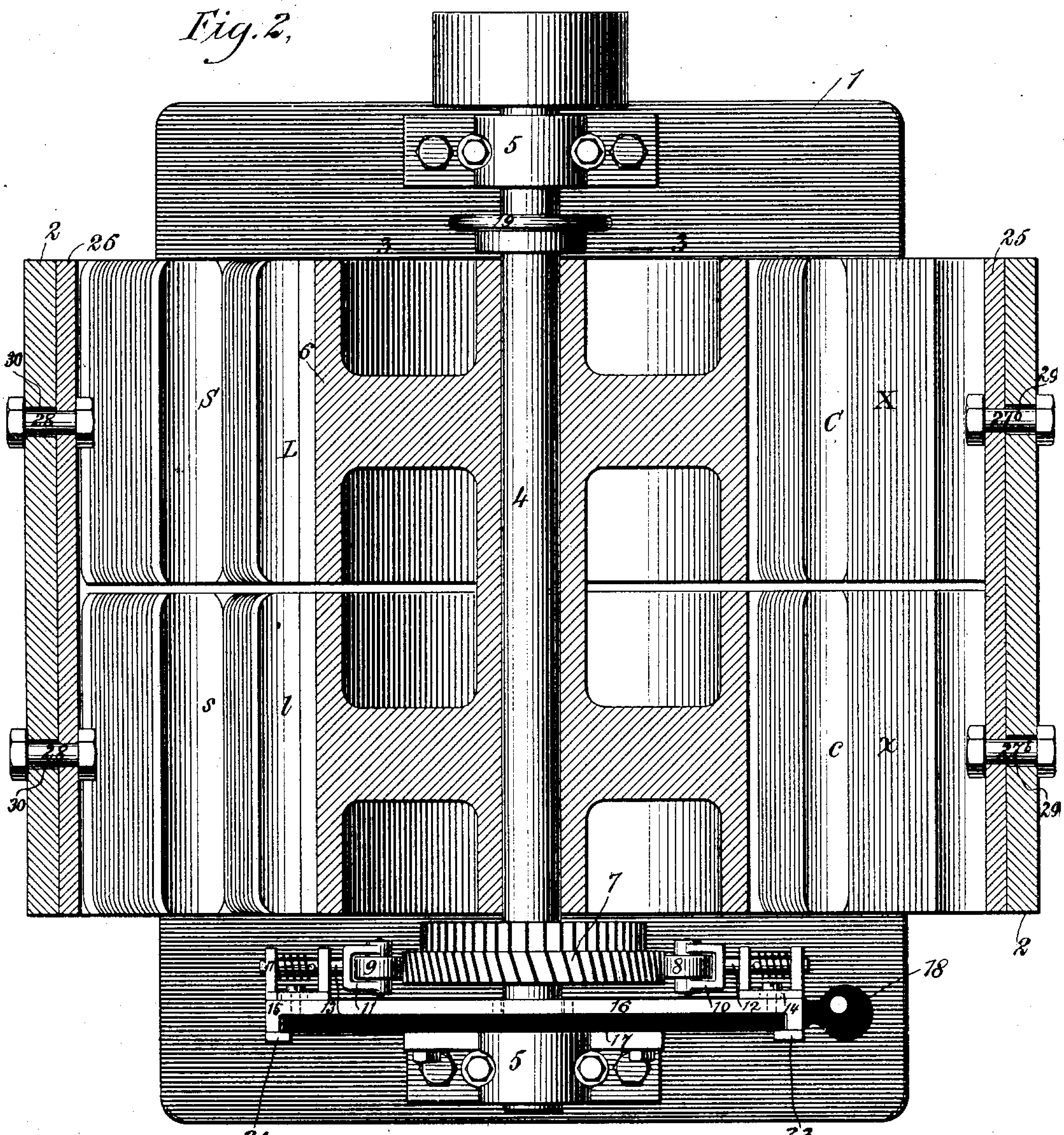
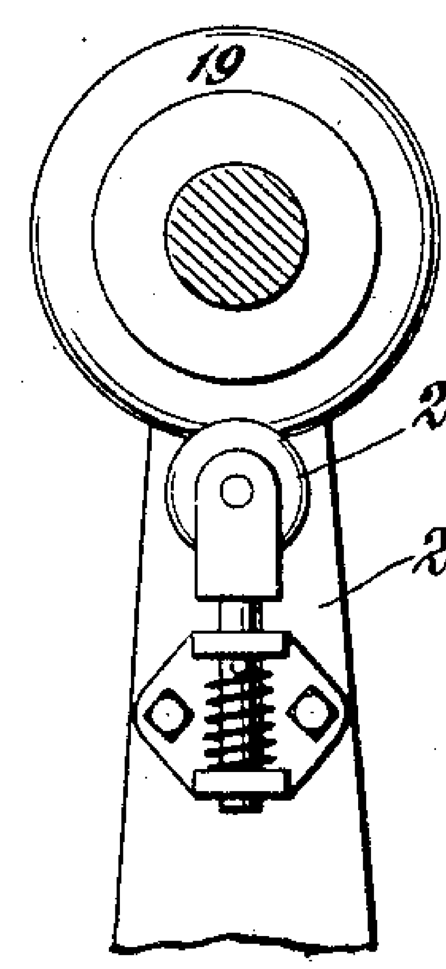


Fig. 3,



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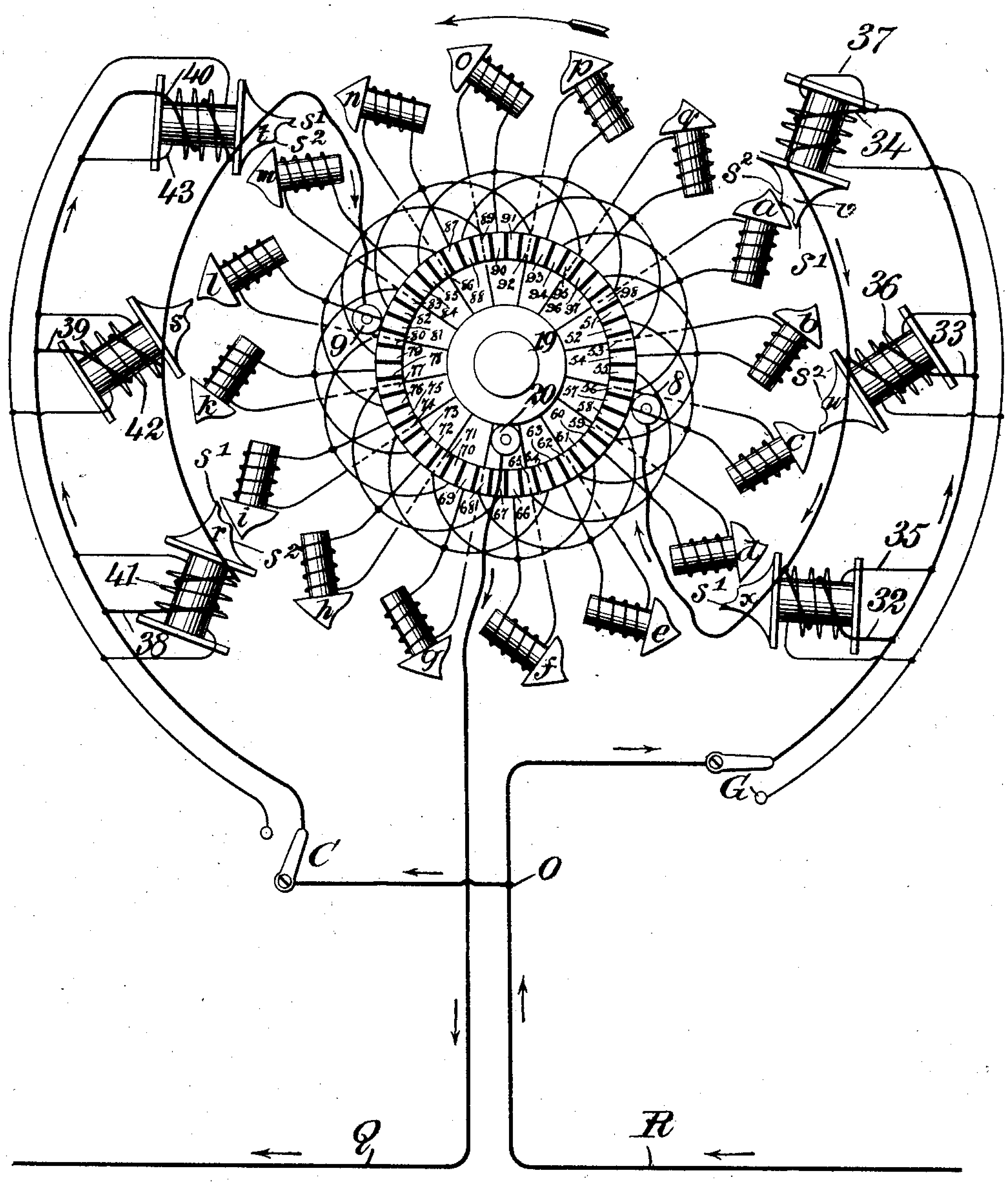
5 SHEETS—SHEET 3.

Fig. 4.



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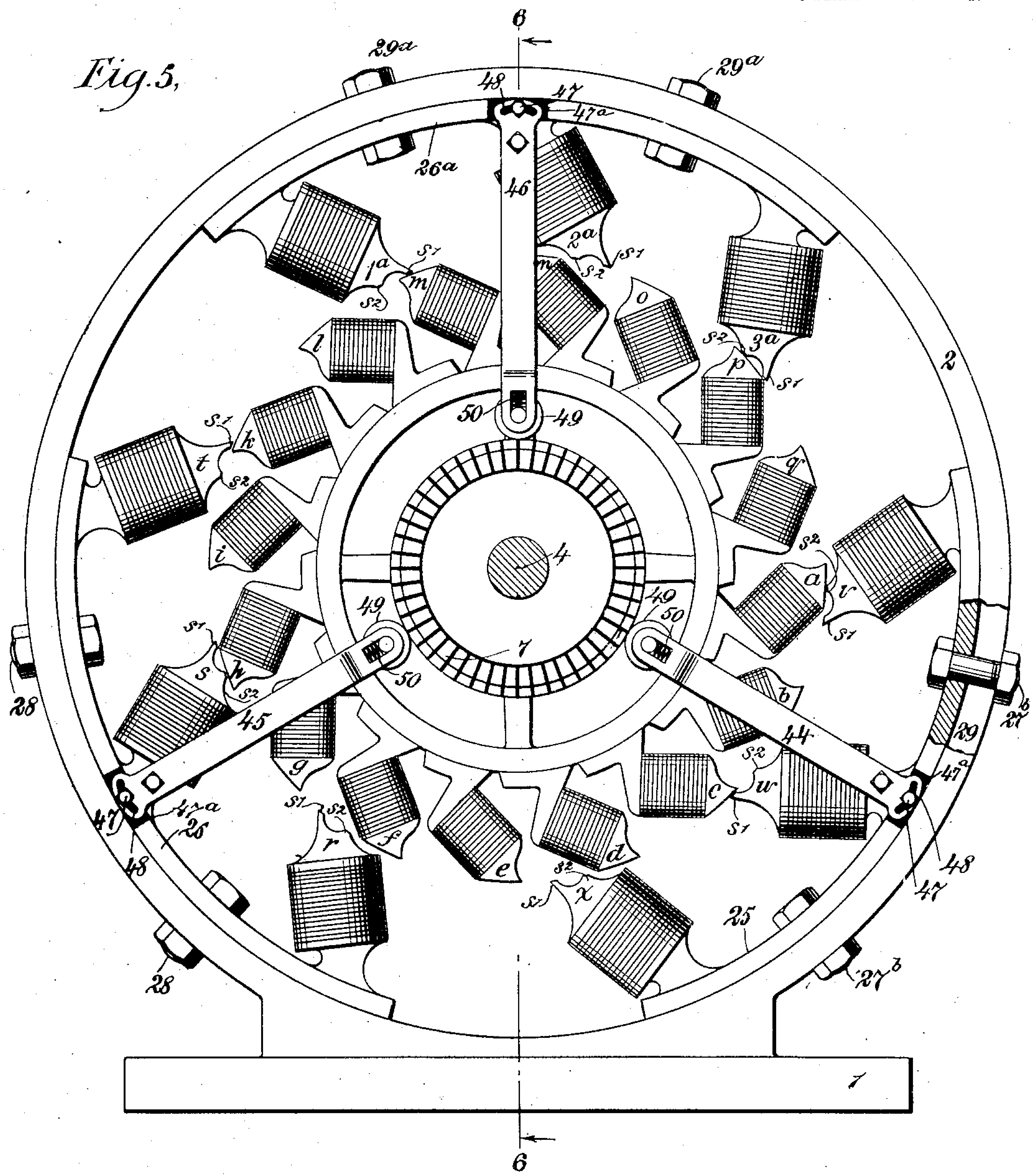
5 SHEETS—SHEET 4.

Fig. 5,



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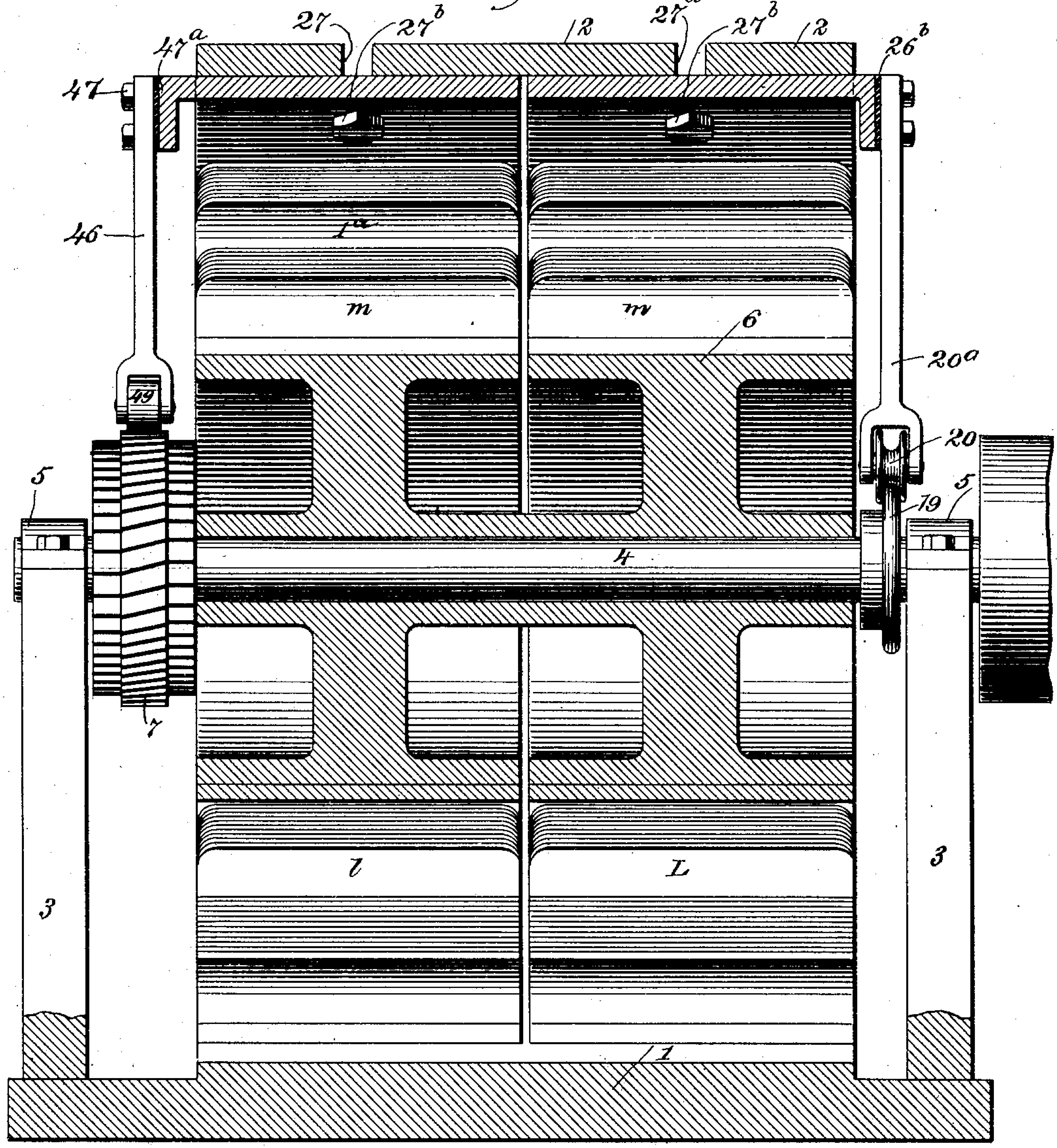
5 SHEETS—SHEET 5.

Fig. 6,



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UNITED STATES PATENT OFFICE.

JOHN ANDREW TITZEL, SR., OF FRANKLIN, PENNSYLVANIA.

DYNAMO OR MOTOR.

SPECIFICATION forming part of Letters Patent No. 788,291, dated April 25, 1905.

Application filed November 9, 1901. Serial No. 81,654.

To all whom it may concern:

Be it known that I, JOHN ANDREW TITZEL, Sr., a citizen of the United States, and a resident of Franklin, in the county of Venango and State of Pennsylvania, have invented a new and Improved Dynamo or Motor, of which the following is a full, clear, and exact description.

My invention relates to a machine which can be used as a dynamo or a motor and for direct currents.

The invention consists in the novel construction and combination of the several parts, as will be hereinafter fully set forth, and pointed out in the claims.

In the accompanying drawings like characters indicate like parts.

Figure 1 is an elevation of my device, showing two groups of field-magnets. Fig. 2 is a horizontal section of the same. Fig. 3 is a detail view, partly in section, on the line 3 3 in Fig. 2 of one of the trolley-brushes. Fig. 4 is a diagram of the wiring and switches. Fig. 5 is an elevation showing three groups of field-magnets and also showing a slight modification in the contact-brushes, and Fig. 6 is a section upon line 6 6 of Fig. 5.

Upon the base-plate 1 is rigidly mounted an annular frame 2, provided with slots 27, 27^a, 29, and 30 and fitted with sector-shaped plates 25, 26, and 26^a, upon which the field-magnets are mounted. Any number of these sector-shaped plates may be used and any number of magnets may be disposed upon them. The plates are adjustable by means of bolts 27^b, 28, and 29^a, so that they can be moved within the annular frame and can be readily taken out or put in. The object of this arrangement is to enable me to use one, two, three, or more of these sector-shaped plates, which with their accompanying magnets I denominate "fragmentary" parts of the field. In other words, I employ a composite field consisting of one, two, three, or any other desired number of fragmentary parts. Any number of field-magnets may be placed upon each of these sector-shaped plates; but I find from experience that three is the preferred number.

The magnets both in the armature and field are preferably made in the form shown and are arranged so that like poles are always opposite unlike poles. The preferred number of sets of magnets in the field and armature that will work upon my principle is five sets of armature-magnets to three sets of field-magnets and one brush on the trolley-contact of the armature, this brush being common to all of the armature-magnets. The next highest number would be ten sets of armature-magnets and six sets of field-magnets; next, fifteen sets of armature-magnets to nine sets of field-magnets; next, one hundred sets of armature-magnets to sixty sets of field-magnets, and so on, the size and number of magnets being unlimited. The best results, however, are attained by using sixteen sets of armature-magnets and only three sets of field-magnets, two magnets in a set, as the drawings show. The larger the number of magnets, however, the more numerous will be the magnetic attractions, and the same weight of material enables a larger amount of current to be carried.

Both the field-magnets and the armature-magnets are arranged tangentially, as shown. I have found by experience that by this arrangement the rotative effect is very greatly increased, the principle being that the magnets pull almost in a direct line passing through their respective axes.

The field-magnets are provided with toe-like points s' and with heel-like points s^2. I have found from experience that these toe-like and heel-like projections add considerably to the efficiency of a magnet for purposes of driving the armature in one direction. With magnets provided with these toe-like and heel-like points, as shown in Figs. 1 to 5, the rotation of the armature toward the left or contra-clockwise is far greater than the rotation toward the right. It seems that the toe-like points s' enable all of the magnetic lines of force to be concentrated within a narrow space, in which they prove most effective. If the armature were intended to rotate only in one direction—as, for instance, contra-clockwise—there would be no need for the points s^2. These points are added for the purpose of reversing the direction of the armature. They do not retard the motion of the armature when the same is run contra-clockwise, for the reason that the pull which they give is directly outward from the center, as shown at *a*, Fig. 1. When the points assume such a position relative to the armature-magnets that they tend to retard the same, the current through the armature-magnets is cut off. In other words, the points are prevented from retarding the motion of the armature by the current being turned on and off at the proper instant.

With a machine of this kind many desirable effects can be attained which could not be attained with other machines. Suppose, for instance, we have a shaft already in operation and we desire to propel the same by aid of a motor. By means of my device the armature can be built around the shaft and the fragmentary field applied around the armature, all of these parts being mere additions to the shaft, whereby the same is virtually converted into a motor.

The field-magnets of this machine are preferably provided with a special winding. (Indicated in Fig. 4.) The cores of the magnets *r s t v w x* are wound one layer deep with coarse wire—say No. 14—and upon this layer of wire are wound several other layers of finer wire. The coarse wire is seen at 32, 33, 34, 38, 39, and 40. The finer wire is shown at 35, 36, 37, 41, 42, and 43. The winding of coarse wire is just sufficient to give the fields opposite polarity when used as a motor. The windings of coarse and fine wire are to some extent independent. Both the coarse and the fine wire are used when the machine is operated as a generator.

Upon a shaft 4, mounted in bearings 5, supported by posts or standards 3 on the base-plate 1, is mounted the armature, consisting of a cylinder 6, provided with sixteen magnets, (designated as *a b c d e f g h i k l m n o p q*,) and the magnets are connected with forty-eight sector-shaped contacts 7, (see Figs. 2 and 6,) numbered from 51 to 98 (See Fig. 4.) These sector-shaped contacts are disposed diagonally, (see Figs. 2 and 6,) so that when the trolley-brush hereinafter described passes over the same contact will be made on the preceding sector before the brush leaves the last contact, and thus sparking is minimized. The connections between the magnets and the sector-shaped contacts are in the following order: The magnet *a* is connected with the sectors 94, 51, and 56. Magnet *b* is connected with the sectors 97, 54, and 59. Magnet *c* is connected with the sectors 52, 57, and 62. The other magnets are connected in the same order, as indicated in Fig. 4, magnet *k* being connected with sectors numbered 73, 78, and 83, magnet *l* being connected with sectors numbered 76, 81, and 86, magnet *m* being connected with sectors numbered 79, 84, and 89, and so on.

When the machine is used as in Fig. 4, the current passes into the armature through the revoluble trolley-brushes 8 and 9 (see Fig. 2) and from these brushes passes to the different sectors in consecutive order. As indicated in Fig. 4, the motor-current (following the arrows shown in full lines) is passing into sectors numbered 57 and 81, thence passing through magnets *c* and *l*, which pull upon the stationary field-magnets *w* and *s*, thus tending to move the armature contra-clockwise. Supposing that the armature moves in response to this tendency, the trolley-brushes 8 and 9 next engage the sectors 58 and 82, thereby energizing the armature-magnets *e* and *n*, these magnets having moved nearer the respective field-magnets *x* and *t*, so as to be in a position to draw upon the same. The current next passes from the trolley-brushes 8 and 9 through the sectors 59 and 83, thereby actuating the armature-magnets *b* and *k*, which by this time are adjacent to the stationary field-magnets *v* and *r*. It will thus be seen that the currents are shifted in a regular order, so as to keep the centers of magnetic attraction constantly changing. The consequence is that the armature-magnets *c l* pull the field-magnets *w* and *s*. Next the armature-magnets *e* and *n* pull the field-magnets *x* and *t*. Next the armature-magnets *b* and *k* pull the field-magnets *v* and *r*. Next the armature-magnets *d* and *m* pull the field-magnets *w* and *s*. Next the armature-magnets *f* and *o* pull the field-magnets *x* and *t*, and so on throughout the system. To reverse the motion of the machine, however, the trolley-brushes 8 and 9 are moved relatively toward the general position of the sectors. Suppose, for instance, that the trolleys be moved so as to engage sectors numbered 54 and 78, respectively. The result is that the armature-magnets *b* and *k* will pull upon the field-magnets *w* and *s*, thus starting the armature backward—that is, in a clockwise direction. This shifts the sectors 53 and 77 under the trolley-brush, with the result that the armature-magnets *g* and *h* are caused to draw the field-magnets *v* and *r*. Next the sectors 52 and 76 pass under the trolley-brushes, with the result that the armature-magnets *c* and *l* attract the field-magnets *x* and *t*, thus continuing the motion of the armature in the direction thus started. All that is necessary, therefore, to reverse the motion of the armature is to change the position of the trolley-brushes relatively to the frame. This is done by the device shown in Figs. 2 and 5, the preferred form being shown in Fig. 2.

Upon a fixed vulcanite ring 17 is mounted a movable arm 16, of metal, provided with a handle 18 for actuating the same. By moving this handle circumferentially the housings 14 and 15, which are adjustable, as shown in Fig. 2, together with the trolley-stems 12 and 13, carrying the forks 10 and 11 and trolley-brushes 8 and 9, are also moved circumferentially. A slight movement of the handle 18, therefore, is all that is necessary to move the trolley-brushes 8 and 9, and thereby throw the current from these trolley-brushes into different sectors, as above described, thereby reversing the direction of the motor, as above described, and also governing the moment when the current enters the armature-magnets. After passing through the field and armature magnets the current is conducted to the rotary disk 19, and from thence through the revoluble trolley-brush 20, through the stem 20^a, and out of the machine. The field-magnets are connected in multiple with the trolley-brush 20. The stem 20^a is insulated, as shown at 26^b in Fig. 6. The ring 17, heretofore referred to, is mounted on a fixed disk 16^a.

In Figs. 5 and 6 the trolley-brushes leading to the sectors have a slightly-modified form. By means of the bolts 47, which pass through slots 48, the trolley-stems 44, 45, and 46 are rendered adjustable, and said stems are provided with revoluble trolley-brushes 49, supported by springs 50. Each of the trolley-stems is placed in the position desired and the bolts are tightened. By this arrangement each sector-shaped plate 25, 26, and 26^a carries its own trolley-brush, and the arrangement of the trolley-brush shown at the bottom of Fig. 2 is not necessary. The trolley-brushes shown in Fig. 5 may be used in instances where it is desired to apply one, two, or three sector-shaped plates to a shaft already in operation. In this event there are nine magnets in the field $v\ w\ x\ r\ s\ t\ 1^a\ 2^a\ 3^a$, the number of armature-magnets and of sectors being the same as shown in Fig. 1. The frame shown in Fig. 1 is similar to the frame shown in Fig. 5. Where the arrangement is used as shown in Fig. 1, the current after passing through the fields, as above described, enters through the trolley-brush 21, thence passes through the metallic rim 22 to the heads 23 and 24, and thence to the trolley-brushes 8 and 9. The device is provided with switches C and G, for purposes explained below. The trolley-stems 44, 45, and 46 are insulated, as shown at 47^a in Fig. 6.

The field-magnets are given different degrees of power controllable to some extent at will for the purpose of varying the capacity of the machine and also for maintaining a proportionate strength of field and armature, according to the purpose for which the machine is used. Suppose now that the machine is operating as a motor using a direct current, the switches C and G being in the respective positions shown. The current from any outward source passes in the direction of the arrows shown in full lines, dividing at the junction O, so that a part of said current goes from the junction O to the switch C, and thence upward, while another part of the current goes to the right through the switch G. From the switches C and G the respective branch currents pass through the windings of coarse wires 32 33 34 and 38 39 40, thus energizing the field-magnets. If, however, the switches C and G be reversed, the currents traverse not only the windings of coarse wire mentioned, but likewise the windings 35 36 37 and 41 42 43 of finer wire. The switches C and G can be operated independently, so that one or both fields may be energized to different degrees and by using either the entire winding of each field-magnet or only a coarser winding thereof. The object of this arrangement is to enable the operator to give the fields a predetermined magnetic strength without otherwise affecting the general operation of the machine. In other words, he is enabled at will to make the field-magnets weak or strong, according to the service required of the machine.

The structure above described may be used either as a direct-current motor or as a direct-current generator. When used as a direct-current motor or generator, the switches are arranged as indicated in Fig. 4. The field-magnets are excited by the main current, and the machine may be considered as series-wound—that is to say, the same current energizes the filed-magnets and also energizes the armature-magnets. The circuit for these purposes may be traced as follows: from the main R to the junction O, where the current divides into two branches. The right-hand branch passes from junction O to switch G, thence in parallel through the three coils 32 33 34 or these and the coils 35 36 37, accordingly as the switch G be so positioned as to send the currents through the coarse coils only or through the fine and coarse coils. The three currents now unite and pass to trolley 8, thence through some one of the sectors, say 57, thence through some one of the armature-magnets, say c, thence through the rotary disk 19, trolley 20, down to left-hand main Q, as shown by the arrows. The left-hand branch passes from junction O to switch C, thence upward and in parallel through the coils 38 39 40 or through these coils in addition to coils 41 42 43, according to the desired position of switch C. Thence uniting the three currents flow as a single current to trolley 9, thence through some one of the sectors, say 81, thence through an armature-magnet adjacent to the sector in question, say magnet l, thence through the rotary disk 19 and trolley 20 to main Q, as shown by arrows.

When the machine is used as a direct-current motor, the current of course comes from an extraneous source and pursues the path just described—that is, it flows in through the main R and out through the main Q. When the machine is used as an alternating-current motor, the alternating current enters at R and leaves at Q and then enters at Q and leaves at R; but in either event its circuit is the same. The polarity of the magnets in both field and armature being simultaneously reversed by the alternating current, the direction of movement of the armature is always the same. This principle, I believe, is true of almost any direct-current motor.

When the machine is used as a generator, the machine is self-exciting, the only current employed being that generated by the passage of the armature-magnets through the lines of force of the magnetic fields, this current pursuing the paths above indicated. As in any other direct-current generator, the paths of the currents are the same as when the machine is operated as a motor.

Considering the machine as a generator, it will be noted that while currents are generated in the armature by the passage of the armature-magnets adjacent to the field-magnets, yet these currents flow into and out of the armature in the same paths as currents flowing into and out of the armature, where the machine is operated as a direct-current motor. The only difference is that when the machine is used as a generator the armature draws the current in from one of the mains and forces it out through the other main, whereas when the machine is used as a motor a current from an extraneous source is forced into the armature from one of the mains and forced out through the other main.

The action of the machine considered as a motor being once understood, the action of the machine considered as a generator can readily be understood by the analogy of any other ordinary direct-current motor compared with itself considered as a direct-current generator. So, also, this machine considered as a direct-current motor can readily be understood as a direct-current generator and for the reason that any ordinary direct-current motor can be operated inversely as a direct-current generator.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A dynamo or motor, comprising a frame, a revoluble armature adjacent to the same, and a fragmentary field built up of segregated groups of magnets, each group being detachably secured upon said frame, and electric connections for said armature and said field.

2. A dynamo or motor, comprising a frame provided with an annular member, a revoluble armature concentric with said annular member, and a composite field built up of separate groups of magnets, each of said groups being mounted upon a sector-shaped block, and means for detachably securing said blocks upon said annular member.

3. A dynamo or motor, comprising a frame provided with an annular member, a cylindrical armature concentric with said member, a plurality of sector-shaped blocks for detachably engaging said annular member and provided with field-magnets, means for adjusting at will the relative positions of said blocks, and electric connections for said armature and said field-magnets.

4. A dynamo or motor, comprising a revoluble cylindrical armature provided with magnets and with sector-shaped contacts connected therewith, consecutive contacts being connected with magnets not consecutive but arranged in a definite order, normally stationary field-magnets disposed radially from said armature and spaced apart, brushes for supplying currents to said sector-shaped contacts, the arrangement being such that when currents are supplied to said sector-shaped contacts consecutively said currents intermittently energize the magnets of said armature in a regular but not consecutive order, the seat of magnetic attraction being constantly shifted.

5. A dynamo or motor, comprising a revoluble cylindrical armature provided with magnets and with sector-shaped contacts, each contact being connected with a magnet, consecutive contacts being connected with magnets not consecutive but arranged in a definite order, normally stationary field-magnets disposed radially from said armature and spaced apart, brushes for supplying the currents to said sector-shaped contacts, and means controllable at will for shifting the position of said brushes, for the purpose of energizing said armature-magnets in a different order relatively to the positions occupied by the stationary field-magnets, for the purpose of reversing the direction of rotation of the armature.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN ANDREW TITZEL, Sr.

Witnesses:

W. G. Boyles,

J. H. Beckfield.