(No Model.)

G. & A. PFANNKUCHE.

DYNAMO ELECTRIC GENERATOR.

No. 391,270. Patented Oct. 16, 1888.

Fig. 1.

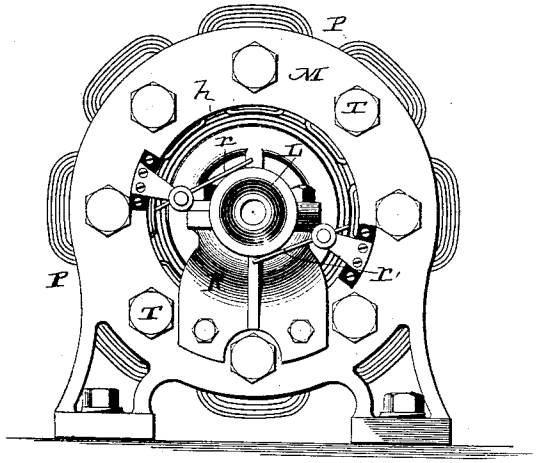


Fig. 2.

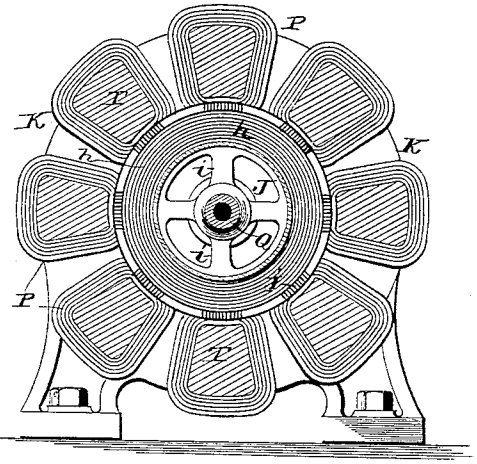


Fig. 3.

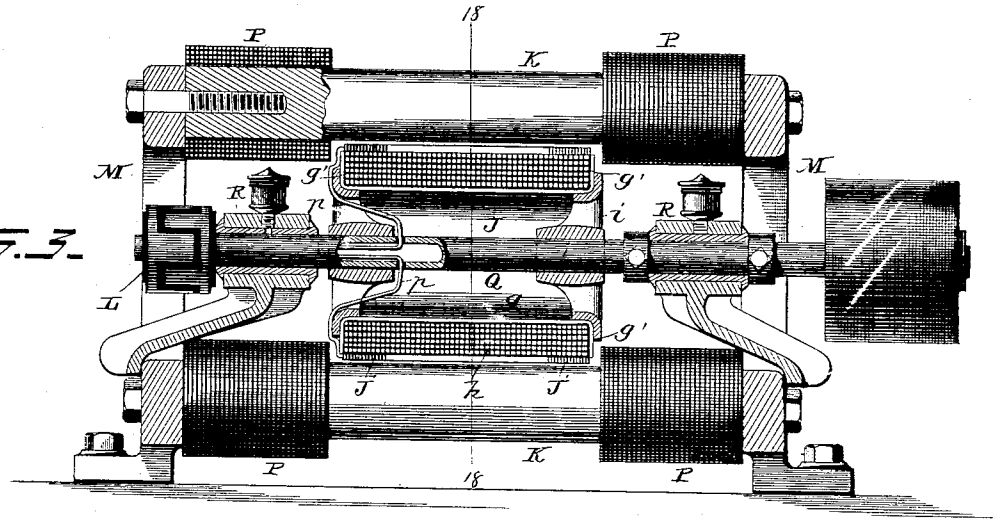
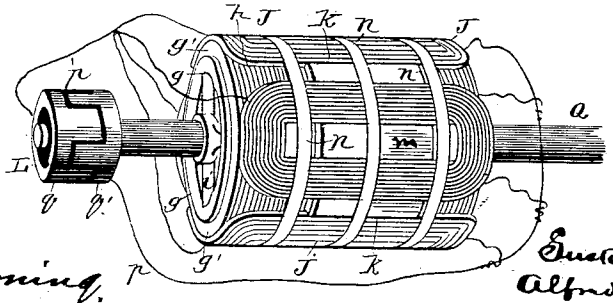


Fig. 4.



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UNITED STATES PATENT OFFICE.

GUSTAV PFANNKUCHE, OF CLEVELAND, OHIO, AND ALFRED PFANNKUCHE, OF EXETER, NEW HAMPSHIRE.

DYNAMO-ELECTRIC GENERATOR.

SPECIFICATION forming part of Letters Patent No. 391,270, dated October 16, 1888.

Application filed June 6, 1888. Serial No. 276,236. (No model.)

To all whom it may concern:

Be it known that we, GUSTAV PFANNKUCHE and ALFRED PFANNKUCHE, of Cleveland and Exeter, in the counties of Cuyahoga and Rockingham and States of Ohio and New Hampshire, respectively, have invented certain new and useful Improvements in Dynamo-Electric Machines; and we 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.

Our invention relates to an improvement in dynamo-electric machines.

The object of our present invention is to provide a dynamo-electric machine by means of which currents of continuous direction made up of successive waves or pulsations are produced.

A further object is to produce a dynamo-machine which will generate a pulsatory current, the waves or pulsations of which will occur with sufficient rapidity, have sufficient potential, and be of sufficient volume to adapt them to the conditions for which in any particular case they are intended.

With these objects in view our invention consists in certain novel features of construction and peculiar combinations and arrangements of parts, as will be hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is an end elevation of the construction of such machines that we consider preferable. Fig. 2 is a vertical transverse mid-section thereof cut in the plane of the line 1S 1S of Fig. 3. Fig. 3 is a vertical longitudinal section thereof cut in the plane of the axis of rotation. Fig. 4 is a perspective view of the armature removed, illustrating the commutator-connections.

The dynamo-electric machine embodied in this application is intended more particularly for use with a system of electric distribution, for which we have made application for Letters Patent, said application bearing Serial No. 237,839.

For the purpose of generating pulsatory currents such as are required for our system a dynamo might be used having the original Siemens shuttle-wound armature, except that the number of impulses produced by such a dynamo at any reasonable speed of rotation would be insufficient for the economical excitation of the converters. Experience has shown that induction apparatus or converters will give the best results when the primary current affords about from one hundred and twenty to two hundred pulsations per second. With a Siemens shuttle-wound armature having a rectifying-commutator there are but two pulsations to each revolution, so that with a speed of, for example, one thousand revolutions per minute we would get only two thousand pulsations per minute; hence to realize a current having from one hundred and twenty to two hundred pulsations per second, or seven thousand to twelve thousand per minute, we would either increase the armature speed to an entirely impracticable degree, or else so construct the dynamo that it shall give out a greater number of pulsations to each revolution. Following the latter method, if we provide eight magnetic fields symmetrically arranged around an armature of one coil, we shall get eight impulses to each revolution, and with a simple eight-part crown-commutator we can rectify these positive and negative impulses, thereby securing a succession of eight positive impulses to a revolution. With such a machine we have only to drive the armature at the entirely practical speed of one thousand revolutions per minute in order to generate a current of eight thousand pulsations per minute—a number which we find to be preferable for producing the most economical effect upon the induction apparatus. It is to be noted, however, that our system is by no means limited to this number, or to any special number of pulsations within the extremes of practicability. In any case the desired number of pulsations per minute will equal the number of magnetic poles symmetrically arranged around the armature multiplied by the number of armature-revolutions per minute.

We have thus far spoken of an armature having but one coil, this coil passing successively through all the fields in each revolution. We prefer, however, to wind the armature with a number of coils corresponding to the number of magnetic fields, and to couple these

coils together, either in series or in multiple, or according to some intermediate arrangement, depending upon whether the currents are desired to be of high potential and low volume, or low potential and high volume, thereby utilizing by this multiplication of coils nearly all the space on the armature and increasing the efficiency of the machines.

The armature may be of any one of various known types—such, for instance, as the "drum" type or the "ring" type, the "flat-ring" type or the "disk" type. It may either have an iron core or be constructed without a core. In any case the field-magnet will be constructed with alternated poles arranged at equal angular intervals around the axis of rotation. In any case, also, the commutator will consist of as many segments as there are magnetic poles, and the segments will be divided into two groups, those of one group being connected to one of the terminals of the respective armature-coils, and those of the other group being connected to the opposite terminal. We will first describe the construction which is shown in Figs. 1 to 4.

J designates the armature, K K the field-magnets, and L the commutator. At the opposite ends of the machine are two ring-shaped frames, M M, which may be made of cast-iron. Between them extend eight (more or less) parallel horizontal bars, T T, of soft iron, their opposite ends being fixed to the frames by screws or otherwise. The opposite end portions of the bars T T are wound with the field-exciting coils P P, leaving their middle portions, which constitute the poles, bare. The armature J is mounted on a shaft, Q, which is carried on bearings R R, which are fastened to and project inside of the end frames, M M. On one end of the shaft is the usual belt-pulley, and on the other end is the commutator L, the latter being preferably arranged within the opening in one of the frames, so that it is in a measure housed therein and protected thereby.

The armature-core is in the form of a hollow cylinder, and is constructed of a tube, *g*, of soft iron, having its opposite ends flanged outwardly at *g' g'*, and forming thus an annular trough or spool in which is wound a soft-iron wire, the convolutions of which are insulated from one another by being wrapped with insulating material or varnished, or oxidized, or otherwise separated in order to suppress Foucault currents. This wire core is lettered *h*. The entire armature-core is supported and connected to the shaft by means of two spiders or peripheral grooved wheels, *i i*, which engage its opposite ends and have central hubs fixed upon the shafts. On the exterior of the cylindrical armature-core are placed four (more or less) armature-coils, *j j*, of rectangular form, as shown in Fig. 4. These coils are preferably made by winding a thin insulated copper ribbon, about half an inch in width, around a former and then planting them against the cylindrical surface of the core, holding them at the proper relative distances by means of blocks of wood or other insulating material, *k k*, placed between them, holding them in the proper shape by blocks *m m*, placed within them, and confining them to the core by insulated bands or wrappings *n n*, passed tightly around the entire armature. These bands *n n* serve to resist the centrifugal strain to which the coils are subjected during the rapid rotation of the armature.

The field-cores T T are of radial outline in cross-section, and their angular width is equal to that of the intervening spaces, as clearly shown in Fig. 4. Correspondingly the widths of the armature-coils and the spaces within the coils and between them are equal; hence the width of the coils is necessarily the same as that of the inner faces of the field-cores T T, as shown in Fig. 2, and is equal almost to the width of the spaces between the cores.

The commutator L is or may be a simple Jacobi "crown-commutator" consisting of two rings each formed with four projecting segments, and the segments of the two parts interlocked with one another and insulated from one another. Fig. 4 shows the method of connecting the armature-coils in multiple, one end of each coil being connected to one part, *q*, of the commutator, and the opposite end of each coil being connected to the other part, *q'*. These connections are made by means of wires *p p*, which pass through the shaft Q, which is tubular, as shown in Fig. 3. The commutator-brushes *r r*, Fig. 1, are so set as to make contact the one with one of the segments of the part *q* and the other with one of the segments of the part *q'* of the commutator.

The parts are in the neutral position in Fig. 2, and in moving from this position to the next neutral point each coil cuts the lines of force flowing from one of the field-cores into the armature-core and out at the next field-core and generates a rising-and-falling wave of potential.

The inner faces of the field-cores T T are preferably rounded, as shown in Fig. 2, and the bars or poles are preferably of the same shape throughout their length.

The armature-coils, being made of thin flat ribbon, afford the maximum conducting cross-section that can be placed within the magnetic field, since there is no waste space, such as occurs in the winding of the round wire.

The armature-coils *j j* may be connected to the commutator in series; or, if preferred, the armature may be wound with only one coil extending back and forth along its exterior in zigzag or serpentine manner, in which case only the two opposite terminals are carried to the commutator.

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A dynamo-electric machine consisting of the combination of a multipolar field-magnet composed of a number of poles of successively-alternated polarities equidistantly disposed

around and parallel with the axis of rotation, an armature consisting of a tubular cylindrical core of coiled iron wire, and coils fastened on the exterior of the core, and a rectifying-commutator for delivering pulsatory currents of continuous direction.

2. The combination, to form a pulsatory-current dynamo, of a multipolar field-magnet composed of a number of poles of successively-alternated polarities equidistantly disposed around and parallel with the axis of rotation, an armature consisting of a tubular cylindrical core, and coils of thin conducting-ribbon fastened on the exterior of the core and presenting the edges of the ribbon to the field-poles, and a rectifying commutator.

3. The combination, to form a pulsatory-current dynamo, of a multipolar field-magnet composed of a number of poles of alternately-opposite polarity equidistantly disposed around and parallel with the axis of rotation, an armature consisting of a tubular iron shell having radial end flanges and wound with insulated iron wire to form a cylindrical core, and coils fastened on the exterior of the core, and a rectifying-commutator.

In testimony whereof we have signed this specification in the presence of subscribing witnesses.

GUSTAV PFANNKUCHE.
ALFRED PFANNKUCHE.

Witnesses:
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