Nov. 11, 1958 N. FELICI ET AL 2,860,264

QUICK STARTING ELECTROSTATIC GENERATOR

Filed Oct. 25, 1956 5 Sheets-Sheet 1

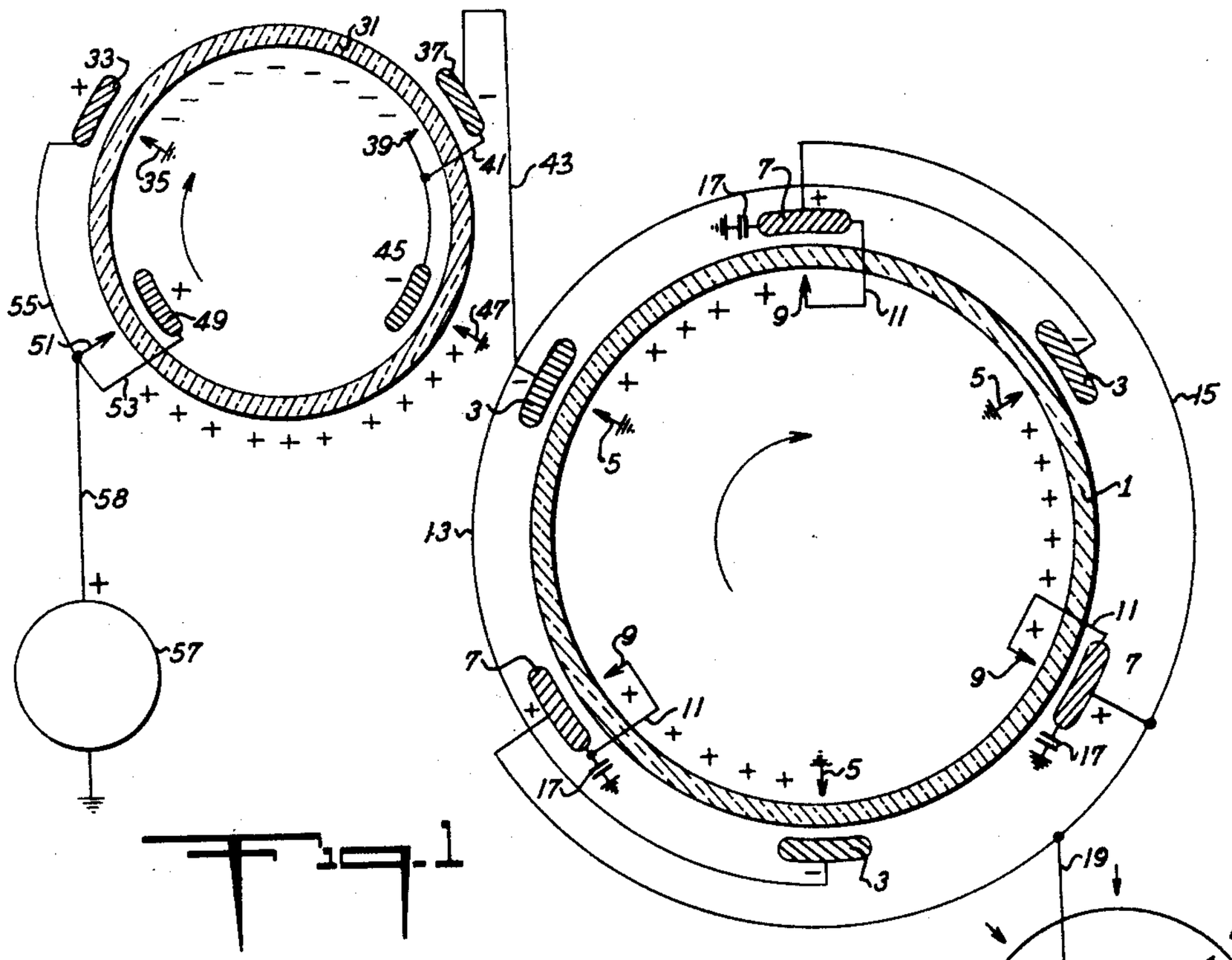


FIG. 1

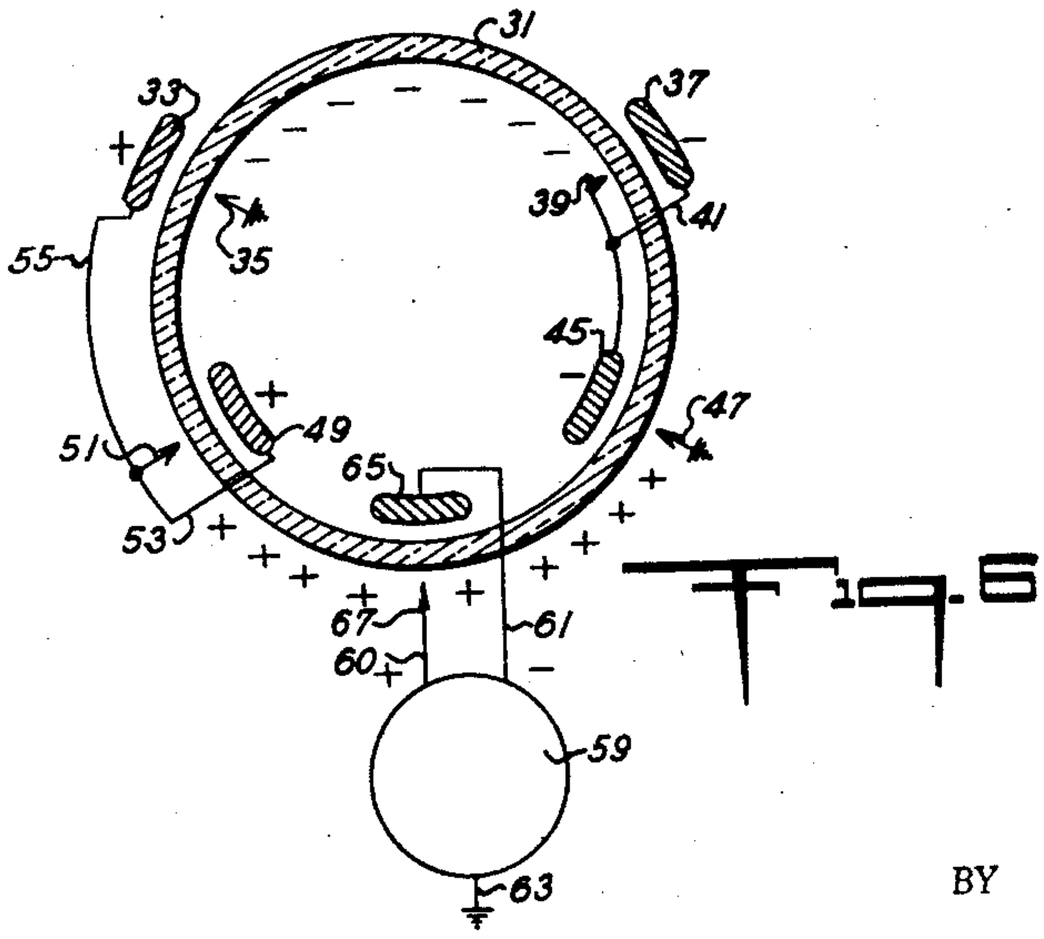


FIG. 6

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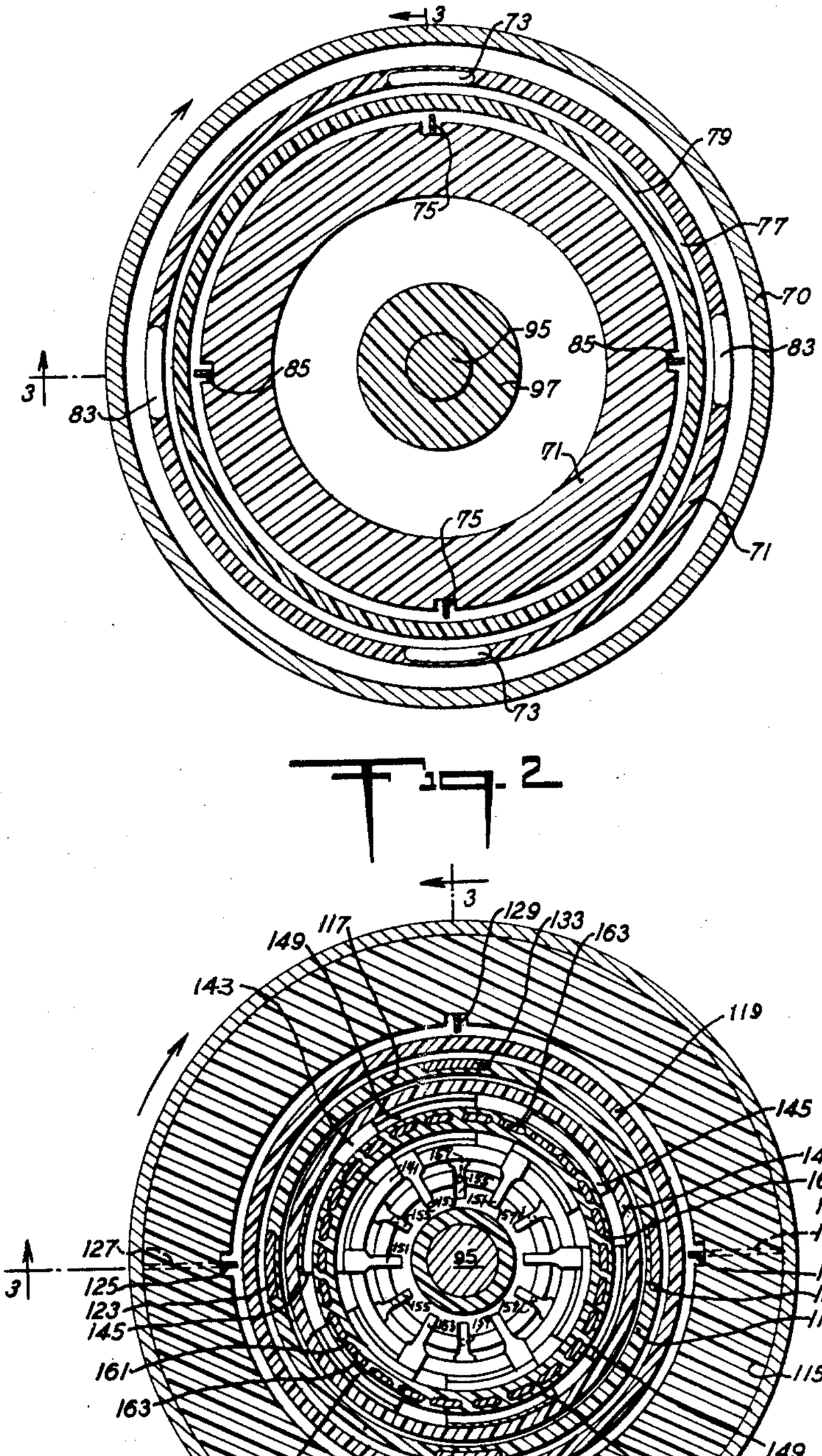


FIG. 2




FIG. 4

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QUICK STARTING ELECTROSTATIC GENERATOR

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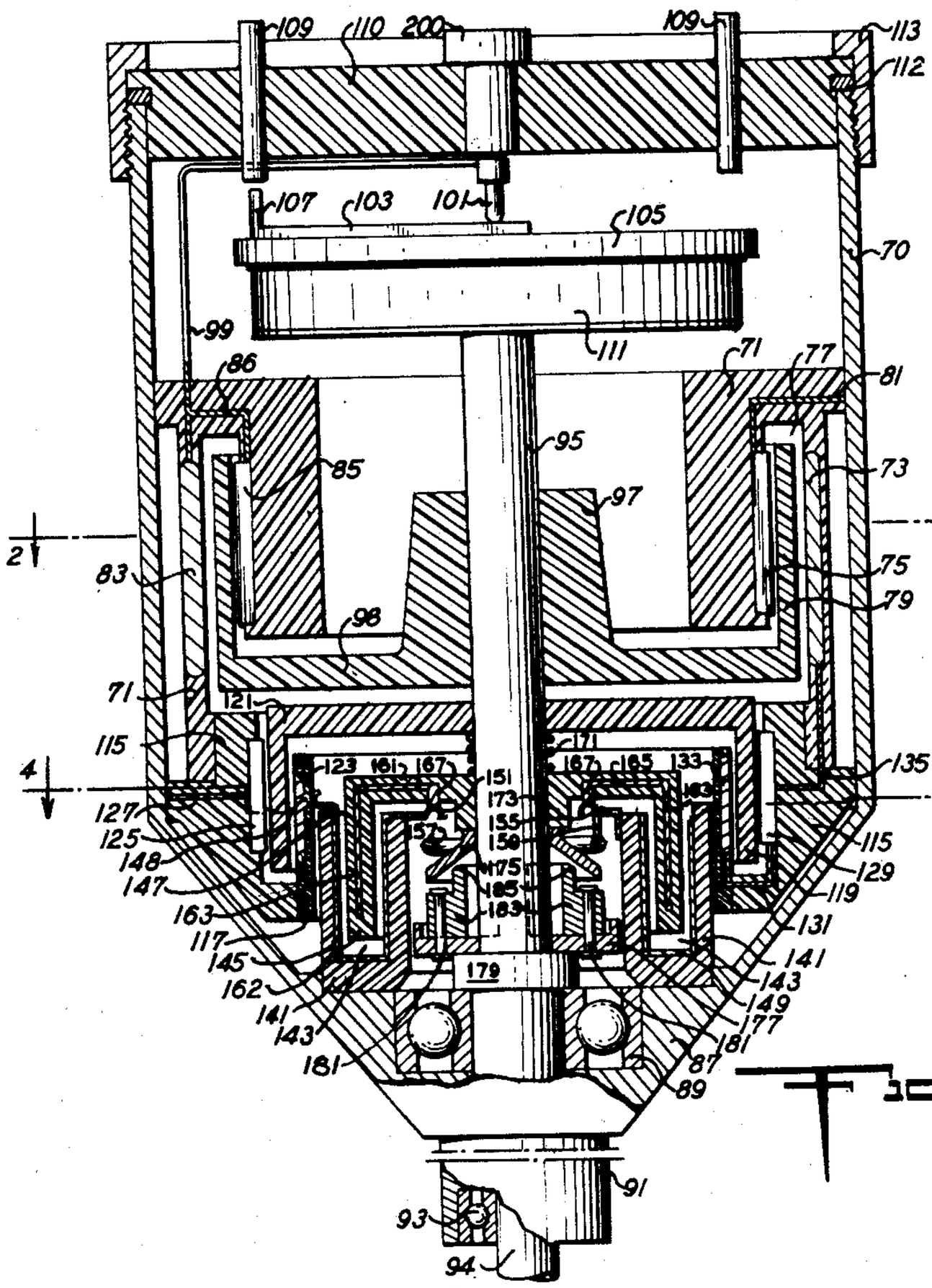


FIG. 5

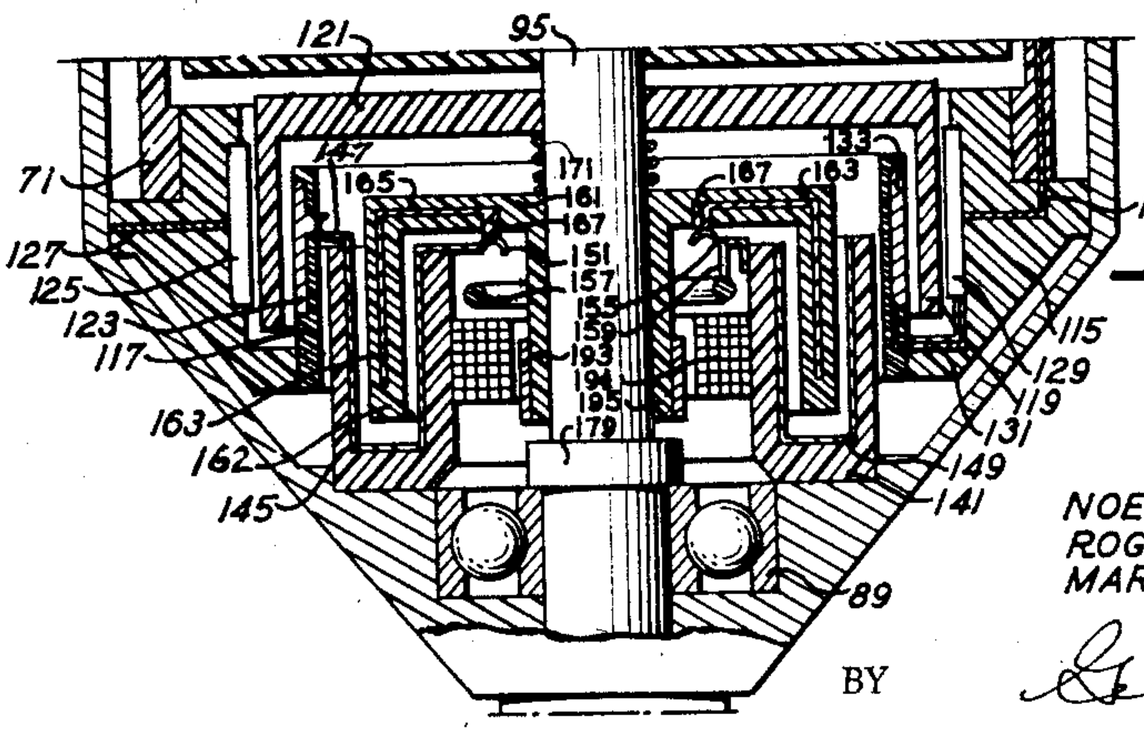


FIG. 6

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QUICK STARTING ELECTROSTATIC GENERATOR

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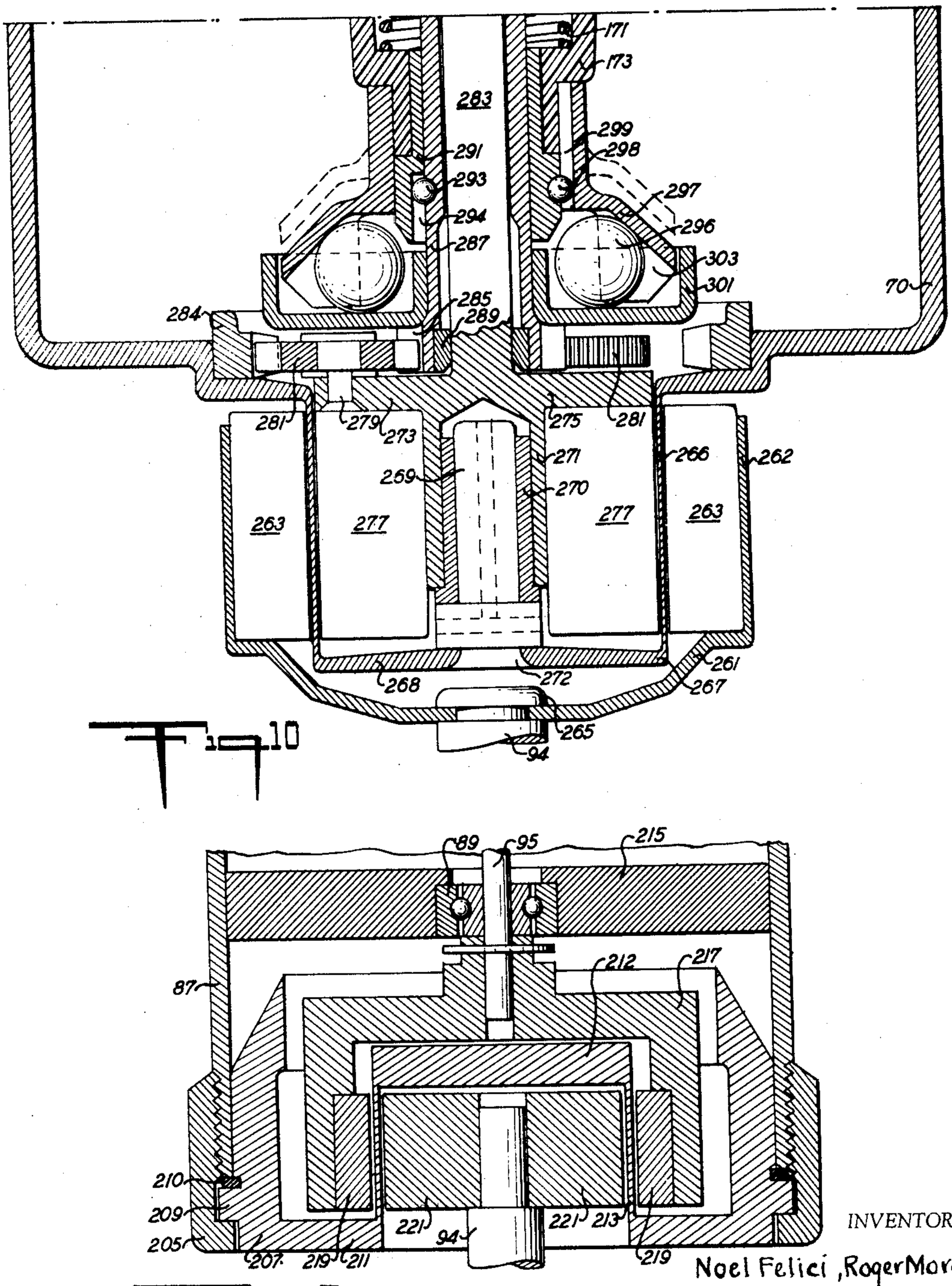


FIG. 10




FIG. 7

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QUICK STARTING ELECTROSTATIC GENERATOR

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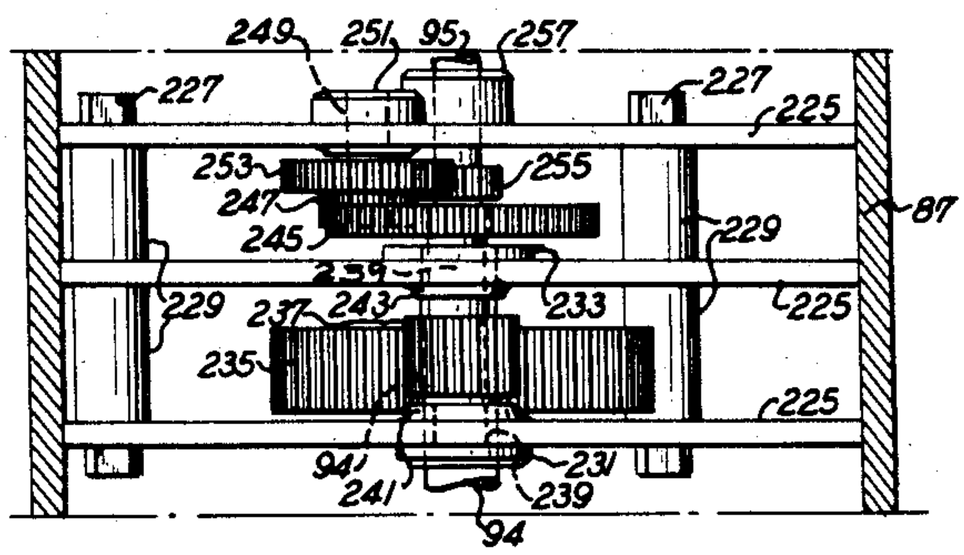


FIG. 8

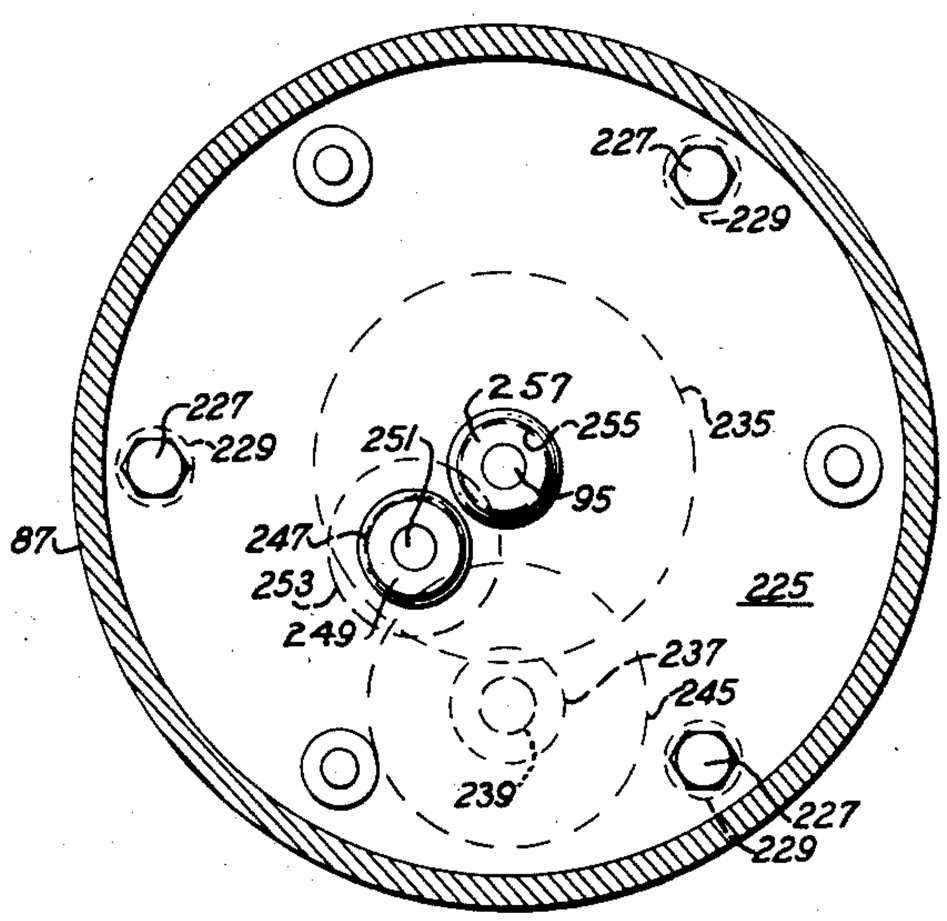


FIG. 9

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United States Patent Office

2,860,264

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2,860,264

# QUICK STARTING ELECTROSTATIC GENERATOR

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Application October 25, 1956, Serial No. 618,407

Claims priority, application France March 10, 1954

29 Claims. (Cl. 310—6)

This invention relates to electrostatic generators and more especially to such generators utilizing a conveyor of insulating material for carrying charges between a charging or exciting element and a collecting or discharging element. The invention more particularly relates to an electrostatic generator of this type provided with means for quickly building up an exciting charge on the exciting element.

The invention finds practical application for different purposes but is particularly useful for the ignition of internal combustion engines. In such engines it is well known that the use of a capacitative discharge has several advantages in comparison with discharge produced by electromagnetic induction for producing the spark. These advantages include the conditions that the quality of the ignition spark is practically independent of the speed of the engine, that precise timing of the ignition is secured, that shielding of the ignition connections and other parts of the circuit is facilitated, that good ignition may be obtained even if the spark plugs are fouled or encrusted or if the insulation thereof is defective, that deterioration of the spark plugs particularly because of heating thereof ordinarily produced by electromagnetic inductive discharge is reduced, and the compression ratio of the engine may be increased.

In order to secure these advantages of capacitative discharge, it has been proposed that a capacitor of substantial capacity charged to a high voltage be utilized, so that the requisite portion of the charge carried by this capacity may be discharged to the spark plug at the proper moment as determined by the distributor and the timing device operated by the engine. In certain applications, such as the ignition of internal combustion engines for automotive vehicles, however, the restrictions of space and of cost limit the size of the capacitor which may be used with an electrostatic generator for ignition purposes. It is desirable, therefore, that the required high potential shall be built up quickly and that the capacity available for capacitative discharge shall be quickly recharged after each discharge to the spark plug.

It is an object of the invention to provide a simplified construction of an electrostatic generator which will develop a high potential and will occupy a relatively small space and be of low cost.

It is another object of the invention to provide an electrostatic generator capable of quickly developing the requisite high potential and adapted for capacitative discharge.

It is a further object of the invention to provide in an electrostatic generator utilizing an insulating conveyor means for quickly developing the charging or exciting potential.

It is a still further object of the invention to provide an electrostatic machine for quickly developing the charging and exciting potential in quick succession after each discharge.

It is an important object of the invention to provide the features above referred to in a compact machine of



rotary type which combines a priming or starting generator with an exciting generator for exciting a main generator.

To this end the present invention provides an electrostatic generator having means for quickly developing a high direct current potential which is utilized to charge the charging or exciting elements of the generator. The electrostatic generator to which the invention particularly relates is one which is constructed with a conveyor of insulating material, preferably in the form of a hollow cylinder adjacent the respective peripheral surfaces of which a charging inductor and a charging ionizing element are disposed in spaced relation to these peripheral surfaces of this conveyor for conducting to the surface of the conveyor adjacent the ionizer a substantially continuous flow of ions which are conveyed by the conveyor upon rotational movement thereof to a collecting ionizer. Preferably at the opposite side of the conveyor wall from the collecting ionizer a screen inductor is disposed to which the collecting ionizer preferably is connected, the ions collected from the conveyor being conducted through suitable connections to the screen inductor and to the load terminal. This electrostatic generator advantageously, and particularly for the ignition of internal combustion engines, may function as the exciter of a main generator also having an insulating conveyor and a charging inductor that is connected to the discharge or collecting ionizer of the exciter, this main generator having a discharge ionizer and preferably a screen inductor in opposed relation thereto, these inductors of the main generator being disposed respectively at opposite sides of the conveyor from the corresponding ionizers in the manner described in the application of Noel Felici, Serial No. 321,351 filed November 19, 1952, now abandoned, and in the application Serial No. 492,491, filed March 7, 1955, now Patent 2,781,460, February 12, 1957, as a continuation in part of said application Serial No. 321,351.

Such a combined exciter and main generator unit may be simplified and may occupy a relatively small space when each generator is constructed in accordance with the disclosure in the application of Roger Morel, Serial No. 492,494, filed March 7, 1955, now Patent 2,785,320, March 12, 1957, corresponding to the French application No. 664,846 filed March 8, 1954. It is necessary, however, that means be provided for developing the initial charge on the charging or exciting elements of the exciter generator in order that the generators may start to operate and so that the main generator may deliver the charges to the spark plugs. This necessity arises in part from the fact that the internal circuits of such generators, which ordinarily are enclosed in casings containing a dielectric gas under pressure, include the gas filled spaces between the insulating conveyor and the ionizers which only become conductive when the gas in these spaces becomes ionized. Ionization may be accomplished by utilizing a radioactive material as the ionizing element or disposing such material adjacent to the usual ionizing element, as proposed in the application of Roger Morel Serial No. 465,395, filed October 28, 1954, now abandoned, and in the application Serial No. 565,253, filed February 13, 1956, as a continuation in part of said application Serial No. 465,395, or such ionization may be accomplished by applying across the exciting inductor and the exciting ionizer a potential difference great enough to produce the ionization of the gas. It is also possible to use frictional electrostatic machines, and in some cases electromagnetic machines or devices, to secure such ionization.

In accordance with the invention the essential difference of potential between the exciting inductor and the exciting ionizer of the exciter for ionization is attained by utilizing an auxiliary priming or starting generator. This

priming generator preferably is constructed with a conductive inductor member and a conductive conveyor member. It may function in general in accordance with the patents to Noel Felici, No. 2,486,140, October 25, 1949, and No. 2,590,168, March 25, 1952. The charges delivered to the output terminal of this auxiliary priming generator at the requisite potential are conducted through a suitable connection or connections to the charging or exciting inductor or inductors of the exciter generator. Particularly when the electrostatic generator includes a main generator utilized for the ignition of an internal combustion engine, it is essential that the time which elapses between the commencement of rotation of the rotatable parts driven by the engine and the first discharge to a spark plug be as short as possible. The priming or starting generator, therefore, must be capable of rapidly developing the requisite potential for charging the exciting inductor of the exciter, so that this exciter generator in turn may rapidly excite the exciting inductor of the main generator.

The auxiliary priming generator has means for connecting the conductive conveyor member thereof to a reference potential at a given point in the movement of the conductive conveyor member with respect to the conductive inductor member and has means for connecting this conductive conveyor member to the output terminal at another point in the movement of this conductive conveyor member with respect to the inductor member, so that the potential of the charge carried by the conductive conveyor member is increased rapidly in such movement and this charge at the increased potential is discharged to the charging or exciting inductor of the exciter generator.

The collecting ionizer of the exciter generator, and preferably a screen inductor in opposed relation thereto and connected thereto, is connected to the charging or exciting inductor of the main generator.

The invention is particularly concerned with the feature that the exciter generator and the auxiliary priming generator may be so constructed and the parts thereof may be so disposed as to occupy a relatively small space, with the auxiliary generator preferably disposed within the hollow space of the conveyor of the exciter generator. Such disposition of these two generators makes possible a compact simple construction, short simple connections from the discharge terminal of the priming generator to the exciting inductor of the exciter generator and advantageous disposition of the other electrodes and of the connections of certain of them to the reference potential with concomitant restriction of the cost. In the preferred embodiment, which also is advantageous for the ignition of internal combustion engines, the combined generators may be disposed within a casing containing a gas at an elevated pressure to provide a fluid dielectric medium within which the generators may operate at high potential and with capacitative discharge. Moreover, the disposition of the parts of the machine, and particularly the disposition of the priming generator within the hollow space of the exciter generator rotor, makes possible a disposition and form of the inductors of the main generator so that the desired capacity may be secured in these inductors of the main generator without the aid of an auxiliary capacitor. Such auxiliary capacity, however, in some cases may be desirable and may be used.

It is a further feature of the invention that means are provided for temporarily establishing connection of the priming or starting generator to the exciting generator to develop the exciting charge on the exciting inductor of the exciter generator on starting of the generators. This means further provides for effective disconnection of the priming generator from the exciter generator when a potential is built up by the priming generator which is adequate for exciting the exciting inductor of the exciter generator, or when the exciter generator generates the requisite exciting potential and charge for exciting the main generator, the exciter generator being constructed



thereafter to be self-exciting or excited by the main generator.

The main generator and the exciter generator may be constructed generally in the manner disclosed in the Patent 2,781,460 to Noel Felici above referred to, and may embody features which are disclosed in the above mentioned Patent 2,785,320 to Roger Morel. In each of these disclosed constructions a conveyor of insulating material is utilized which is of hollow cylindrical form which may be referred to as "bell type" because the hollow cylinder provides a cylindrical wall supported at one end by a flange or web extending between a central hub mounted on a rotatable shaft and the wall of the hollow cylinder, the opposite end of the hollow space being open. In each of these constructions the bell shaped rotor or conveyor rotates on its axis between two stators of insulating material, one of which is disposed outwardly of the outer peripheral surface of the cylindrical portion of the bell and the other of which extends into the hollow space within the bell at the open end thereof.

With respect more particularly to the portion of the machine of this invention which is referred to as the exciter generator utilizing a conveyor of insulating material, the stator may be constructed to provide an annular recess within which is disposed the cylindrical portion of the bell shaped insulating conveyor of this exciter generator, the inductor and ionizing electrodes of this exciter generator being disposed at the opposed annular peripheral surfaces of this recess extending about the axis of rotation of the insulating conveyor.

This stator, in accordance with the invention, also may provide a second annular recess about the axis of rotation providing opposed annular peripheral surfaces, the rotor of the auxiliary starting or priming generator having a cylindrical portion thereof disposed within this second annular recess for rotation of this rotor on the axis of rotation of the generator. In accordance with the invention, this priming generator may have a conductive inductor member having portions thereof disposed adjacent the opposed annular surfaces of the second recess and supported by the stator. A conductive conveyor member of this priming generator, preferably disposed within and enrobed by the insulating material of the rotor of the primer generator, is movable, upon rotation of the rotor, into and out of inductive relation to the conductive inductor member of this primer. In a practical machine in accordance with the disclosure in the application of Felici and Point Serial No. 492,495, filed March 7, 1955, corresponding to the French application No. 664,847, filed March 8, 1954, two sets of inductor members, the sets being maintained by suitable means at two different potentials, are disposed with inductors in spaced relation about the axis of rotation, the inductor members at the two potentials alternating with respect to each other. In such a practical embodiment also a plurality of conductive conveyor members, preferably in number substantially greater than, for example, three or four times, the number of inductor members may be carried by the rotor of the primer in spaced relation about the axis of rotation for movement of these conductive conveyor members in succession into and out of inductive relation to the inductor members of the primer in succession.

The means above referred to for connecting the conductive conveyor members carried by the rotor of the primer in sequence to a reference potential and to an output terminal may include contacts supported by the stator and contacts carried by the rotor of the primer and movable therewith successively into engagement with the stator contacts in the rotation of the rotor. Alternate stator contacts may be connected to the reference potential and to a terminal of the machine, the contacts connected to a terminal of the machine preferably being connected also to alternate conductive inductor members of the primer.

Within the scope of the invention, the means above referred to for temporarily establishing connection of the priming or starting generator to the exciter generator and the subsequent disconnection thereof when the exciter generator has become primed may comprise a mechanical device utilizing centrifugal force or other means responsive to the speed of rotation of the rotor of the auxiliary priming generator, or responsive to the speed of rotation of the exciter rotor. In the preferred embodiment these two rotors are connected together for rotation on a common axis and, therefore, the device referred to is responsive to their common speed. The invention, however, is not limited to the use of such mechanical devices and electrical devices utilizing electrostatic or electromagnetic forces may be used that are responsive to a given potential in the electrostatic machine, for example, the difference of potential between the exciting inductor and the exciting ionizer of the exciter generator. Energization of such an electrostatic or electromagnetic device may effect the disconnection of the contacts when the exciter has become properly operative to enable the priming generator to rotate without developing and discharging charges and without friction and wear which otherwise would occur.

In the design of any of these devices, it is important and in some cases essential, after the device has moved the contacts out of engagement with each other, the exciter generator then operating as a self-exciting machine or by excitation from the main generator, that the device should again come into action at a speed lower than that at which it was effective to disengage the contacts. This may be accomplished by designing the device in such a manner that electrostatic or magnetic forces that are inversely proportional to the square of the distance between the cooperating elements are utilized and are only effective if, the contacts having been separated, the cooperating elements have moved into positions of close attraction for each other.

The electrostatic capacity for storing the energy supplied by the main generator and for releasing it to the output circuit, by sudden discharge through a spark plug in the case of the ignition of an internal combustion engine, may be obtained in different ways. An auxiliary condenser may be utilized of which one plate or electrode may be provided by the housing or casing of the machine which if need be may be connected to ground. Preferably, however, having regard to the ability of the auxiliary priming generator rapidly to build up potential for charging the exciter generator, the inherent capacity which exists between the housing and the output inductors of the main generator may be utilized, these output inductors being connected together and connected to the rotatable member of a conventional distributor for distributing the charges to the respective spark plugs.

Preferably for the purposes of the invention and in general for electrostatic machines utilizing conveyors of insulating material, the casing or housing is filled with a compressed gas that has a high ionic mobility and little affinity for electrons, for example, pure hydrogen or nitrogen. The increase in the dielectric strength of the dielectric fluid which is obtained by utilizing such a gas improves the functioning of all parts of the apparatus. The allowable differences of potential between different components may be greater and the precision of operation of the distributor is improved.

The movable parts of the generator within the housing or casing may be driven by any suitable method, such as by an electric motor disposed within the housing, by a magnetic drive having an element within the housing and an element exterior thereto, or by a spindle passing through a stuffing box. The housing, of course, also is provided with pressure confining seals at the outlet for the high voltage terminal and for other leads if brought to the outside of the casing.

The means for driving the rotor of the auxiliary priming generator, if desired, may include a speed multiplying device or mechanism, such as gearing, to multiply the rotations of the rotor carrying the conductive conveyor members relative to the movement of the driving means, so that these conveyor members will move with greater speed into and out of inductive relation to the inductor members of the auxiliary priming generator. A spring which may be coiled up upon initial rotation of a shaft driven by the driving motor may be utilized to release its energy thereafter to drive the conveyor member with a very rapid movement for a few revolutions, thereby rapidly to build up the requisite potential for exciting the exciting inductor of the exciter generator.



The invention will be more clearly understood from the description to follow taken in connection with the drawings in which:

Fig. 1 shows diagrammatically a main generator connected to a distributor for an internal combustion engine, this generator being excited by an exciter generator primed by an auxiliary generator.

Fig. 2 is a cross section transverse to the axis of rotation of an ignition unit for a four-cylinder internal combustion engine.

Fig. 3 is a longitudinal section taken on line **3—3** of Fig. 2.

Fig. 4 is a transverse section through the exciter and auxiliary priming generators taken on line **4—4** of Fig. 3.

Fig. 5 shows a modification of the device for disengaging contacts carried by the rotor of the auxiliary priming generator from fixed contacts.

Fig. 6 shows a modified arrangement of the exciter generator and auxiliary priming generator shown in Fig. 1.

Fig. 7 shows in longitudinal section in simplified form a magnetic drive for the machine of the invention.

Fig. 8 shows a speed multiplying device constructed so as to be disposed within the casing of the machine.

Fig. 9 shows an end view of the device of Fig. 8.

Fig. 10 shows in section a portion of a machine embodying the invention and utilizing both a magnetic drive and a speed multiplying device operable to disengage contacts of the auxiliary priming generator.

In Fig. 1 the main generator is of the type utilizing a conveyor **1** of insulating material. This conveyor in the embodiment shown is a cylinder supported for rotation thereof on the axis of the cylinder in the direction of the arrow. For the purpose of a clearer showing, the mechanical supports for the bearings for the rotatable conveyor, as well as for the parts diagrammatically shown in Fig. 1, are omitted. Adjacent and in spaced relation to the outer surface of the conveyor wall **1** three exciter inductor members **3** are supported. At the inner face of the wall in opposed relation to the respective inductor members **3** exciter ionizers **5** are supported in adjacent spaced relation to this inner face of the wall. In the embodiment being described these exciter ionizers **5** are connected to ground as a reference potential. Circumferentially spaced from the inductor members **3** and interspersed therebetween screen inductor members **7** are disposed adjacent and in spaced relation to the outer face of the wall. Adjacent and in spaced relation to the inner face of the wall and respectively in opposed relation to the screen inductor members **7** collector ionizers **9** are disposed which are connected by conductors **11** to the respective screen inductor members **7**.

In the embodiment of Fig. 1, therefore, the main generator comprises three sets of electrodes, each set comprising an exciter inductor member **3** and the corresponding ionizer **5** and a screen inductor member **7** and the corresponding ionizer **9** connected to the screen inductor member. The sets are disposed in succession in the direction of rotation of the conveyor wall **1** about the axis of this conveyor in the manner shown in Fig. 1. All of the exciter inductor members **3** are connected together by the conductor **13** and all of the screen inductor

members 7 are connected together by the conductor 15. In the embodiment shown in Fig. 1 each screen inductor member is connected to a plate of an auxiliary condenser 17 which has the other plate thereof connected to ground. As indicated above, these condensers serve to increase the capacity which is charged by the operation of the main generator so that sufficient charge may be stored and available to be discharged from the inductor members 7 and the condensers 17 through the conductors 15, 19 to the rotatable element 21 of a distributor for the internal combustion engine, this distributor having eight fixed electrodes 23 into spark gap relation to which the rotatable element 21 is moved in succession upon rotation thereof. The stationary electrodes 23 may be connected respectively to the spark plugs of an 8-cylinder internal combustion engine.

The exciter generator in the embodiment of Fig. 1 comprises a conveyor providing a cylindrical wall 31 supported for rotation thereof on the axis of the cylinder in the direction of the arrow Adjacent and in spaced relation to the outer surface of the conveyor 31 an excited inductor member 33 is disposed. Adjacent and in spaced relation to the inner surface of the conveyor wall 31 and in opposed relation to inductor member 33 an exciter ionizer 35 is supported which is connected to ground as a reference potential. In spaced relation circumferentially about the axis of rotation to the inductor member 33, a screen inductor member 37 is disposed adjacent and in spaced relation to the outer surface of the conveyor wall 31. In opposed relation to the screen inductor member adjacent and in spaced relation to the inner surface of the conveyor wall 31 a collector ionizer 39 is supported. The ionizer 39 is connected by the conductor 41 to the screen inductor member 37. This screen inductor member 37 and the collector ionizer 39 are connected by the conductor 43 to the exciter inductor members 3 of the main generator. The collector ionizer 39 also is connected to the exciter inductor member 45 disposed adjacent and in spaced relation to the inner surface of the conveyor wall 31.

In opposed relation to the inductor member 45 adjacent and in spaced relation to the outer face of the wall 31 an exciter ionizer 47 is supported which is connected to ground as a reference potential. In circumferentially spaced relation to the inductor member 45 adjacent and in spaced relation to the inner face of the conveyor wall 31 a screen inductor member 49 is disposed. Adjacent and in spaced relation to the outer face of the conveyor wall 31 in opposed relation to the inductor member 49 a collector ionizer 51 is disposed which is connected by the conductor 53 to the screen inductor member 49. The collector ionizer 51 and the screen inductor member 49 connected thereto are connected by the conductor 55 to the exciter inductor member 33.

In Fig. 1 an auxiliary priming generator 57 is shown merely diagrammatically, this generator having the output terminal thereof connected through the conductor 58 to the conductor 55 and to the exciter inductor member 33. The other terminal of the auxiliary priming generator 57 is connected to ground in this embodiment.

It will be understood from the description of the generators shown in Fig. 1 that, if the priming generator generates a positive potential, it may serve to charge the exciter inductor member 33 at a positive potential, thereby to induce negative ions to flow through the ionizer 35 and be collected upon the inner surface of the conveyor wall 31 to be conveyed thereby and collected by the collector ionizer 39 and delivered to the screen inductor member 37 as well as to the exciter inductors 3 of the main generator which thereby become charged with negative charges. Positive ions thereby are induced upon the inner surface of the main conveyor 1 which in the rotation of this conveyor are collected from the inner surface by the collector ionizers 9 and delivered to the screen inductor member 7 and to the plates of the condensers 17.



When the rotatable element 21 of the distributor is in spark gap relation to a fixed electrode 23, spark discharge may take place therebetween concomitantly with discharge of charges from the condensers and the screen inductor members connected thereto.

The exciter inductor member 45 of the exciter generator also will be charged with negative charges received from the collector ionizer 39 and will induce positive charges upon the outer face of the conveyor 31 through the ionizer 47. These charges will be conveyed to the collector ionizer 51 and delivered to the screen inductor member 49 as well as to the exciter inductor member 33. The exciter generator utilizing the conveyor 31, therefore, when its inductor member 33 has been primed, is capable of generating the exciting charges for the main generator, as well as for exciting the exciter inductor member 45 so that this exciter inductor member and the exciter ionizer 47, together with the collector ionizer 51 and the screen inductor member 49, serve to generate the positive charges for continuously charging the exciter inductor member 33. The two portions of the exciter generator thus are mutually exciting.

It will be noted that the exciter generator conveyor 31 carries the positive and negative charges on opposite faces of the wall thereof in accordance with the U. S. application of Marcel Point, Serial No. 492,493, filed March 7, 1955, now Patent 2,754,433, July 10, 1956, corresponding to the French application Serial No. 664,845, filed March 8, 1954. Within the scope of the invention, however, the exciter generator may be of the type disclosed in the application of Roger Morel, Serial No. 465,395, filed October 28, 1954, above mentioned, in which two sections of the generator are mutually exciting, the charges generated in one section being positive and in the other section negative, both these sections operating at the same face of the conveyor of insulating material.

In the manner hereinafter described, the auxiliary priming generator may be disconnected from the exciter generator when the potential of the charges generated by the exciter generator and delivered to the exciter inductor members 33 has increased sufficiently to maintain the excitation of the main generator, as well as of the exciter inductor member 45, so as to continue the operation above described.

In Fig. 6 is shown a modification of the arrangement of the auxiliary priming generator in connection with the exciter generator. In Fig. 6 the same reference numerals as those used in Fig. 1 are intended to indicate the same parts. In order, however, to secure initial priming of the exciter generator, in the modification of Fig. 6 an auxiliary priming generator 59 provides a terminal 60 at positive potential and a terminal 61 at negative potential. If desired, a neutral terminal 63 of the priming generator 59 may be connected to ground. The negative terminal 61 in this modification is connected to an exciter inductor member 65 disposed adjacent and in spaced relation to the inner surface of the conveyor wall and the positive terminal 60 is connected to an exciter ionizer 67 disposed in opposed relation to inductor member 65 adjacent and in spaced relation to the outer surface of the conveyor wall. Initially, when the exciter generator utilizing the conveyor 31 of insulating material is without charge, for example, after standing idle for a long period, by operation of the generator 59 positive charges may be induced upon the outer surface of the conveyor wall 31 through the ionizers 67 and conveyed to and collected by the ionizer 51 and delivered to the exciter inductor 33 which then serves to induce negative charges on the inner surface of the conveyor wall 31 through the exciter ionizer 35, as described in connection with Fig. 1. The negative charges thus generated by the exciter inductor member 33 and the ionizer 35 are collected at the ionizer 39 and delivered to the exciter inductor 45 in the same manner as in Fig. 1. When the potential of the exciter inductor member 33 has been built up sufficiently so that charges are

delivered to the exciter ionizer **45** at sufficient potential, the positive charges induced by the outer surface of the conveyor wall **31** through the ionizer **47** will become developed at a potential sufficient to maintain the inductor member **33** at the required potential for charging the exciter inductor members **3** of the main generator as well as the exciter inductor member **45** of the exciter generator. In the manner to be described hereinafter the auxiliary priming generator **59** then may be disconnected from the exciter inductor member **65** and the exciter ionizer **67**.

Figs. 2 and 3 show the mechanical form and arrangement of a main generator having a conveyor of insulating material excited by an exciter generator having a conveyor of insulating material, this exciter generator being primed by an auxiliary priming generator having a rotor of insulating material which carries conductive conveyor members. Figs. 2 and 3 also show the compact arrangement of these three generators, as well as the device for putting the auxiliary priming generator out of operation and for again bringing it into operation, as above referred to.

Within a casing **70** which is cylindrical in this embodiment and is capable of confining therein a gas under substantial pressure is fitted a stator **71** of insulating material supporting exciter inductor members **73** and exciter ionizers **75** disposed at opposite peripheral faces of an annular recess **77** formed in the stator **71** coaxially with the axis of the casing, the inductor members **73** being adjacent and in spaced relation to the outer peripheral surface of a cylindrical conveyor wall **79** of insulating material disposed in the recess **77**. The ionizers **75** are disposed adjacent and in spaced relation to the inner peripheral surface of the conveyor wall and are electrically connected by conductors **81** to the casing **70** which may be of a conductive material, such as a metal, providing a body at a reference potential. Upon excitation of the exciter inductor members **73** ions may be induced through the ionizers **75** upon the inner cylindrical surface of the conveyor **79**.

Adjacent and in spaced relation to the outer surface of the conveyor **79** at positions 90° from the inductor members **73** screen inductor members **83** are supported by the stator **71**. Adjacent and in spaced relation to the inner surface of the conveyor **79** collector ionizers **85** are supported by the stator **71** in opposed relation to the inductor members **83** and are connected by the conductor **86** to the respective screen inductor members **83**. The two screen inductor members may be electrically connected together as are the screen inductor members **7** in Fig. 1.

The casing **70** is provided with a hub portion **87** adjacent the lower end thereof in Fig. 3 which supports a ball bearing **89**. The hub portion **87** also carries a housing **91** extending therefrom along the vertical axis of the cylindrical casing **70**, this housing carrying an outer ball bearing **93** and also providing within the housing a seal about the extension **94** of a shaft **95** rotatable on the axis of the casing. On shaft **95** is fitted a hub **97**, the cylindrical conveyor wall **79** being connected to the hub **97** by a web portion **98**. It will be understood, upon rotation of the shaft **95** in the direction of the arrow, Fig. 2, in the bearings **89** and **93**, that the cylindrical wall **79** of the conveyor disposed within the annular recess **77** is rotated on the vertical axis of the casing between the inductor members **73** and their ionizers **75** and between the inductor members **83** and the ionizers **85**. Charges induced upon the inner surface of the conveyor **79** through the ionizers **75** are conveyed on its inner surface to the ionizers **85** and are collected from the inner surface by the ionizers **85** and delivered to the screen inductor members **83**. These charges also are delivered through a conductor **99** connecting the screen inductor members to a contact pin **101** bearing on a radial conductive arm **103** carried by an insulating disc **105** supported on the upper end of the shaft **95** by rotation therewith. The arm **103** has an upstanding end portion **107** disposed thereon for movement into and out of positions registering with respective fixed electrodes **109** disposed about the axis of rotation as are the electrodes **23** in Fig. 1 and supported by a cover **110** of insulating material. The upstanding end portion **107** passes in succession at spark gap distance from the electrodes **109** and charges stored on the screen inductor members **83** are delivered through the conductor **99** and through the contact pin **101** and the arm **103** to the electrodes **109** in succession for delivery to the respective spark plugs.

Carried on the shaft **95** adjacent the insulating disc **105** is a conventional automatic advance mechanism **111** for moving the disc and the arm and its end portion **107** angularly with respect to the shaft **95**, for example, upon increase of the speed of the internal combustion engine, so that the sparks will be produced at the respective spark plugs in properly timed relation to the rotation of the engine. The cover **110** serves also to close the end of the cylindrical casing **70** and is held pressure tight against a gasket **112** bearing on the end of the casing wall **70** by a ring **113** threaded on the end of the casing wall.

In order to produce the exciting charge on the exciter inductor members **73** the exciter generator is constructed with a stator **115** of insulating material, Figs. 3 and 4, fitted in the casing **70** and fitted to the stator **71** of the main generator, so that these stators are rigidly held with respect to each other and with respect to the axis of the shaft **95**. Also fitted to the stator **115** is a cylindrical stator portion **117** of insulating material which forms with the stator **115** an annular recess extending about the axis of rotation of the shaft **95**. Within this recess the cylindrical portion **119** of a conveyor of insulating material of the exciter generator is supported by a web portion **121** carried on the shaft **95** for rotation with this shaft. Adjacent and in spaced relation to the inner surface of the conveyor wall **119** an exciter inductor member **123** of the exciter generator is supported by the stator **117**. Adjacent and in spaced relation to the outer surface of the wall **119** of the conveyor and in opposed relation to inductor members **123** exciter ionizer **125** is supported by the stator **115**. This ionizer **125** is electrically connected by the conductor **127** to the conductive casing **70** as a body at a reference potential. Upon excitation of the inductor member **123** charges may be induced upon the outer surface of the conveyor wall **119** to be conveyed thereon, upon rotation of the shaft **95** in the direction of the arrow, Fig. 4, to and to be collected by a collector ionizer **129** supported by the stator **115**, this ionizer being connected by the conductor **131**, Fig. 3, to the screen inductor member **133** supported by the stator **117** in opposed relation to the ionizer **129** adjacent and in spaced relation to the inner face of the cylindrical insulating conveyor wall **119**. Charges collected by the collector ionizer **129** are delivered to the screen inductor member **133** and to the exciter ionizer **73** of the main generator through a conductor **135**.

As shown in Fig. 4 a second exciter inductor member **123** is supported by the stator **117** at the opposite end of a diameter from exciter inductor member **123** and in opposed relation to a second exciter ionizer **126** supported by the stator **115**. A second collector ionizer **130** supported by stator **115** at the opposite end of the diameter from the ionizer **129** is disposed in opposed relation to a second screen inductor member **134** electrically connected thereto. The two screen inductors **133**, **134** may be electrically connected to the respective exciter inductor members **73** of Fig. 2 in the manner shown at the right of Fig. 3, or the screen inductor members **133**, **134** may be electrically connected together and connected to the exciter inductor members **73** electrically connected together. When the exciter inductor members **123**, **124** are sufficiently charged the exciter generator comprising the conveyor **119** and the inductor members **123**, **124** and the screen inductor members **133**, **134**, together with the respective ionizers **125**, **126** and **129**, **130**, will be

capable of delivering to the exciter inductor members 73 of the main generator charges in sufficient amount and at such potential that the excitation of the main generator will be effected and the generation by the main generator of charges for delivery to the electrodes 109 of the distributor will be secured.

The exciter inductor member 124, however, may be charged at a different potential with respect to the exciter inductor member 123, or at the opposite polarity. By connecting the screen inductor 133 and the collector ionizer 129 connected thereto to the second exciter inductor member 124 and further connecting the screen inductor member 134 and the collector ionizer 130 connected thereto to the exciter inductor member 123, the exciter generator may be operated as a self exciting generator, as disclosed in the application Serial No. 465,395, filed October 28, 1954, above referred to, when initial excitation of the exciter inductor member 123 is effected. If desired, however, the two exciter inductor members 123 and 124 may be supported by the stators at opposite surfaces of the conveyor wall 119, as in Fig. 1, the respective ionizers 125, 126 being correspondingly disposed at opposite surfaces of this conveyor wall, in order to utilize both faces of the conveyor wall for carrying the charges and to secure mutual excitation in the manner described in connection with Fig. 1.

In order to produce the initial excitation of the exciter inductor member 123 of the exciter generator an auxiliary priming generator is provided constructed in accordance with the invention with a third stator 141 rigidly supported within the stator portion 117 and provided with an annular recess 143 between two walls of the stator 141 extending about the axis of the shaft 95. As shown in Figs. 3 and 4, in the embodiment being described conductive inductor members 145 which are of U section in the radial plane through the axis of rotation and are of arcuate form about this axis are disposed in and with the legs of the U extending along the respective surfaces of the annular recess 143. In the embodiment of Fig. 4 three conductive inductor members 145 are disposed in symmetrically spaced relation about the axis of rotation of the shaft 95. These conductive inductor members may be connected together in parallel and connected by the conductive lug 147 to the inductor member 123 by engagement of the lug 147 with a button 148 carried by the inductor member 123 and extending through the wall of the supporting stator 117. For simplicity only one such connection is shown in Fig. 3 such as may serve when the two sections of the exciter generator are mutually exciting as above referred to.

Intermediate between the conductive inductor members 145 in symmetrically spaced relation about the axis of the shaft 95, Fig. 4, inductor members 149 are disposed which also are of U section in the radial plane and have their arcuate portions extending along the annular surfaces of the recess 143.

The inductor members 145 and 149 respectively are provided with contact elements 151 and 153 extending generally radially inwardly therefrom and electrically connected to the respective inductor members. In the spaces between the contacts 151 and 153 contacts 155 are disposed each connected to a ring 157 by a conductive pin 159. Only one such pin is shown at the right in Fig. 3 connected to the contact 155 supported on the inner wall of the stator 141 in insulated relation to the inductor members 145, 149. The ring 157 may be connected to ground or to a body at a selected reference potential.

Supported on the shaft 95 for rotation therewith a rotor 161 of insulating material has its cylindrical portion 162 disposed within the annular recess 143 so that its inner and outer surfaces rotate between the legs of the U shaped inductor members 145, 149 that respectively are adjacent the walls of the recess 143. Embedded in the cylindrical wall 162 and extending therealong parallel to the axis of rotation are conductive conveyor members 163, each of which is provided with a transverse portion 165 connecting to a contact lug 167 supported in the web portion 161 of the rotor, the lug 167 being exposed at the lower face of the web so as to rotate successively into contact with the reference potential contacts 155 and with the contacts 151, 153 respectively connected to the conductive inductor members 145, 149. A large number of relatively narrow conductive conveyor members 163 is carried by the rotor wall 162 disposed in circumferentially spaced relation about the axis of rotation as shown in Fig. 4, so that, upon rotation of the rotor, a large number of inductive cycles are effected with respect to each inductor member. The insulating material of the rotor not only insulates the conveyor members from each other but reduces the risk of discharge between the conveyors and the parts at different potentials, such as the inductors, adjacent which these conveyors move, while providing for the requisite inductive relation of the conveyor members 163 to the inductor members 145, 149. Other advantages disclosed in the application Serial No. 492,495, filed March 7, 1955, corresponding to the French application No. 664,847, filed March 8, 1954, above mentioned, may be secured by this form of auxiliary priming generator.

A charge received by a conductive conveyor member 163 through a contact 155 from ring 157 under the influence of an inductor 145, 149 is conveyed by the conveyor member rotating in the direction of the arrow, Fig. 4, after breaking engagement with the contact 155, to the position where the lug 167 engages a contact 151, 153 connected to the next inductor member for delivering the charges to this next inductor member at increased potential in the manner disclosed in the application Serial No. 492,495, filed March 7, 1955, above mentioned, corresponding to the French application No. 664,847, filed March 8, 1954. The charge also is delivered to the inductor member 123 of the exciter generator when the conveyor members 163 move into inductive relation to the inductor members 145 and are connected thereto, these inductor members 145 being connected to the exciter inductor member 123. The exciter generator thus may build up its potential and continue to generate potential for excitation of the main generator as long as the exciter inductor members 123 remain charged. Such charging of the inductor members 123 will continue as long as the rotor 161 of the auxiliary priming generator is disposed in the position shown in Fig. 3 in which the lugs 167 connected to the conveyors 163 make contact in succession with the contacts 155 and then with the contacts 151, 153, as the case may be.

If it is assumed for purposes of explanation that an inductor member 145 has a charge at a positive potential delivered thereto by the conveyor members 163 and is charged at this positive potential, the conveyors will acquire a negative charge when connected to the next contact 155 while still in inductive relation to the inductor member 145 but disconnected therefrom by movement out of engagement with its contact 151. This negative charge will be delivered to the next inductor member 149 and the conveyor member 163 moving in inductive relation to the inductor member 149, after breaking connection with its contact 153, will acquire a positive charge upon connection to the next contact 155 while still in inductive relation to the inductor member 149. The two sets of inductor members 145 and 149 thereby may operate at opposite polarities. The inductor members 149 negatively charged thus serve to maintain the positive polarity of the inductor members 145. If desired, however, the negatively charged inductor member 149 of the auxiliary priming generator may be connected to an additional exciter inductor member in the exciter generator, not shown in Figs. 3 and 4, corresponding to the exciter member 65 of Fig. 6 and cooperating with an additional exciting ionizing element initially to produce the charges of positive

potential on the exciter generator conveyor as described in connection with Fig. 6.

When the excitation of this exciter generator is established and, if this generator is arranged for mutual excitation of the two portions thereof as above referred to, it becomes possible to disconnect the auxiliary priming generator and to move the contacts thereof which are rotatable with the rotor out of contact with the fixed contacts, thereby to avoid frictional wear as well as to avoid erosion due to sparking which may occur between these contacts upon approach and separation thereof in the relative movement thereof upon rotation of the rotor. To this end, the rotor **161** of the priming generator in the embodiment of Figs. 3 and 4 is supported for movement along the shaft against the bias of spring **171** which is disposed between the web **161** of the priming generator rotor and the web **121** of the conveyor **119**. The spring **171** biases the rotor **161** downwardly in Fig. 3 into position such that the lugs **167** may engage the contacts **151, 153, 155** and so that the hub **173** of the rotor bears against a conical member **175** which also is slidable on the shaft **95** with the rotor **161**. Provision may be made to limit the movement of the rotor and of the conical member **175** downwardly in Fig. 3 so that the contact of the lugs **167** may be secured without interference with the movement of these lugs by the stationary contacts **151, 153, 155**.

In order to secure separation of the lugs **167** from the contacts when the exciter generator has built up its excitation and has attained a speed sufficient to maintain its own excitation and that of the main generator in the manner described in connection with Fig. 1 for the exciter conveyor **31**, a flange **177** is secured upon the shaft **95** adjacent a shoulder **179** of this shaft to prevent movement of the flange **177** downwardly in Fig. 3. Two pins **181** parallel to the axis of the shaft are fixed on the flange **177** and support weights **183** that are pivotally movable on the pins **181** outwardly with respect to the axis of the shaft under the action of the centrifugal force, the effective mass of the weights being disposed in circumferentially offset relation to the pivotal pins **181**.

In the outward movement of these weights under the action of centrifugal force conical surfaces **185** thereon engage the inner conical surface of the conical member **175** and by camming action the conical member **175** is moved upwardly along the shaft **95**, thereby moving the rotor **161** upwardly and moving the lugs **167** out of position to engage the contacts **151, 153, 155**. As long as a given speed of rotation of the shaft is maintained, the lugs **167** will continue to be separated from the position where they may make contact with the fixed contacts. Upon reduction of the speed of the shaft **95**, the spring **171** tending to move the rotor **161** and the conical member **175** downwardly is effective to move the weights **183** inwardly toward the axis by a reverse camming action of the inner surface of the conical member **175**. If desired, additional springs or other bias means may be utilized to produce the return movement of the weights **183** so that the lugs **167** may return to the plane transverse to the axis in which they may make contact with fixed contacts **151, 153, 155**. The auxiliary priming generator then again will become capable of initiating the priming charge for the exciter inductor member **123** for effecting the build-up of excitation of the exciter generator and thereafter the excitation of the main generator in the manner which has been described.

It will be recognized that the electrostatic machine disclosed in connection with Figs. 2, 3 and 4 comprises not only the main generator driven by the same shaft as the exciter generator and its auxiliary priming generator but that the exciter generator is arranged with respect to the main generator so that the connections therebetween are simple and short. Moreover, the space within the cylindrical conveyor of the exciter generator and particularly within the inner stator wall thereof is utilized for disposition of the structure of the auxiliary priming generator.



It will be understood further that this priming generator, which utilizes a rotor of insulating material in which preferably a large number of conductive conveyor members are embedded so that a large number of cycles of charge and discharge of these conductive conveyor members is effected in each revolution of the shaft, also utilizes a stator providing a recess in which the rotor carrying the conveyor members rotates.

The arrangement shown of the auxiliary priming generator with respect to the exciter generator also provides for the disposition of the fixed contacts inwardly with respect to the rotors and supported on the inner wall of the stator of the auxiliary generator. Moreover, the automatic device described for moving the rotor out of position in which the lugs **167** are engaged with the fixed contacts is disposed within the stator of the auxiliary priming generator. Although the stators **115, 117, 141** are shown as separate parts, within the scope of the invention, these stators may be made of a single piece or of such number of pieces as conveniently to provide a rigid stator in which are formed at least two annular recesses co-axial with the axis of rotation of the shaft. In the outer recess the insulating conveyor of the exciter generator is disposed and in the inner recess the rotor of the auxiliary priming generator for priming the exciting generator is disposed.

Within the scope of the invention other means may be utilized for effecting movement of the rotor **161** along the shaft to move the contact lugs **167** out of position for engagement with the fixed contacts **151, 153, 155** for the purpose of reducing wear and erosion as above mentioned. In Fig. 5 the corresponding parts have like reference numerals as in Fig. 3, Fig. 5 being a vertical section corresponding to that of Fig. 3. In Fig. 5, however, instead of a mechanical device operated by centrifugal force for effecting movement of the rotor **161** against the bias of the spring **171** to carry the contacts **167** upwardly away from the plane of the contacts **151, 153, 155**, a solenoid coil **191** is supported within the inner wall of the stator **141** and in such position with respect to an armature **193** fixed upon the extended hub **195** of the rotor **161** that, upon energization of the coil **191**, the armature **193** and the hub **195** will be drawn upwardly in Fig. 5, thereby to move the rotor **161** upwardly against spring **171** and to move the lugs **167** upwardly from the plane of engagement with the fixed contacts. The solenoid coil **191** may be energized by any suitable means, for example, a hand switch, upon the attainment of a desired speed for effective excitation of the main generator or upon satisfactory ignition and running of the internal combustion engine. Within the scope of the invention such energization of the solenoid **191** may be effected automatically, for example, upon the attainment of a given potential by the exciter generator. The operation of the machine shown in Fig. 5 otherwise will be the same as in Fig. 3.

It will be understood that within the casing **70** a dielectric fluid medium, preferably a gas under pressure, may be confined, for example, pure hydrogen or nitrogen having little affinity for electrons. This gas may be introduced through the valve **200** carried by the insulating cover **110**. The valve **200** may be of conventional design for connection to a pump or other device for pumping the gas into the casing **70** and sealing off connection when sufficient pressure is secured.

The extension shaft **94** of the composite generator of Figs. 2, 3 and 4 may be connected by any suitable transmission means to the internal combustion engine to drive the generator in properly timed relation to the internal combustion engine. When utilized for electrostatic generation for other purposes the shaft **94** may be driven by a suitable motor.

Fig. 7 shows a simple form of a magnetic drive which may be disposed within the portions **87, 91** of the casing of Fig. 3, suitably modified, for effecting rotation of the shaft **95** upon rotation of the shaft **94**. The casing **87** in Fig. 7 provides a cylindrical wall on which is thread-

ed a ring nut **205** for retaining a closing member **207** having an annular flange **209** pressing a gasket **210** against the end of the wall of casing **87** in pressure tight relation, thereby to confine the fluid under pressure within the casing **87** as within the casing **70**, **87** of Fig. 3.

The closing member **207** provides a continuous wall without stuffing box or other seal such as that used in the embodiment of Fig. 3. In the embodiment of Fig. 7 the closing member **207** is formed with relatively thick flat walls **211**, **212** extending transverse to the axis and connected by a thin wall **213** of non-magnetic material as a body of revolution providing surfaces of revolution extending about the common axis of rotation of the shaft **94**, **95**. In the embodiment of Fig. 7 the wall **213** is of cylindrical form but this wall may be of other forms which provide the solid of revolution and surfaces of revolution extending about the common axis.

Secured to the shaft **95** which is supported in bearing **89** mounted in a transverse member **215** similarly to Fig. 3 is a cylindrical cup-shaped member **217** at the inner periphery of which are mounted driven magnetic elements **219** providing inwardly disposed peripheral surfaces of revolution adjacent the surface of the wall **213** that is disposed outwardly of this wall with respect to the common axis. Mounted on the shaft **94** are driving magnetic elements **221** providing outwardly disposed peripheral surfaces of revolution adjacent the surface of revolution of the wall **213** that is disposed inwardly of the wall **213** toward the common axis. The spaces between the magnetic elements **219** and the adjacent outer surface of the wall **213** and between the magnetic elements **221** and the inner surface of the wall **213** are restricted to provide a restricted magnetic gap between the magnetic elements **219** and the magnetic elements **221**. Because of the restricted thickness of the wall **213**, this magnetic gap is restricted sufficiently to make effective the magnetic pull of the driving magnetic elements **221** upon the driven magnetic elements **219** upon rotation of the shaft **94** so as to effect rotation of the shaft **95** together with the shaft **94**.

Having regard to the form of the wall **213** as a solid of revolution, the thickness of this wall may be restricted to provide the restricted magnetic gap while at the same time providing sufficient thickness of the wall **213** to resist rupture under the pressure of the fluid within the casing **87**.

In Figs. 8 and 9 is shown diagrammatically a speed multiplying device which may be mounted within the casing **87** for effecting rotation of the shaft **95** at a substantially higher speed than the rotation of the shaft **94**. In Fig. 8 a portion of the casing **87** is represented in which walls **225** transverse to the common axis of the shaft **94**, **95** are supported, these walls being secured together by bolts **227** and spaced apart by spacers **229**. The shaft **94** extends through bearing **231** and is supported at its end in bearing **233**, these bearings being respectively supported by two adjacent walls **225**.

The shaft **94** has secured thereto the driving gear **235** of a gear set which includes a driven gear or pinion **237** which is secured to a short shaft **239** which is supported in bearings **241** and **243** respectively mounted on the two adjacent walls **225** which carry the bearings of the shaft **95**.

The short shaft **239**, however, extends through the middle wall **225** and has secured to its projecting end the driving gear **245** of the gear set which includes the driven pinion **247** meshing with the gear **245**. The pinion **247** is supported for rotation on a stud **249** fixed in a boss **251** carried on the upper wall **225** in Fig. 8. Secured to the pinion **247** for rotation therewith is the driving gear **253** of a third set of gears which includes the pinion **255** secured upon the shaft **95** the end of which is mounted for rotation in the bearing **257** carried by the upper transverse wall **225**.

It will be understod that upon rotation of the shaft **94** the large gear **235** meshing with the pinion **237** drives this pinion in a greatly increased ratio of speed because of the ratio of the diameters and number of teeth of these two gears. Similarly the ratios of the other gear sets **245**, **247** and **253**, **255** are such as greatly to multiply the rotations of the driven gears or pinions and thereby greatly to multiply the overall ratio of rotation of the shaft **95** with respect to the shaft **94**.



It will be noted from Fig. 9 that the gear sets are disposed generally about the common axis of the shafts **95** and **94**, so that the whole gear train may be mounted within the inner circumference of the casing **87**. Depending upon the particular conditions of operation of the machine the casing may be made larger than as shown in Fig. 3 and similarly to the casing **87** of Fig. 7.

In Fig. 10 is shown a portion of a practical embodiment of the electrostatic machine which includes a magnetic drive and a speed multiplying device. The arrangement of Fig. 10 is somewhat different from those of Fig. 7 and of Figs. 8 and 9. In Fig. 10 the shaft **94** carries a cup-shaped member **261** providing a cylindrical wall **262**. Upon the inner surface of the cylindrical wall **262** are supported driving magnetic elements **263** for rotation of these driving magnetic elements upon rotation of the shaft **94**, the cup **261** being secured in a shouldered portion of the shaft **94**, the end **265** of this shaft being riveted over the transverse web portion of the cup **261**.

The casing **70** of Fig. 3 is modified in Fig. 10 to provide both for a magnetic drive and for a speed multiplying device. This casing **70**, has a downwardly extending portion **267** which provides a wall **266** which broadly is a solid of revolution providing inner and outer surfaces of revolution. In the specific embodiment of Fig. 10 the wall **266** is a cylinder providing inner and outer cylindrical surfaces. The driving magnetic elements **263** provide inner cylindrical surfaces disposed in closely adjacent relation to the outer cylindrical surface of the wall **266**. The downwardly extending portion **267** of the casing **70** is closed at its lower end by a transverse wall **268** to confine the fluid under pressure within the casing **70** without recourse to a stuffing box or other seal. The transverse wall **268** also serves to support a stud **269** which is riveted or welded to the transverse wall **268**. This stud **269** carries a bearing **270** on which the inner bore of a hub **271** of a carrier **273** bears to provide for rotation of the carrier **273** relative to the stud **269** and bearing **270**.

To the flange portion **275** of carrier **273** are secured driven magnetic elements **277**. These driven magnetic elements also provide outwardly disposed surfaces of revolution adjacent the inner surface of revolution of the wall **266**. As in the embodiment of Fig. 7 the wall **266** is of restricted thickness and the spaces between the magnetic elements and the respective surfaces of revolution of the wall **266** are restricted to secure the restricted magnetic gap between the magnetic elements **263** and **277** so as to provide for the magnetic pull of the elements **263** upon the elements **277** upon rotation of the shaft **94**, thereby to rotate the carrier **273**. It will be noted in the embodiment of Fig. 10 that the downwardly extending portion **267** of the casing **70** is disposed so that the internal pressure of the fluid acts outwardly upon the wall **266**, whereas in Fig. 7 this pressure acts upon the wall **213** inwardly toward the axis. Nevertheless, the thickness of the wall **266**, having regard to the non-magnetic material from which the casing is made, is such as to resist the pressure within the casing while restricting the magnetic gap as above described.

To the carrier **273** is riveted a pin **279** upon which is rotatably supported a planet gear **281** for rotation with the carrier **273** about the common axis of the shaft **94** and the stud **269**, the shaft **94** and the stud **269** being disposed on the axis of rotation of a stem **283** of the carrier which projects co-axially with shaft **94** upwardly to a suitable bearing, not shown in Fig. 10.

The teeth of the planet gear **281** engage the teeth of the

fixed ring gear **284** supported in a shouldered portion of the casing **70**. The planet gear **281** also meshes with the sun gear **285** cut on the end of a sleeve shaft **287** provided with a bearing **289** at its lower end which is secured in the sleeve and bears on the outer surface of the stem **283** with respect to which the sleeve **287** is rotatable. This sleeve at its upper end is supported in suitable bearings not shown in Fig. 10 and carries a bushing **291** which is slidable parallel to the axis of rotation along the sleeve **287**, a ball key **293** being disposed in a socket in the sleeve **287** and engaging an internal slot **294** in the bushing **291**. The bushing **291** has secured thereto the hub **173** of the rotor **161** of the priming generator similar to that shown in Fig. 3, the spring **171** being provided for biasing the hub **173** and the sleeve **291** downwardly in Fig. 10.

Upward movement of the bushing **291** along the sleeve **287** is accomplished by centrifugal action of the balls **296** engaging the inner conical surface of member **297** which extends about bushing **291** and is slidable along this bushing, being held against rotation relative to the bushing by the ball key **298** disposed in a socket in the bushing and engaging an inner keyway **299** of the member **297**. The balls **296** are retained by the cup-shaped annular member **301** secured upon the outer surface of the sleeve **287** for rotation with this sleeve. It will be understood by virtue of the ball keys **293**, **298** that the member **297** also rotates with the bushing **291** and with the sleeve **287**. The member **297** is provided with inwardly projecting wings **303** between and engaging the balls **296** so that under centrifugal action the balls are retained against relative peripheral movement about the axis of shaft **94** and move outwardly with respect to this axis and cam the member **297** along the axis against the bias of the spring **171** to move the rotor **161** in the manner and for the purpose described in connection with Fig. 3.

Other modifications may be made within the scope of the invention while securing the constructive features and arrangements of the generators which have been described and the effective disconnection and connection of the priming generator upon attaining of the requisite excitation of the exciter generator. All such variations are intended to be within the scope of the appended claims.

We claim:

1. An electrostatic generator comprising a conveyor providing a wall of insulating material extending about a hollow space and about an axis of rotation, means for supporting said conveyor for rotation on said axis, means disposed adjacent said conveyor for developing an electric field transversely of the wall of said hollow conveyor, a conductive inductor member supported within said hollow conveyor, a conductive conveyor member disposed within said hollow conveyor and supported for rotation thereof about said axis of rotation into and out of inductive relation to said conductive inductor member, means for establishing connection of said conductive conveyor member to a reference potential at a predetermined point in the rotation of said conductive conveyor member on said axis relative to said conductive inductor member, and means for establishing connection of said conductive conveyor member to said means for producing said electric field at another predetermined point in said rotation of said conveyor member on said axis relative to said conductive conveyor member.

2. An electrostatic generator comprising a conveyor providing a wall of insulating material extending about a hollow space and co-axial with an axis of rotation, means for supporting said conveyor for rotation on said axis and with the hollow space within said conveyor open at an end thereof, a stator of insulating material having a portion extending at said end within said hollow space of said conveyor and supporting an element which when charged is capable of and disposed for developing an electric field transversely of said wall of said conveyor, a plurality of conductive inductor members supported by said stator inwardly toward said axis with respect to said conveyor wall and in spaced relation to each other about said axis of rotation, a rotor disposed inwardly toward said axis with respect to said conveyor wall and supported for rotation thereof on said axis of rotation, a plurality of conductive conveyor members supported by said rotor in spaced relation to each other about said axis of rotation for rotation thereof in succession into and out of inductive relation to said conductive inductor members in succession, means supported by said stator for establishing at a predetermined position of the respective conductive conveyors in relation to respective conductive inductor members connection of said conductive conveyor members in succession to a reference potential for charging said conveyor members, and means supported by said stator for establishing at another predetermined position of the respective conductive conveyor members in relation to respective conductive inductor members connection of said conductive conveyor members in succession to said element capable of developing an electric field transversely of said wall of said conveyor for producing said electric field.

3. An electrostatic generator as defined in claim 2 in which said means for establishing said connection of said conductive conveyor members to said reference potential and said means for establishing connection of said conductive conveyor members to said element for producing said electric field comprise fixed contacts carried by said stator and connected respectively to said reference potential and to said element, and movable contacts carried by said rotor and connected to the respective conveyor members and rotatable into contact with said fixed contacts upon rotation of said rotor, said rotor being supported for predetermined movement thereof with respect to said stator for effecting movement of said movable contacts out of and into engagement with said fixed contacts upon said predetermined movement of said rotor.

4. An electrostatic generator as defined in claim 3, in which said rotor is supported for said predetermined movement thereof generally along said axis of rotation between positions in which said movable contacts carried thereby respectively engage and are disengaged from said fixed contacts.

5. An electrostatic generator as defined in claim 4, which comprises means biasing said rotor toward the position thereof in which said movable contacts carried thereby engage said fixed contacts carried by said stator, and means responsive to the speed of rotation of said rotor and operatively connected to said rotor to effect movement of said rotor against said bias means in response to a predetermined speed of said rotor to move said movable contacts out of engagement with said fixed contacts.

6. An electrostatic generator comprising a conveyor providing a wall of insulating material of cylindrical form extending about a hollow space and co-axial with an axis of rotation, means for supporting said conveyor for rotation on said axis and with the hollow space within said conveyor open at an end thereof, a stator of insulating material having a portion extending at said end within said hollow space of said conveyor and extending about said axis of rotation in spaced relation to the inner surface of said wall of said hollow cylindrical conveyor, said stator having a portion extending about said axis and in spaced relation to the outer surface of said wall of said hollow cylindrical conveyor, ionizing elements and generating inductor members supported by said portions of said stator adjacent and in spaced relation to the cylindrical surfaces of said wall of said hollow cylindrical conveyor with the ionizing elements disposed in opposed relation to and at the opposite side of said cylindrical conveyor wall from respective generating inductor members, a cylindrical rotor supported for rotation thereof on said axis of rotation and disposed inwardly toward said axis with respect to the portion of

said stator which extends within said hollow space of said cylindrical conveyor, an auxiliary conductive inductor member carried by said portion of said stator extending within said hollow cylindrical conveyor, a conductive conveyor member carried by said rotor for movement thereof into and out of inductive relation to said auxiliary inductor member in the rotation of said rotor, means for establishing connection of said conductive conveyor to a reference potential at a predetermined position of said conductive conveyor in relation to said auxiliary inductor member in said rotation of said rotor on said axis, and means for connecting said conductive conveyor member to a selected generating inductor member disposed adjacent a surface of said cylindrical insulating conveyor at another predetermined position of said conductive conveyor member in relation to said auxiliary inductor member in the rotation of said rotor on said axis.

7. An electrostatic generator which comprises a conveyor providing a wall of insulating material of cylindrical form extending about a hollow space and co-axial with an axis of rotation, means for supporting said conveyor for rotation on said axis and with the hollow space within said conveyor open at an end thereof, an ionizing element, a generating inductor member, said ionizing element and said generating inductor member being supported adjacent and in spaced relation respectively to the opposite surfaces of the wall of said cylindrical conveyor and in opposed relation to each other, a plurality of auxiliary conductive inductor members disposed inwardly toward said axis of rotation with respect to said wall of said cylindrical conveyor and supported in spaced relation to each other about said axis, a plurality of conductive conveyor members disposed inwardly toward said axis with respect to said wall of said cylindrical conveyor and supported in spaced relation to each other about said axis of rotation for rotation about said axis in succession into and out of inductive relation to said auxiliary conductive inductor members in succession, means for establishing connection of said conductive conveyor members in succession to a reference potential at predetermined points in the movement of the respective conductive conveyor members relative to said auxiliary conductive inductor members, and means for establishing connection of the respective conductive conveyor members to said generating inductor member at points in the rotation of said conductive conveyor members relative to the respective auxiliary inductor members spaced about said axis from said predetermined points.

8. An electrostatic generator which comprises a conveyor providing a wall of insulating material of cylindrical form extending about a hollow space and co-axial with an axis of rotation, means for supporting said conveyor for rotation on said axis and with the hollow space within said conveyor open at an end thereof, a stator having a portion extending at said end within said hollow space of said conveyor and extending about said axis of rotation, an ionizing element supported by said stator adjacent and in spaced relation to the inner cylindrical surface of said wall of said conveyor, a generating inductor member supported by said stator in spaced relation about said axis of rotation from said ionizing element and adjacent and in spaced relation to said inner surface of said wall of said hollow cylindrical conveyor, said ionizing element and said generating inductor member respectively being disposed in opposed relation to a second generating inductor member and a second ionizing element supported adjacent and in spaced relation to the outer surface of said wall of said hollow cylindrical conveyor for developing electric fields between said ionizers and the respective inductors transversely of the wall of said cylindrical conveyor, said generating inductors being electrically connected together, a plurality of auxiliary conductive inductor members disposed inwardly toward said axis with respect to said wall of said cylindrical conveyor and supported by said stator in spaced relation to each other about said axis of rotation, a plurality of conductive conveyor members disposed inwardly toward said axis of rotation with respect to said cylindrical conveyor wall and supported in spaced relation to each other about said axis of rotation for rotation about said axis in succession into and out of inductive relation to said auxiliary conductive inductor members in succession, means supported by said stator and connected to a reference potential and successively connected to said auxiliary conveyor members in the rotation of said conveyor members about said axis for establishing connection of said auxiliary conveyor members in succession to said reference potential, and means supported by said stator and connected to said electrically connected generating inductor members and successively connected to said auxiliary conveyor members in the rotation of said auxiliary conveyor members about said axis for establishing connection of said auxiliary conductive conveyor members in succession to said generating inductor members for developing electric fields between said generating inductor members and the respective ionizers disposed in opposed relation thereto.

9. An electrostatic generator comprising a stator providing a wall of insulating material of cylindrical form extending about a hollow space and co-axial with an axis of rotation, a rotor providing a wall of insulating material of cylindrical form extending about a hollow space and supported for rotation thereof on said axis of rotation with the cylindrical wall of said rotor in spaced parallel face to face relation to the cylindrical wall of said stator, said rotor being supported for movement thereof along said axis of rotation between two predetermined positions, a conductive inductor member supported by said stator in parallel relation to said cylindrical wall of said stator, a conductive conveyor member carried by said rotor in parallel relation to said cylindrical wall of said rotor for movement of said conductive conveyor member into and out of inductive relation to said conductive inductor member upon rotation of said rotor, a fixed contact carried by said stator connectible to a terminal of said electrostatic generator, a contact carried by said rotor and connected to said conductive conveyor member and movable into and out of engagement with said fixed contact to provide for passage of charges between said conductive conveyor member and said fixed contact upon rotation of said rotor when said rotor is in a given one of said predetermined positions of said rotor, means biasing said rotor toward said given predetermined position thereof, and means responsive to the speed of rotation of said rotor and operatively connected to said rotor to effect movement of said rotor against said bias means toward said other predetermined position of said rotor in response to a predetermined speed of said rotor.

10. An electrostatic generator as defined in claim 9 in which said means responsive to the speed of rotation of said rotor comprises a member supported by said rotor for movement thereof outwardly with respect to the axis of rotation of said rotor under the action of centrifugal force upon rotation of said rotor, and means operatively connected to said means movable outwardly with respect to said axis under centrifugal force and engageable with said rotor in response to a predetermined speed of said rotor to effect said movement of said rotor along said axis of rotation.

11. An electrostatic generator comprising a stator of insulating material providing therein a pair of annular recesses disposed in concentric relation to each other with opposed annular peripheral surfaces of each recess extending along and co-axial with a common axis of rotation, a rotor of insulating material supported for rotation on said axis and having two concentric radially spaced walls each providing peripheral surfaces extending along and co-axial with said axis of rotation, said walls of said rotor being disposed within the respective recesses of said

stator and in spaced relation to said peripheral surfaces of said recesses, means disposed adjacent and in spaced relation to opposite peripheral surfaces of a given one of said walls of said rotor for developing an electric field transversely of a said given wall of said rotor, said means being supported by said stator within the recess within which said given wall of said rotor is disposed, a conductive member supported by said stator within the annular recess within which said other wall of said rotor is disposed, another conductive member carried by said other wall of said rotor for movement of said other conductive member into and out of inductive relation to said conductive member supported by said stator upon rotation of said rotor, a rotatable member supported for rotation thereof with said rotor on said axis of rotation of said rotor and for movement thereof along said axis between a given position and another position spaced along said axis, a contact carried by said stator and connected to said means for developing said electric field for conducting a charge between said stator contact and said means, a contact carried by said rotatable member and connected to said conductive member carried by said rotor, said contact carried by said rotatable member being engageable with said contact carried by said stator upon rotation of said rotatable member and said rotor on said axis in said given position of said rotatable member and being disengaged from said stator contact in said other position of said rotatable member, and means responsive to the speed of rotation of said rotor and operatively connected to said rotatable member for effecting said movement of said rotatable member along said axis from said given position toward said other position thereof to disengage said contacts from each other in response to a predetermined speed of rotation of said rotor.

12. An electrostatic generator comprising a stator of insulating material providing therein a pair of annular recesses disposed in concentric relation to each other with opposed annular peripheral surfaces of each recess extending along and co-axial with an axis of rotation, a rotor of insulating material supported for rotation on said axis and having two concentric radially spaced walls each providing peripheral surfaces extending along and co-axial with said axis of rotation, said walls of said rotor being disposed within the respective recesses of said stator and in spaced relation to the said peripheral surfaces of said recesses, means disposed adjacent and in spaced relation to opposite peripheral surfaces of a given one of said walls of said rotor for developing an electric field transversely of said given wall of said rotor, said means being supported by said stator within the recess within which said given wall of said rotor is disposed, conductive members respectively supported by said stator and by said rotor within the annular recess in which said other wall is disposed for movement of said conductive members into and out of inductive relation to each other upon rotaion of said rotor, means supporting said other wall of said rotor for movement of said other wall relative to said stator between a given poistion of said other wall within its recess and another position thereof spaced along said axis of rotation from said given position, contacts respectively supported by said stator and carried by said other wall of said rotor, a contact supported by said stator being connected to said means for developing said electric field for conducting a charge between said stator contact and said field developing means, a contact carried by said other wall of said rotor being connected to a conductive member carried by said other wall of said rotor and being moved into and out of engagement with said contact supported by said stator upon rotation of said rotor on said axis of rotation when said other wall is disposed in said given position thereof within its recess, said contact carried by said other wall of said rotor being moved out of position for engagement with said contact supported by said stator upon said movement of said other wall of said rotor along said axis from said given position of said other wall toward said other position thereof, and means responsive to the speed of rotation of said rotor and operatively connected to said other wall of said rotor for effecting said movement of said other rotor wall along said axis from said given position thereof to disengage said contacts from each other in response to a predetermined speed of rotation of said rotor.

13. An electrostatic generator as defined in claim 1 which comprises charge collecting means disposed adjacent the wall of said conveyor of insulating material for collecting therefrom charges developed thereon and conveyed thereby upon rotation of said conveyor of insulating material upon said axis of rotation, a main generator conveyor providing a wall of insulating material extending about a hollow space and co-axial with said axis of rotation of said first conveyor and rotatable with said first conveyor on said axis, means disposed adjacent said main generator conveyor wall for producing an electric field transversely of said wall of said main conveyor for developing charges upon a surface of said main conveyor wall, said charge collecting means being connected to said means for producing said electric field of said main generator for conducting to said field producing means charges generated by said first conveyor and collected therefrom for exciting said main generator.

14. An electrostatic generator as defined in claim 2 which comprises a conveyor of a main generator providing a wall of insulating material extending about a hollow space and coaxial with said axis of rotation of said first conveyor and rotatable with said first conveyor on said axis, a plurality of inductor members of said main generator disposed in spaced relation to each other about said axis of rotation and each supported by said stator adjacent a peripheral surface of said wall of said conveyor of said main generator, a plurality of ionizing elements disposed in spaced relation to each other about said axis of rotation and supported by said stator respectively in opposed relation to said inductor members adjacent and at the opposite side of said main generator conveyor wall from said inductor members, charge collecting means disposed adjacent said wall of insulating material of said first conveyor for collecting charges developed thereon and conveyed thereby upon rotation of said first conveyor, said charge collecting means being connected to a given inductor member of said main generator for charging said given inductor member to develop an electric field between said given inductor member and the corresponding ionizing element, another inductor member of said main generator being connected to the ionizing element disposed in opposed relation thereto and being connected to a load terminal of said main generator.

15. An electrostatic generator system comprising a primer generator, an exciter generator having a conveyor of insulating material supported for movement of said conveyor along a given path of movement, a plurality of inductor members disposed adjacent to and in spaced relation along said path, a plurality of ionizers disposed adjacent to and in spaced relation along said path in opposed relation to and at opposite sides of said conveyor from the respective inductor members, said inductors and ionizers being interconnected with respect to each other so as to sustain an excitation potential at the respective inductor members upon an initial application of a priming potential to a given one of said inductor members, means operatively connecting said primer generator to said given inductor member to apply said priming potential to said given inductor member, and means operatively connected to said primer generator and to said given inductor member and operable for terminating said application of said priming potential to said given inductor member.

16. An electrostatic generator system comprising a primer generator, an exciter generator having a conveyor providing a wall of insulating material having opposite surfaces extending generally along a path of movement

of said conveyor, means for supporting said insulating conveyor for movement thereof along said path, an input inductor disposed adjacent to a given surface of said wall of insulating material, an input ionizer disposed adjacent the surface of said insulating conveyor opposite to said given surface and in opposed relation to said input inductor, charge collecting means disposed adjacent said opposite surface of said conveyor in spaced relation to said input ionizer along said path for collecting charges carried by said insulating conveyor from said input ionizer to said charge collecting means, means operatively connected to said charge collecting means and operable to convert charges collected by said collecting means to charges for exciting said input inductor, means connected to said converting means and to said input inductor for delivering said converted charges to said input inductor to render said exciter generator self-sustaining, means operatively connected to said primer generator and to said exciter generator input inductor for applying to said input inductor a priming potential, and means operatively connected to said primer generator and to said exciter generator input inductor and operable to terminate said application of said priming potential to said exciter generator input inductor.

17. An electrostatic generator system including a self-priming primer generator having a plurality of inductors disposed in spaced relation to each other along a path of movement and having a conductive conveyor movable along said path relative to said inductors into and out of inductive relation to said inductors in succession, an insulating conveyor exciter generator having a plurality of inductor and ionizer elements disposed adjacent an insulating conveyor supported for movement relative to said inductor and ionizer elements of said exciter generator and interconnected with respect to one another to render said exciter generator self-sustaining in response to the momentary application of a priming potential to a given one of said exciter inductors, means for applying an output priming potential from said primer generator to said given exciter inductor to excite said exciter generator, means for removing said priming potential from said given exciter inductor after said exciter generator becomes self-sustaining, a main electrostatic generator requiring an external source of excitation, means applying an output potential from said exciter generator to activate said main generator, and a load device connected to the output of said main generator and energized thereby.

18. An electrostatic generator system as defined in claim 17 in which said load device comprises a plurality of spark plugs, and a distributor operatively connected to said main generator for applying the output of said main generator to said spark plugs in a predetermined program.

19. An electrostatic generator system comprising a primer generator having a plurality of conductive inductors and a conductive conveyor supported for movement of said conveyor into and out of inductive relation to said inductors in succession, means interconnecting said conveyor and inductors during said relative movement to develop a priming output potential relative to a reference potential, an exciter generator having a conveyor providing a wall of insulating material extending about an axis of rotation, means for supporting said insulating conveyor for rotation on the axis thereof, an input inductor of said exciter generator disposed adjacent a given surface of said insulating conveyor, an input ionizer disposed adjacent a surface of said insulating conveyor opposite to said given surface of said insulating conveyor in opposed relation to said input inductor, a collector ionizer disposed adjacent said opposite surface of said conveyor in spaced relation to said input ionizer along the path of rotation of said conveyor and collecting charges carried by said insulating conveyor from said input ionizer to said collector ionizer, means operatively connected to said charge collector ionizer for converting charges collected by said collector ionizer to charges for exciting said input inductor, means connected to said converting means and to said input inductor of said exciter generator for delivering said converted charges to said input inductor to render said insulating conveyor exciter generator self-sustaining, means operatively connecting said primer generator to said exciter generator input inductor to apply a priming potential to said exciter generator input inductor, and means operable to terminate the application of said priming potential to said exciter generator input inductor after said exciter generator attains a self-sustaining condition.

20. An electrostatic generator comprising a conductive inductor member, a conductive conveyor member supported for movement of said conveyor member into and out of inductive relation to said inductor member, means for delivering charges to said conveyor member at a predetermined point in the movement of said conveyor member relative to said inductor member, a conductive charge receiving element, means for establishing connection of said conductive conveyor member to said element at another predetermined point in the movement of said conveyor member relative to said inductor member for transferring to said element charges conveyed by said conveyor member, a conveyor providing a wall of insulating material extending about an axis of rotation, means for supporting said insulating conveyor for rotation on the axis thereof, means operatively connected to said element to receive charges therefrom and disposed adjacent said insulating conveyor wall and capable when charged of producing an electric field transversely of said wall for effecting transfer of charges to said insulating conveyor wall, means disposed adjacent said insulating conveyor wall in spaced relation along said wall about the axis thereof with respect to said field producing means for collecting charges from said insulating conveyor wall, a main conveyor providing a wall of insulating material extending about an axis of rotation, means for supporting said main conveyor wall for rotation on its axis, means disposed adjacent said main conveyor wall and connected to said charge collecting means to receive charges therefrom and capable when charged of sustaining an electric field transversely of said main conveyor wall, a main terminal, and means disposed adjacent said main conveyor wall in spaced relation about the axis of said main conveyor wall from said field sustaining means for collecting charges from said main conveyor wall and connected to said main terminal for delivering charges to said main terminal.

21. An electrostatic generator as defined in claim 20 which comprises means connected to said first charge collecting means and capable of converting charges collected by said first charge collecting means to charges capable of producing said electric field transversely of said first conveyor wall of insulating material, said converting means being connected to said field producing means for delivering converted charges to said field producing means.

22. An electrostatic generator system comprising a primer electric generator, an electrostatic generator having a conveyor of insulating material movable in a predetermined path, an input inductor member disposed adjacent said path of movement of said insulating conveyor, an input ionizer disposed adjacent said path of movement of said insulating conveyor in opposed relation to said inductor member, a collector ionizer disposed adjacent said path of movement of said conveyor in spaced relation to said input ionizer along said path for collecting charges carried by said insulating conveyor from said input ionizer to said collecting ionizer, and means connected to said primer electric generator and to said input inductor member for applying to said input inductor member a priming potential to develop the excitation of said insulating conveyor generator, said means

being operable for interrupting said application of said excitation of said primer generator to said input inductor member of said insulating conveyor generator.

23. An electrostatic generator as defined in claim 22 which comprises means responsive to the speed of rotation of said insulating conveyor and operatively connected to said operable means for operating said operable means to remove said application of said excitation of said primer generator from said input inductor member upon attainment of a predetermined speed of said insulating conveyor.

24. An electrostatic generator as defined in claim 22 which comprises means responsive to the potential developed at said collector ionizer and operatively connected to said operable means for operating said operable means to remove said application of said excitation of said primer generator from said input inductor member upon attainment of a predetermined potential at said collector ionizer.

25. An electrostatic generator system comprising a primer generator having a conductive conveyor member movable in a predetermined path and a conductive input inductor member disposed adjacent said path and a conductive output inductor member disposed adjacent said path in spaced relation to said inductor member along said path, said conveyor member being movable in said path into and out of inductive relation to said inductor members one subsequently to the other, means connected to said conveyor member in a given position thereof in inductive relation to said input inductor member for delivering charges to said conveyor member, means connected to said conveyor member in another position thereof in inductive relation to said output inductor member for receiving charges from said conveyor member, an electrostatic generator having a conveyor of insulating material rotatable on an axis providing mutually opposite surfaces and supported for movement thereof parallel to said surfaces, an input inductor member disposed adjacent a given one of said surfaces of said insulating conveyor, an input ionizer disposed adjacent the surface of said insulating conveyor opposite to said given surface in opposed relation to said input inductor member, charge collecting means disposed adjacent said opposite surface of said conveyor in spaced relation to said input ionizer along said path for collecting charges carried by said insulating conveyor from said input ionizer to said charge collecting means, means operatively connected to said charge receiving means of said primer generator and to said input inductor member of said insulating conveyor generator for applying to said input inductor member a priming potential to develop the excitation of said insulating conveyor generator and operable to remove said priming potential from said input inductor member.

26. In an electrostatic generator the combination with a pressure tight casing, and a rotor supported within said casing for rotation on an axis and carrying the rotatable parts of said electrostatic generator, of a driven magnetic element within said casing and connected to said rotor for rotation with said rotor on said axis, and a driving magnetic element exterior to said casing and supported for rotation thereof on said axis of said rotor in magnetic inductive relation to said driven magnetic element to effect rotation of said driven magnetic element and said rotor on said axis upon rotation of said driving magnetic element on said axis, said casing providing a wall between said magnetic elements having thickness restricted to provide a restricted magnetic gap between said elements and capable of confining a fluid under pressure within said casing, a member supported by said casing and disposed outwardly along said axis with respect to said driven magnetic element, and a bearing supported by said member and disposed within said casing and supporting said driven magnetic element for rotation on said axis.

27. In an electrostatic generator the combination as defined in claim 26 in which said wall is annular about said axis, said driving magnetic element being disposed outwardly from said axis of rotation of said rotor with respect to said annular wall of said casing between said magnetic elements, said driven magnetic element being disposed inwardly toward said axis with respect to said annular wall of said casing between said magnetic elements.

28. In an electrostatic generator the combination as defined in claim 26 which comprises a driving rotatable member, a gear train connecting said driving member to said rotor in driving relation for effecting rotation of said rotor upon rotation of said driving rotatable member, the ratio of the gears of said train providing an overall ratio of the rotation of said rotor to the rotation of said driving rotatable member substantially greater than one, means supporting said driving rotatable member for rotation on its axis in alignment with the axis of said rotor and supporting said gear train with the gears thereof disposed about said aligned axes, and means connecting said driven magnetic element to said driving rotatable member for effecting rotation thereof and of said rotor.

29. In an electrostatic generator the combination as defined in claim 28 in which said gear train comprises a stationary ring gear concentric with said aligned axes, a sun gear mounted on said rotor for rotation therewith on said aligned axes, a carrier supported for rotation on said aligned axes relative to said ring gear and to said sun gear, a planet gear supported on said carrier for rotation relative to said carrier on an axis offset outwardly from and parallel to said aligned axes, said planet gear being disposed between and meshing with said ring gear and said sun gear, and means operatively connecting said carrier to said driving rotatable member for effecting rotation of said carrier upon rotation of said driving rotatable member to effect rotation of said rotor in a multiplied ratio with respect to said driving rotatable member.

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