No. 693,578. Patented Feb. 18, 1902.

H. H. WAIT.

CONDUCTOR FOR ELECTROMAGNETIC INDUCTION APPARATUS.

(Application filed Jan. 12, 1901.)

(No Model.)

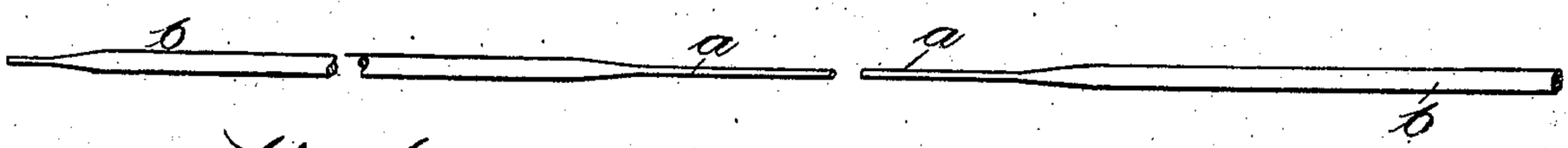


Fig. 1.

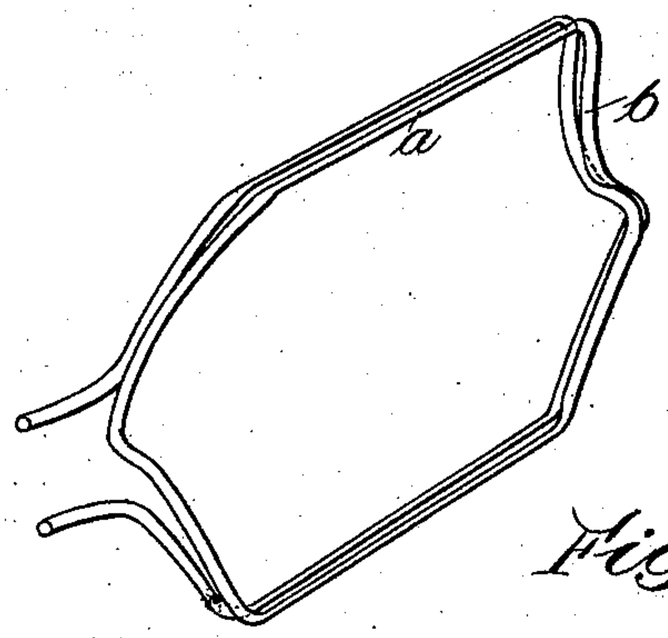
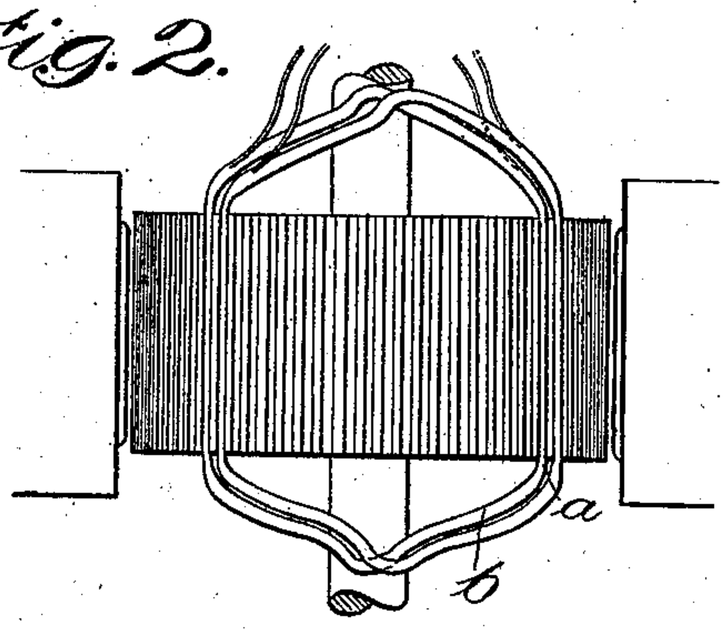


Fig. 4.

Fig. 2.



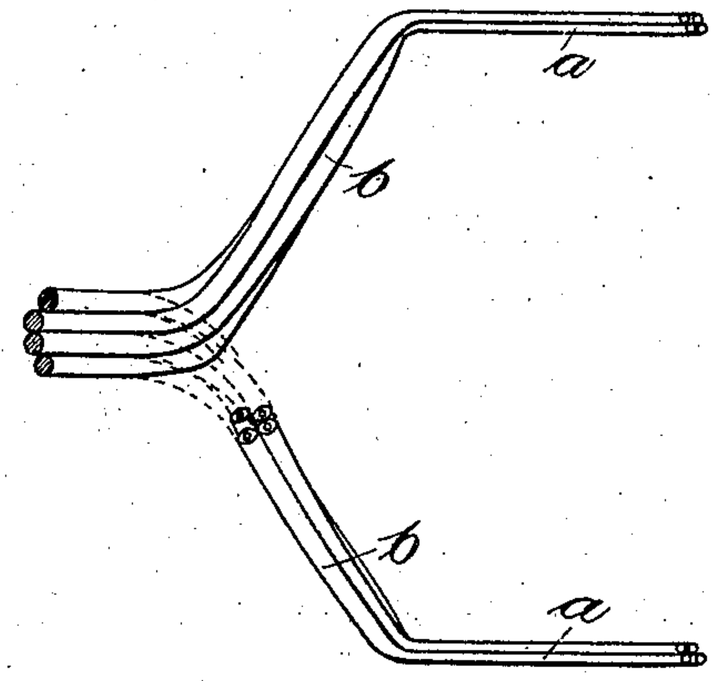


Fig. 5.

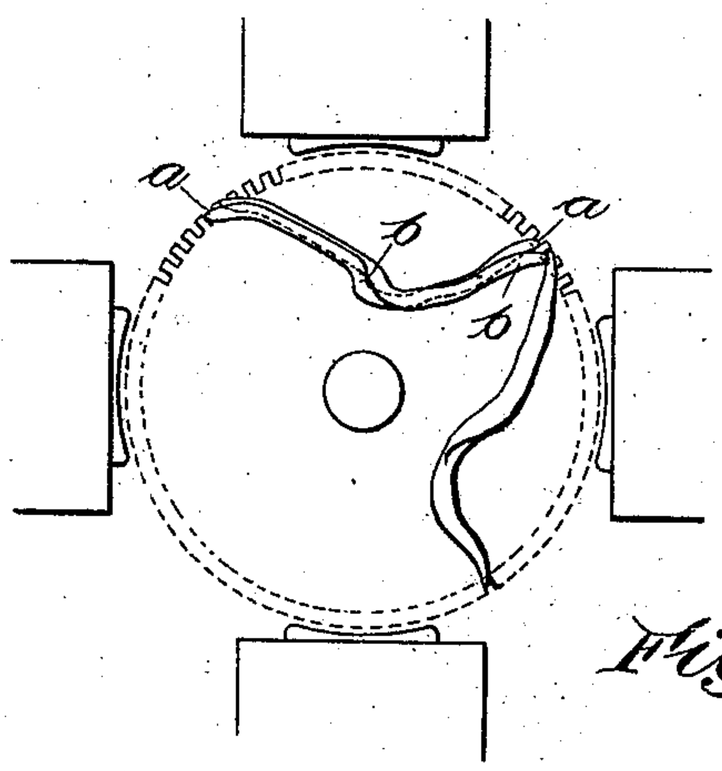


Fig. 3.

Witnesses:
J. W. Skinkle.
W. H. Leach

Inventor:
Henry H. Wait,
By George P. Barton,
Attorney.

UNITED STATES PATENT OFFICE.

HENRY H. WAIT, OF CHICAGO, ILLINOIS.

CONDUCTOR FOR ELECTROMAGNETIC INDUCTION APPARATUS.

SPECIFICATION forming part of Letters Patent No. 693,578, dated February 18, 1902.

Application filed January 12, 1901. Serial No. 42,959. (No model.)

To all whom it may concern:

Be it known that I, HENRY H. WAIT, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Conductors for Electromagnetic Inductive Apparatus, (Case No. 15,) of which the following is a full, clear, concise, and exact description.

My invention relates to a conductor or wire for the windings of electromagnetic inductive apparatus, such as the armatures of dynamo-electric generators and motors and the cores of transformers.

My object is to permit machines of a given output or capacity for work to be constructed with active or working parts smaller than has heretofore been possible—as, for example, in the case of a generator to provide for a given power with an armature much smaller in circumference than heretofore.

My invention consists, primarily, in an improved conductor for winding electrical machines, said conductor being made alternately of large and small cross-section, the portions of smaller cross-section being adapted to form the working or active parts of the winding, and the heavier portions being adapted to form the connectors which unite the active parts and which may be placed where their increased bulk is not so objectionable.

My invention also consists in linking such a conductor with magnetic material constituting a magnetic circuit, the portions of the conductor of smaller cross-section being placed within the magnetic circuit, where space is valuable, and the portions of larger cross-section being disposed outside the magnetic circuit, in space in which no magnetic condition is being maintained.

I will describe my invention more particularly by reference to the accompanying drawings, in which—

Figure 1 illustrates the varisectional conductor of my invention, showing the alternate lengths of large and small cross-section. Fig. 2 is a diagram illustrating the armature of a dynamo-electric machine in side elevation to show the application of my improved conductor to the winding of such a machine. Fig. 3 is a diagrammatic end view of the machine shown in Fig. 2. Fig. 4 is a perspective view in diagram of a single armature-coil detached to show more clearly the disposition of the differently-sized portions of the conductor; and Fig. 5 is a view of the end of an armature-coil, showing how the winding may be disposed in order to permit its adjustment to bring portions of smaller diameter always in the proper relative position upon the armature.

Similar letters of reference designate the same parts wherever they are shown.

In Fig. 1 I have illustrated a continuous copper wire drawn in alternate lengths of large and small cross-section. The lengths *a a* are intended to form the active portions of the conductor when the same are interlinked with a magnetic circuit, within which space is valuable, and the lengths *b*, whose diameter is much larger, are intended to form connections of low resistance between the active portions *a a*, and may be placed in those parts of the machine where more space is available.

The remaining figures of the drawings illustrate the application of my invention to the armature of a dynamo-electric generator, such a machine being one of a very large class in which my invention will be useful.

With armatures as heretofore constructed the limit to the number of conductors or lengths of wire which are to be subjected to the magnetic field is found in the space upon the periphery of the armature which is available for this purpose. The depth of the slots in the armature-core in which the coils are disposed may not be increased beyond a given point, since this would too greatly increase the resistance of the magnetic circuit and so necessitate a greater number of ampere-turns in the field. The problem then is to get the greatest number of conductors of a given minimum resistance in this limited space upon the periphery of the armature. With the ordinary conductors heretofore available for winding armatures it has not been practicable to use wires or conductors of less than a given gage or size, because to do so would increase the internal resistance of the armature beyond the proper point for the output required.

If the size of the armature be increased in order to provide for more space for working conductors, a corresponding increase in the

size of all parts of the machine and in the amount of energy necessary to maintain the required magnetic field is necessitated.

My invention permits a reduction in size of the active or working parts of the armature-conductors to allow a greater number to be disposed in a given space upon the periphery of the machine, or, what amounts to the same thing, if the same number of conductors is used, to allow the armature to be made with smaller circumference or with smaller slots in its periphery. I do this by making up for the increased resistance of the smaller active portions of the winding in the increased size and decreased resistance of the connecting portions *b b*, which, as shown in the drawings, occupy the spaces at the ends of the armature instead of in the magnetic field. Since the armature-shaft may be as long as desired, there is no objection to the increased bulk of the conductors upon the ends of the armature.

Other advantages besides the obvious one of reducing the bulk of the conductors in the valuable spaces result from the construction above set forth. For example, the armature-teeth between which the active lengths of the armature-winding are passed can be made shorter and so of smaller cross-section without requiring a higher number of ampere-turns for the field-magnet, the result being that the magnetic lines of force passing through the armature are condensed or crowded together more at the teeth—that is, the teeth are more thoroughly "saturated." The higher the degree of magnetic saturation of the armature-teeth the less will be the change of flux caused by the variation of the reactive ampere-turns on the armature, and consequently the greater will be the range through which the current may be varied without requiring readjustment of the brushes to secure sparkless commutation. Again, since the size of the armature-teeth is the principal factor going to make up the self-induction of an armature-coil, it is evident that by applying my invention the self-induction of the armature may be materially reduced. The self-induction of the armature-coils is the principal cause of sparking in direct-current dynamos and motors and is a disturbing factor in a great many other kinds of electrical machinery.

In Fig. 5 I have illustrated diagrammatically the manner in which the connector portions of the winding may be looped in order to bring the portions of smaller cross-section in the proper position across the face of the armature. This manner of looping the conductor at the ends of the armature may be desirable in some cases where there is a slight variation in the proper relative lengths of the heavy and fine portions of the conductor.

It will be apparent that my improved varisectional conductor will be useful in connection with very many different kinds of electrical machines and in all places where an electric conductor is interlinked with a magnetic circuit, within which space is valuable. I do not therefore desire to be understood as limiting myself to the precise construction shown; but,

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

1. A continuous or integral conductor adapted to be interlinked with a magnetic circuit, formed in alternate lengths of large and small cross-section, substantially as set forth.

2. The combination with magnetic material arranged in a magnetic circuit, of an electric conductor interlinked therewith, said conductor being formed integrally in alternate lengths of large and small cross-section, the finer lengths being disposed in active relation to the magnetic circuit, and the heavier lengths serving as low-resistance connectors between the active portions, and occupying space in which no magnetic condition need be maintained, substantially as set forth.

3. A continuous or integral conductor for the windings of electrical machines, having alternate active and connecting portions, the active portions being smaller in cross-sectional area than the connecting portions, substantially as set forth.

4. In a dynamo-electric machine, the combination with the armature-core, of inductors or active conductors crossing the same and subjected to the magnetic field, and connecting portions uniting the inductors formed integrally therewith, but of greater cross-sectional area, substantially as herein set forth.

5. An inductor-coil for dynamo-electric machines having active portions *a a* and connector portions *b b* formed integrally with said active portions, but larger in cross-section, whereby the conductivity of the coil is increased by the larger mass of the connector portions, substantially as set forth.

In witness whereof I hereunto subscribe my name this 31st day of December, A. D. 1900.

HENRY H. WAIT.

Witnesses:
ELLA ELDER,
ADELL HOCKETT.