No. 745,805. PATENTED DEC. 1, 1903.

G. H. ENNIS.

ELECTRIC MOTOR.

APPLICATION FILED APR. 20, 1889. RENEWED JUNE 12, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

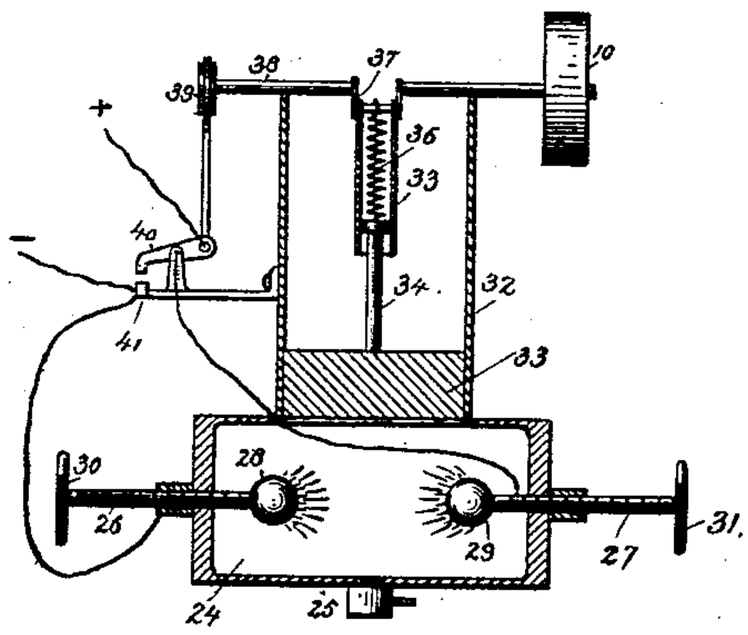


Fig. 2.

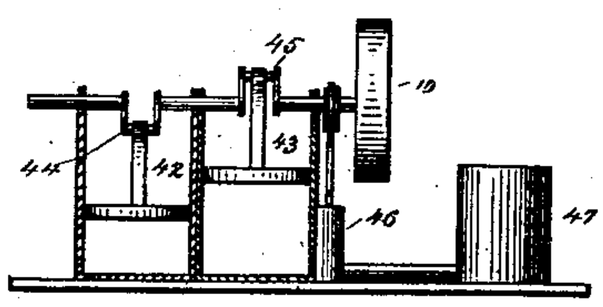


Fig. 3.

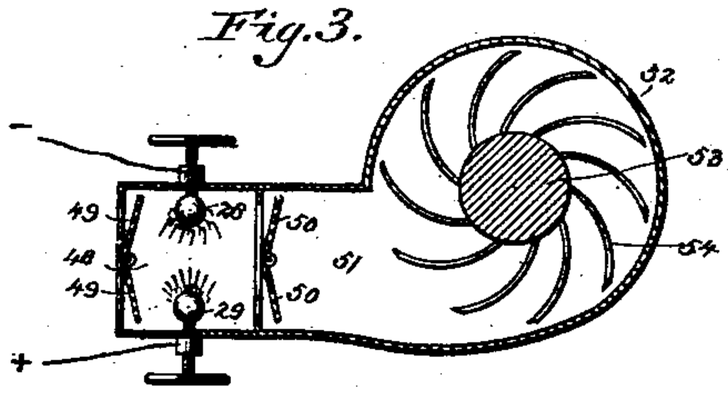
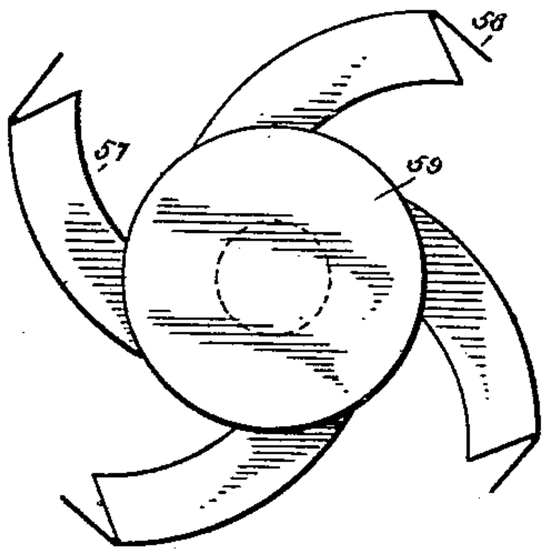
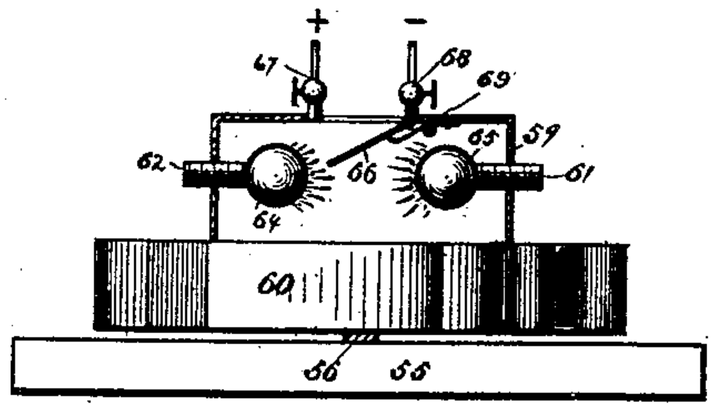


Fig. 4.





Witnesses.

H. W. Elmore.

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Inventor:

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 5.

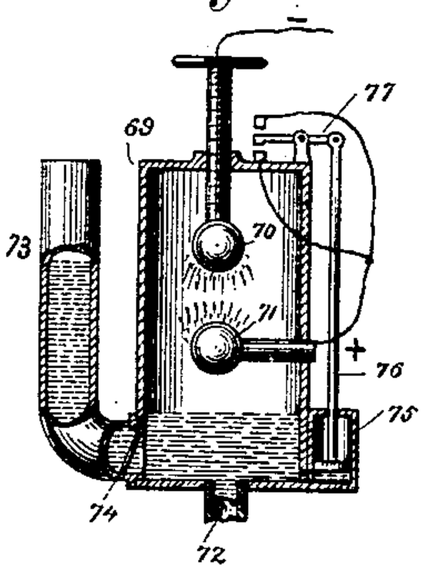


Fig. 6.

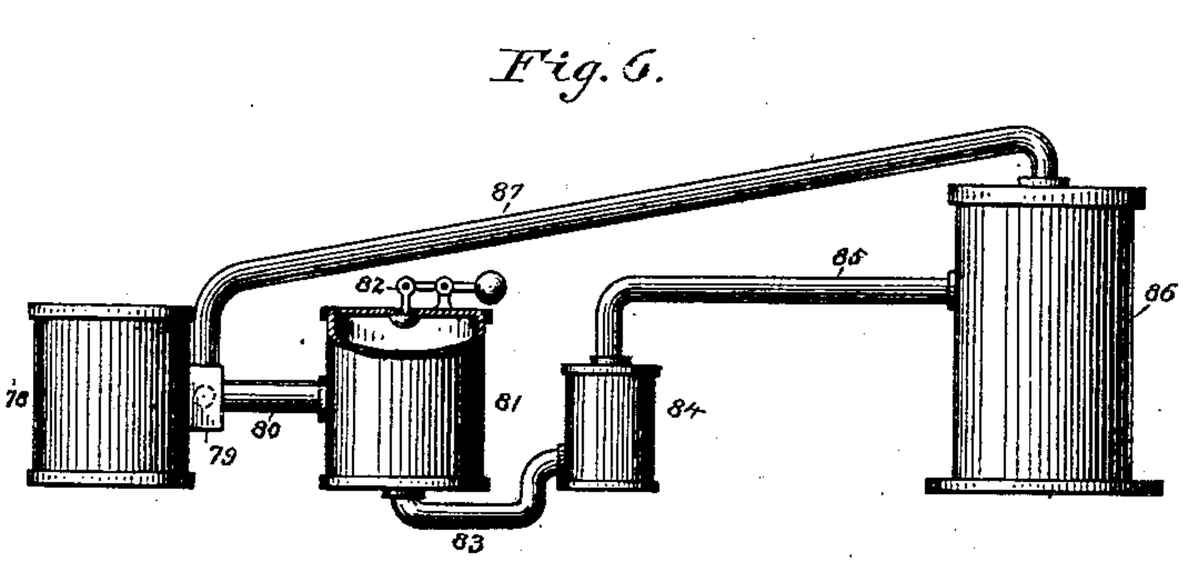


Fig. 7.

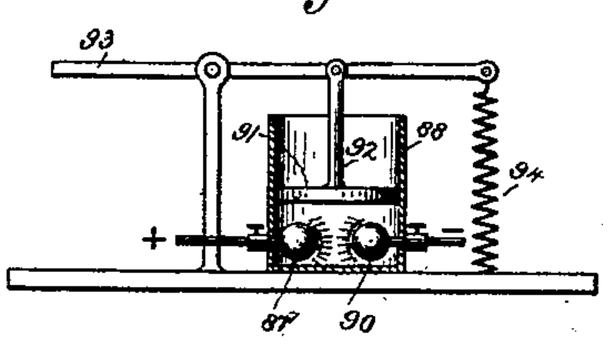


Fig. 8.

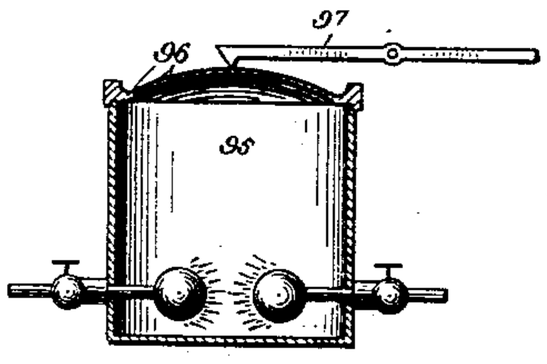
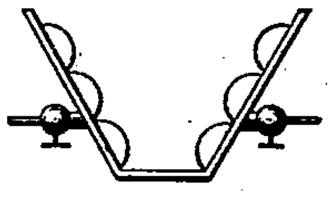


Fig. 9.



Witnesses.

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UNITED STATES PATENT OFFICE.

GEORGE H. ENNIS, OF TROY, NEW YORK, ASSIGNOR TO JESSIE D. ENNIS, OF TROY, NEW YORK, AND HENRY R. GARDNER, OF BOSTON, MASSACHUSETTS.

ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 745,805, dated December 1, 1903.

Application filed April 20, 1889. Renewed June 12, 1903. Serial No. 161,216. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. ENNIS, a citizen of the United States, residing at Troy, in the county of Rensselaer and State of New York, have invented certain new and useful Improvements in Electric Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the utilization of the disruptive discharge of electric currents of high tension for motive purposes.

The effect of a disruptive discharge of a current of high tension is twofold, as may be observed in the well-known phenomenon of atmospheric lightning, wherein the discharge takes place in the form of a thunderbolt of great dynamic force, which destroys or scatters objects interposed in its path and at the same time expands or rarefies the air through which it passes. For general purposes it would probably be impractical to utilize industrially the disruptive discharge of a current of as high tension as that manifested in a thunderbolt, even if apparatus was available for artificially generating such current. Effects less in degree, but similar in kind, are, however, attendant upon the disruptive discharge of the high-tension current generated in dynamo-electric machines, induction-coils, and the like, and in carrying out my invention I avail myself of both of the phases of dynamic energy referred to which the discharge of high-tension currents thus produced develops.

In the accompanying drawings, illustrative of my invention, Figure 1 is a view in vertical section and partial elevation of my invention, which is adapted to utilize the rarefying expansive effect of the disruptive charge upon the air or other dielectric through which it passes. Fig. 2 is a view showing a form of apparatus adapted to be used with compressed air as the dielectric. Fig. 3 is a view showing the arrangement of parts adapted to utilize the expansion of the dielectric in rotary energy. Fig. 4 is a bottom plan and vertical section disclosing a reaction apparatus operating in accordance with my invention. Fig. 5 is a vertical section, in partial elevation, of a water or air pump which is equipped with and operates upon the same general principle of my invention. Fig. 6 shows the application of my invention to a compressed-air and vacuum system adapted for use in connection with well-known forms of steam-engines. Fig. 7 is a view in sectional elevation showing the application of the expansive force of a disruptive discharge to telegraphy or the like. Fig. 8 is a view in elevation of a modified form of apparatus for employing the expansive force for like uses, and Fig. 9 shows a modified form of the discharging-surfaces.

Similar numerals of reference indicate similar parts throughout the several views.

In the form of my invention shown in Fig. 1 I avail myself of the expansion or rarefaction of the air or other dielectric through which the disruptive discharge takes place for actuating the motor mechanism. Referring to the figure, 24 indicates a suitable receptacle provided with a valve-box 25, having an inwardly-opening valve of any suitable construction. Through the walls of the chamber extend the adjustable rods 26 27, terminating at their inner ends in discharging-surfaces 28 29 and at their outer ends in hand-wheels 30 31, whereby the distance between them may be regulated to suit the tension of the current employed. The discharging-surfaces 28 29 are connected, respectively, with the negative and positive poles of the generator. The chamber 24 is provided with an auxiliary piston-chamber 32, within which plays the piston 33, whose rod 34 fits within the sleeve 35, said sleeve serving to contain the spring 36, which is interposed between the end of the piston-rod and a crank 37 upon the fly-wheel shaft 38. Upon the shaft 38 is mounted an eccentric and rod 39, connected at its lower end with the rocking circuit-closer 40. The mode of operation of this apparatus is as follows: When the circuit is closed at 40 41, a disruptive discharge will take place between the rounded surfaces 28 29, whereby the air in the chamber 24 will be expanded, thereby closing the inwardly-opening valve in the valve-box 25 and raising the piston 33. To prevent the piston from acting too suddenly upon the crank, the spring

36 is interposed, said spring acting as a cushion between the piston-rod 34 and said crank, so that the sleeve or case 35 does not communicate motion to the shaft or crank until the spring is sufficiently compressed. When the piston has completed its upward movement, the valve in the valve-box 25 is opened automatically or otherwise and the expanded and rarefied air allowed to escape, after which a second charge of air is admitted and the same series of operations repeated. Further repetitions of the same operation insure a continuous revolution of the fly-wheel, which latter, where the engine is of the single-acting type, as shown, should be sufficiently large to insure steadiness of motion.

In the form of my invention shown in Fig. 2 I have illustrated two engines 42 43, located side by side and having their cranks 44 45 at different angles, so that by their alternate movement continuous motion will be communicated to the crank-shaft.

To intensify the expansive or rarefying power of the disruptive discharge, I may employ compressed air in the expansion or discharge chamber. This compressed air can be fed into the expansion or discharge chamber from a reservoir in which the air is compressed by a pump connected with the crank-shaft, said pump being represented in Fig. 4 at 46 and the reservoir of compressed air being represented at 47 in said figure.

In Fig. 3 I have represented the production of a movement of continuous rotation from the expansive effect of the disruptive discharge without the interposition of a reciprocating piston. In said figure the expansion-chamber 48 is provided with the discharging-bodies 28 29 and their adjusting devices, as described with reference to Fig. 3, and is furthermore provided with a pair of inlet-valves 49, opening inwardly, and with a pair of outlet-valves 50, opening outwardly into a trunk 51, communicating with a chamber 52, within which is contained a shaft 53, provided with a series of curved blades or vanes, as shown at 54. On the passage of the disruptive discharge the expansion of the air will close the valves 49 and open the valves 50, thereby admitting a blast of air into the trunk 51 and chamber 52, which air will strike the vanes or blades 54, thereby causing the shaft 53 to revolve. When the expansive action has ceased, the valves 50 will close and the valves 49 will open inwardly, thereby furnishing a fresh charge of air. On a recurrence of the disruptive discharge another blast of air will, as before, strike the vanes or blades 54, and thus by a series of discharges a practically-continuous blast of air will act upon the said vanes and a continuous motion will be produced.

In Fig. 4 I have illustrated the application of the expansive or rarefying action of the disruptive discharge for the actuation of a reaction apparatus. The construction of this apparatus is as follows: Upon a suitable base is mounted, by means of a step 56, a revoluble reaction-wheel having the curved chutes or branches 57, said branches being provided at their free ends with outwardly-opening flap-valves 58. Upon the reaction-wheel is mounted the electric-discharge chamber 59, communicating with the central or main body portion of the reaction-wheel, and said chamber 59 is in turn provided with the adjustable rods 61 62, terminating in the disruptive-discharge surfaces 64 65. The chamber 59 is provided with an opening adapted to be closed by the inwardly-opening valve 66, said valve being of conducting material, so that when closed it will complete the generator-circuit through the contacts of terminals 67 68. A spring 69 normally holds said valve 66 closed, closing the circuit at that point. The application of this form of my invention is apparent. To set the apparatus in motion, the generator-circuit is completed outside of the apparatus by any suitable device, thereby causing a disruptive discharge between the rounded surfaces 64 65, causing an expansion of the air in the chamber 59, and driving the expanded or rarefied air out through the arms 57, thereby causing the whole apparatus to revolve in an opposite direction to that of the outgoing air. The air driven out by the action of the high-tension current is supplied through the valve 66, and the subsequent closing of said valve will again cause a disruptive discharge, continuing the previous operation and enabling the apparatus to revolve continuously, the valves 58 closing after the expulsion of the air with each discharge, so as to prevent the air from returning and reducing the motion of the wheel. It will be evident, of course, that communications will be made between the conductors from the generator and the discharge-chamber of a kind similar to those for connecting ordinary electric motors with the generator-conductors by which they are driven.

In Fig. 5 I have illustrated the adaptation of the expansive effect of the disruptive discharge to the raising or lifting of water or to the pumping of air. In this form of my invention, 69 represents the disruptive-discharge chamber provided with the discharge surfaces or bodies 70 71, connected, respectively, with opposite poles of the generator employed, the chamber connecting at its lower end by a pipe having an inlet-valve 72 with the reservoir of water or the like and having an uptake 73. An outlet-valve 74 is located at the point of connection between the chamber 69 and the uptake, as shown. An auxiliary piston-chamber 75 communicates freely at its lower end with the chamber 69, the piston-rods 76 extending outwardly to the outer end of the pivoted arm 77, the other end of said arm constituting a contact-closer. When the generator-circuit is closed, a disruptive discharge will occur between the surfaces 70 71, thereby expanding the air in the chamber 69, and said expanded air acting

upon the surface of the liquid in the chamber 69 will close the valve 72 and force the liquid up through the uptake 73, past the outwardly-opening valve 74. At the same time the liquid passing into the piston-chamber 75 will lift the piston-rod 76 and break the contact at 77. After the force of the expansion of the air has ceased the water previously driven into the cylinder 75 will flow back into the main chamber 69, thereby permitting the piston-rod to fall and reëstablishing the generator-circuit through the circuit-closer 77. In the meantime a new supply of water will enter the chamber 69 through the valve 72, and the recurrence of the disruptive discharge, due to the reëstablishment of the generator-circuit, will act upon said liquid in like manner as before. It is evident that this apparatus can be used for pumping air, the only essential change required being that the connection or communication between the piston-chamber 75 and the main chamber 69 will be larger for water than for air, as will be obvious.

In Fig. 6 I have illustrated the application of my invention to an ordinary form of steam-engine provided with the usual piston-rods, valve-chests, &c. 78 represents the steam-cylinder, and 79 the valve-chest, said valve-chest being provided with an exhaust-pipe 80, communicating with the exhaust-chamber 81. The exhaust-chamber is provided with the valve 82, properly weighted and opening inwardly, and is connected by a pipe 83 with an electric air-pump 84, of a kind analogous to that heretofore described. A pipe 85 connects said electric air-pump with a reservoir 86, constituting a pressure-chamber for the reception of compressed air, said pressure-chamber communicating by a pipe 87 with the valve-chest of the engine and taking the place of the steam-supply pipe of an ordinary steam-engine. The operation of this modification of my invention is as follows: The disruptive discharge of high-tension currents within the electric pump 84 will expand the air therein and compress it within the reservoir 86, from which it may be led by the pipe 87 to the valve-chest, as shown. The exhaust will be led from the valve-chest to the exhaust-chamber 81, from which it will be returned to the electric pump. It will be seen that the action of the electric pump will be to drive the engine by compressed air, assisted by the additional pressure due to the exhaust. The valve 82 will allow additional air to enter the exhaust-chamber 84 should the supply from the engine not be sufficient to satisfy the demands of the electric pump.

In Fig. 7 I have illustrated the employment of the expansive effect of a disruptive discharge to telegraphy and similar uses. In said figure, 88 indicates a piston-chamber provided with the discharging-bodies 89 90, connected with opposite poles of the high-tension-current generator, as before. To the piston 91 is connected the piston rod or arm 92, hinged at its upper portion to the pivoted lever 93, which it is adapted to actuate for any kind of mechanical work. 94 represents a spring connected to the outer end of the said lever. When a current is passed through or between the discharging-surfaces by the closing of a telegraphic key or any other form of circuit-closer, the expansion of the air due to the disruptive discharge will lift the piston and its connecting-levers, which will be thereafter, at the cessation of the expansive action, returned to their original position by the spring.

As represented in Fig. 8, instead of employing the piston 91 and piston-rod 92 I may provide the top of the discharge-chamber with a thin air-tight cover 95 of convex curvature, said cover having at its outer edge the groove 96. Under the action of the expanded air and its contraction the metallic top will undergo a series of pulsations which may be communicated to the lever 97. Various uses of this mechanical arrangement will suggest themselves.

It will be evident that the number and the shape of the discharging bodies or surfaces may be varied to suit special conditions and uses, as indicated, for instance, in the form of my invention shown in Fig. 9. The discharging-surfaces may be either round or pointed in all of the instances illustrated and heretofore described, although for most purposes it is probable that a rounded contour will be preferable. I may also say that wherever it is desired to intensify the effects produced by the expansion of the dielectric through which the disruptive discharge takes place I may in each instance employ said dielectric in a compressed condition—as, for instance, compressed air instead of air at the ordinary atmospheric pressure.

Having thus described my invention, what I claim is—

1. In a motor the combination with a generator or producer of electric currents of high tension, of discharge-surfaces connected respectively with the opposite poles of said producer a confined or inclosed body of air and a circuit maker and breaker applied to the circuit of the high-tension current for producing a succession of discharges between the discharge-surfaces substantially as described.

2. In a motor, the combination with a generator or producer of electric currents of high tension, of discharge-surfaces connected respectively with the opposite poles of said producer, a confined or inclosed body of air, and a circuit maker and breaker for producing a succession of discharges between the discharge-surfaces, said circuit maker and breaker being also a circuit-reverser; substantially as described.

3. In a motor the combination with a generator or producer of electric currents of high

tension of discharge-surfaces connected respectively with the opposite poles of said producer a confined or inclosed body of air and a circuit maker and breaker applied to the circuit of the high-tension current for producing a succession of discharges between the discharge-surfaces said circuit maker and breaker being automatically actuated by the movement of the motor substantially as described.

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

GEORGE H. ENNIS.

Witnesses:

JESSIE D. ENNIS,

T. FRANK REARDON.